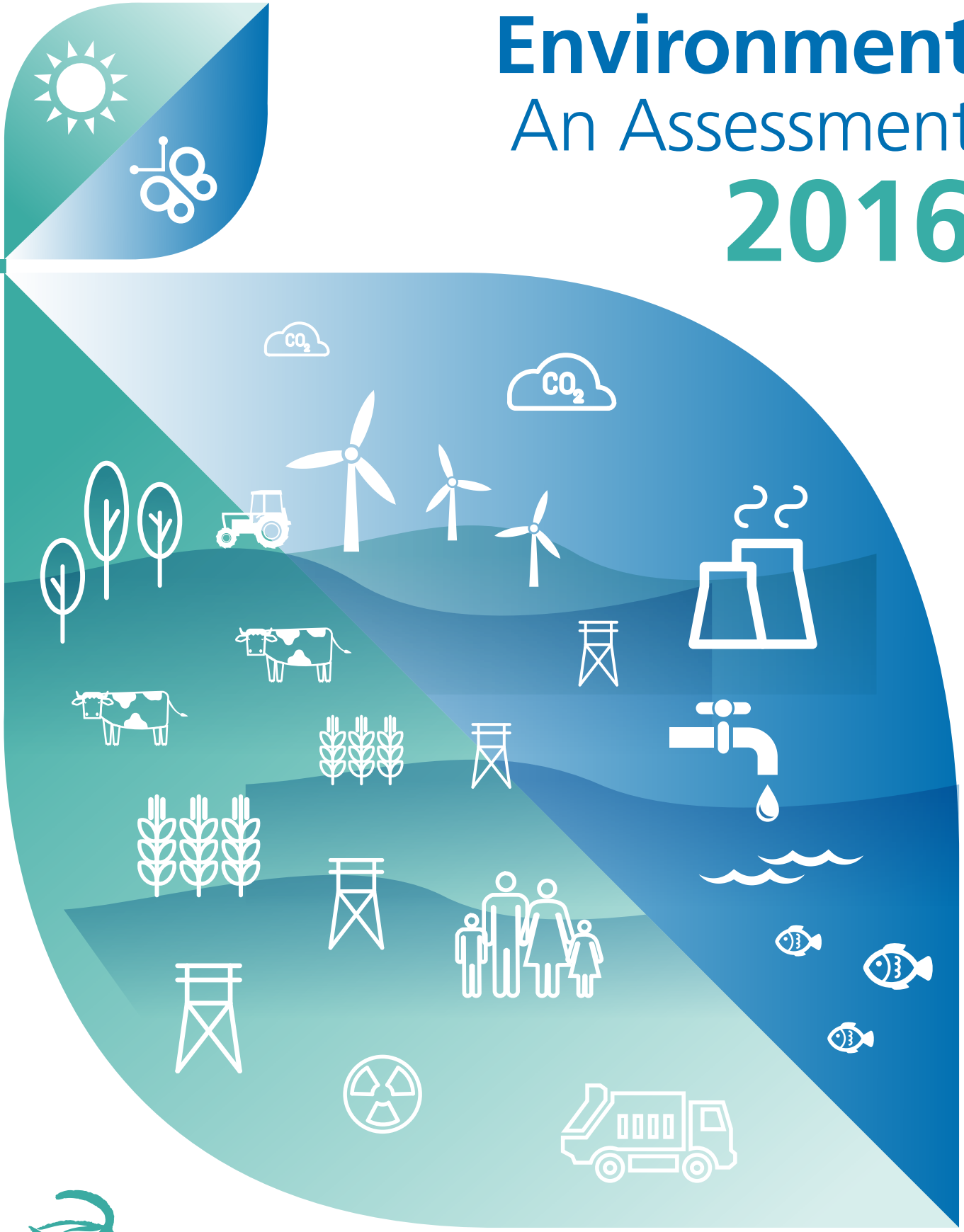
Ireland's Environment
An Assessment
2016



epa
Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

Environmental Protection Agency

The Environmental Protection Agency (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: *We implement effective regulation and environmental compliance systems to deliver good environmental outcomes and target those who don't comply.*

Knowledge: *We provide high quality, targeted and timely environmental data, information and assessment to inform decision making at all levels.*

Advocacy: *We work with others to advocate for a clean, productive and well protected environment and for sustainable environmental behaviour.*

OUR RESPONSIBILITIES

LICENSING

We regulate the following activities so that they do not endanger human health or harm the environment:

- waste facilities *(e.g. landfills, incinerators, waste transfer stations)*;
- large scale industrial activities *(e.g. pharmaceutical, cement manufacturing, power plants)*;
- intensive agriculture *(e.g. pigs, poultry)*;
- the contained use and controlled release of Genetically Modified Organisms *(GMOs)*;
- sources of ionising radiation *(e.g. x-ray and radiotherapy equipment, industrial sources)*;
- large petrol storage facilities;
- waste water discharges;
- dumping at sea activities.

NATIONAL ENVIRONMENTAL ENFORCEMENT

- Conducting an annual programme of audits and inspections of EPA licensed facilities.
- Overseeing local authorities' environmental protection responsibilities.
- Supervising the supply of drinking water by public water suppliers.
- Working with local authorities and other agencies to tackle environmental crime by co-ordinating a national enforcement network, targeting offenders and overseeing remediation.
- Enforcing Regulations such as Waste Electrical and Electronic Equipment (WEEE), Restriction of Hazardous Substances (RoHS) and substances that deplete the ozone layer.
- Prosecuting those who flout environmental law and damage the environment.

WATER MANAGEMENT

- Monitoring and reporting on the quality of rivers, lakes, transitional and coastal waters of Ireland and groundwaters; measuring water levels and river flows.
- National coordination and oversight of the Water Framework Directive.
- Monitoring and reporting on bathing water quality.

MONITORING, ANALYSING AND REPORTING ON THE ENVIRONMENT

- Monitoring air quality and implementing the EU Clean Air for Europe (CAFE) Directive.
- Independent reporting to inform decision making by national and local government *(e.g. periodic reporting on the State of Ireland's Environment and Indicator Reports)*.

REGULATING IRELAND'S GREENHOUSE GAS EMISSIONS

- Preparing Ireland's greenhouse gas inventories and projections.
- Implementing the Emissions Trading Directive, for over 100 of the largest producers of carbon dioxide in Ireland.

ENVIRONMENTAL RESEARCH AND DEVELOPMENT

- Funding environmental research to identify pressures, inform policy and provide solutions in the areas of climate, water and sustainability.

STRATEGIC ENVIRONMENTAL ASSESSMENT

- Assessing the impact of proposed plans and programmes on the Irish environment *(e.g. major development plans)*.

RADIOLOGICAL PROTECTION

- Monitoring radiation levels, assessing exposure of people in Ireland to ionising radiation.
- Assisting in developing national plans for emergencies arising from nuclear accidents.
- Monitoring developments abroad relating to nuclear installations and radiological safety.
- Providing, or overseeing the provision of, specialist radiation protection services.

GUIDANCE, ACCESSIBLE INFORMATION AND EDUCATION

- Providing advice and guidance to industry and the public on environmental and radiological protection topics.
- Providing timely and easily accessible environmental information to encourage public participation in environmental decision making *(e.g. My Local Environment, Radon Maps)*.
- Advising Government on matters relating to radiological safety and emergency response.
- Developing a National Hazardous Waste Management Plan to prevent and manage hazardous waste.

AWARENESS RAISING AND BEHAVIOURAL CHANGE

- Generating greater environmental awareness and influencing positive behavioural change by supporting businesses, communities and householders to become more resource efficient.
- Promoting radon testing in homes and workplaces and encouraging remediation where necessary.

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 Radiological Protection
- Office of Communications and Corporate Services

The EPA is assisted by an Advisory Committee of twelve members who meet regularly to discuss issues of concern and provide advice to the Board.

Ireland's Environment 2016

An Assessment

Editors

Mr Brendan Wall, Dr Jonathan Derham and Mr Tadhg O'Mahony

ENVIRONMENTAL PROTECTION AGENCY

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Contents

Foreword

This is the sixth State of the Environment report published by the EPA since its first such report in 1995, twenty one years ago. These reports provide the national evidence base about the condition of our natural environment and the challenges and opportunities associated with its protection and management. They chart both the successes and failures of national environmental policy over these years and are a critical resource for the State in planning for the next quarter of a century.

Ireland and the world are at a crossroads and the choices we make over the coming decade will have implications for the future of humanity for centuries to come. We are fast approaching the end of the fossil age and we now fully understand the consequences of the large-scale consumption of fossil fuels over the past two centuries for the future health and wellbeing of our planet.

We must now, with a far greater sense of urgency, make the transition from a society and economy dependent on fossil fuels and the wasteful consumption of natural resources to one that uses renewable and clean energy and one that takes much greater care of our precious and non-renewable natural resources. Transformational change is urgently needed across our entire economy and society, change that will affect how we work, how we live, travel, heat our homes, produce our food and use our purchasing power as consumers and citizens.

We have nothing to fear though from these changes. Ireland, in fact, has much to gain by becoming a leader in this transition to a low carbon and resource efficient economy and by making sure that this transition is underpinned by a clean, healthy and well-protected environment.

The overall quality of Ireland's natural environment, the subject of this report, is good in comparison with many other countries and this gives Ireland a competitive economic advantage which is of great value and needs to be protected.

As an island nation, Ireland also has particular vulnerabilities to climate change and so has a strong stake in ensuring that global action on reducing carbon emissions is effective. Ireland now has a clear policy direction and legislation for tackling climate change and the key challenge is to convert this policy intent into action to bring about a transformation in the most carbon intensive sectors like energy, transport and agriculture.

The most pressing issue we face is to work out how we de-carbonise our economy. This will affect all parts of society as we are all dependent on energy for almost everything that we do, and as things stand, most of that energy in Ireland is still generated from fossil fuels. Full and urgent implementation of the White Paper on Energy will be central to making progress, as will the full implementation of a strong and ambitious set of climate mitigation measures and adaptation plans, across all sectors, as required under the Climate Action and Low Carbon Development Act.

While the overall quality of Ireland's natural environment is "good", I would qualify that "good". Many of the problems such as air quality, water pollution, odours and noise in Ireland tend to be localised and these problems can be masked by national level assessments. These localised problems can have severe impacts on the health and wellbeing of the people in affected communities and on the quality of their local environment.

Making the link between environment and health is therefore of critical importance in both understanding and dealing with these problems and this is a key theme of the report. Targeting actions in the right places is also of critical importance if we are to address the problems in both an effective and efficient manner. This applies, for example, to problems with water and air quality which tend to be localised in many cases.

We have in Europe and in Ireland a strong suite of laws for protecting our natural environment. We have made progress in several areas, including waste recycling, reduction in landfilling of waste, bathing water protection, reductions in transboundary pollutants and reducing emissions from industrial facilities. However, we face particular challenges in meeting our climate change commitments and in the implementation of a number of Directives designed to protect the environment, such as the Water Framework

Directive and the Habitats Directive. Ireland also faces open EU complaints or infringement proceedings in relation to drinking water and urban waste water treatment.

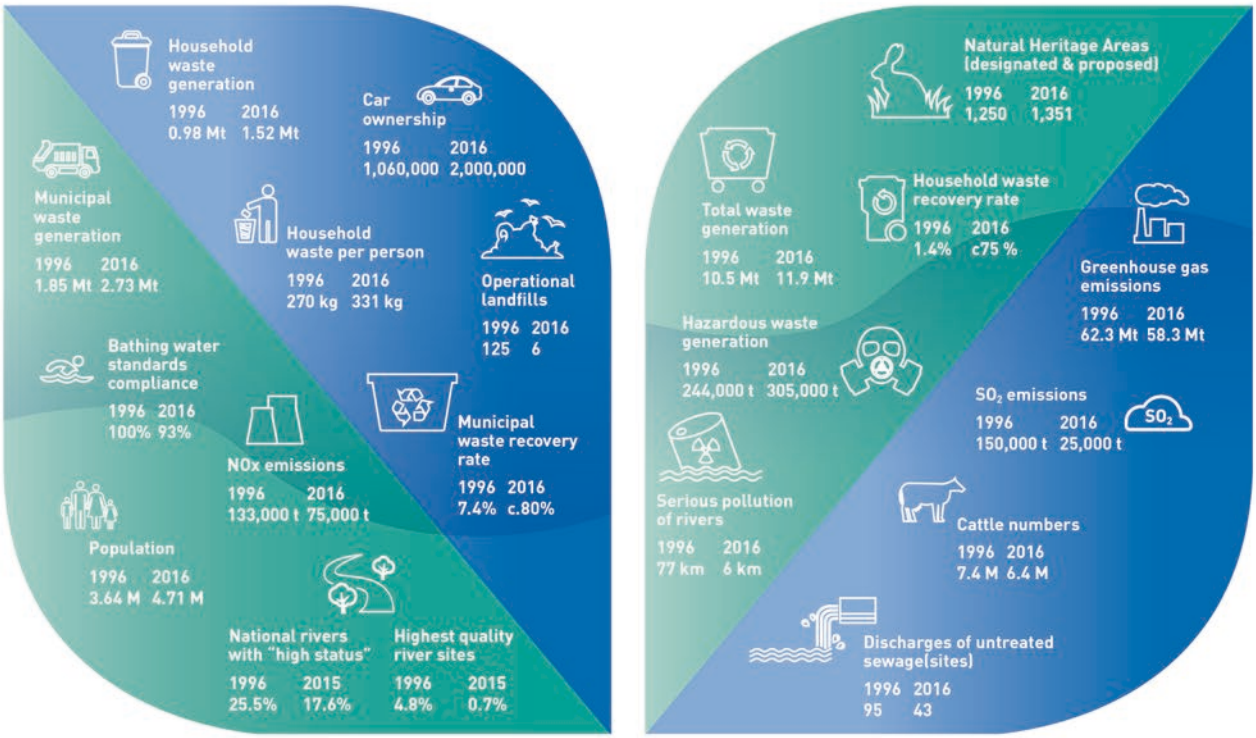
This is not about the EU imposing unnecessary or unreasonable demands on Ireland – it is about making sure as a minimum, for example, that the water we drink or swim in will not make us sick.

These are all areas where significant investment is needed to bring Ireland into compliance. Meanwhile, the 'environment' has to compete with many other policy areas such as health, education and policing for scarce resources. This is one of the reasons why it is so important that environmental considerations are fully factored into other policy areas as a clean and well protected environment helps support public health, food production, industrial development, tourism and gives an overall sense of civic pride about where we live, work and play.

This report and its many online supporting materials, provides the public, policymakers, non-governmental organisations, community groups, companies, teachers and students with the evidence base about Ireland's natural environment to help them make informed decisions about what they can do to help both protect and improve our natural environment. The underlying data is available online and we will be keeping this information up to date on the Ireland's Environment website. I hope that you find the report useful and informative and that it can help you play your part in protecting our environment.

Laura Burke
Director General

20 Years of State of the Environment Reporting 1996-2016



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Executive Summary

This report is the latest in the EPA State of the Environment series, which is published every 4 years. The report outlines at a strategic level the current state of Ireland's environment. It provides an update on environmental challenges that we face both nationally and globally. The report adds to the range of thematic and research reports available from the EPA that cover many of the issues reported on in further detail. To complement this report the EPA has developed the "Ireland's Environment" section on the EPA website[1] which provides up-to-date online information that includes environmental indicator data.

Colour Composite Satellite Image of Ireland (May 2015) (Source: © ESA)

Environment and Health and Wellbeing

Recognition of the Benefits of a Good Quality Environment to Health and Wellbeing

The state of the environment can influence our health in positive terms (e.g. amenity) but also in negative terms, because of the risks to health posed by pollution. Ireland's environment is generally good, and it can be concluded that on the whole Ireland does present a clean, safe environment to live in. While the overall quality of Ireland's natural environment is "good" this has to be qualified. There are many challenges surrounding its protection both for now and into the future, along with more immediate local environmental issues such as air quality, water pollution, odours and noise that need to be resolved. Many of these problems can be masked by national level assessments but can have severe impacts on the health and wellbeing of the people in individual communities and on the quality of the local environment. From an emerging risks perspective, we need to be vigilant in relation to climate change-induced health risks, antimicrobial resistance and new chemicals and substances.

It is now accepted that even low levels of air pollution, notably from particulates (soot and dust), can have negative health impacts. Ireland remains fortunate to have better air quality than most countries in Europe, but some key challenges remain. Traffic is a key pressure on air quality and is the main cause of air quality problems in our larger towns and cities. Local air quality, particularly in small Irish towns with a high dependence on coal, turf and wood for home heating, can be poor at times. Air pollution is estimated to have contributed to annual mortality rates which need to be addressed. Work on the development of the Clean Air Strategy for Ireland[2] should be an opportunity to highlight some of these issues, put forward policy solutions and develop a better understanding of linkages between climate and air quality policies. The adoption of the newer more stringent World Health Organization guideline values for air quality into Irish legislation as part of this process would provide an impetus for action to protect air quality.

Radon – a naturally occurring radioactive gas – is a risk to human health. Some of our citizens are living in houses that may impact their health because of the presence of radon, although they are not aware of it. Continued resourcing of the National Radon Plan is essential.

There are still an unacceptable number of public drinking water supplies on long-term Boil Water Notices and on the EPA's Remedial Action List. Major investments are still needed in the public water sector and in the group water sector to make sure consumers are protected from pollution and health risks. More also needs to be done to highlight the risks faced by over 180,000 households which have their own private well. A multi-barrier approach that protects the source waters from pollution – linked with effective treatment and operation designed to match the quality and variability of the source water – is recommended to ensure safe and secure drinking water.

1 *www.epa.ie/irelandsenvironment*

2 Lead by the Department of Communications, Climate Action and Environment

Nuisance, whether this is noise, odour or litter/fly-tipping of waste, is a threat to human health and wellbeing, as well as to the wider environment. Local authorities receive over 60,000 environmental complaints each year from the public. The majority of these relate to nuisance, litter and waste-related issues. The EPA also receives a significant number of complaints about odours emanating from industrial activities, in particular waste management, food and drink facilities. The primary responsibility rests with industrial operators to effectively control their activities but environmental policymakers and regulators have a key role to play in resolving these nuisance issues for citizens.

Climate Change

Acceleration of the National Response to Reducing Greenhouse Gas Emissions, Climate Mitigation and Adaptation

Climate change is now with us, and the sooner we act, the less damage will be done to our society, economy and environment. The national policy position for Climate Change establishes a vision for Ireland of low-carbon transition based on an aggregate reduction in carbon dioxide (CO_2) emissions of at least 80% (compared with 1990 levels) by 2050 across the electricity generation, built environment and transport sectors; and, in parallel, an approach to carbon neutrality in the agriculture and land use sectors, including forestry, that does not compromise capacity for sustainable food production. The adoption of the Paris Agreement on climate change in December 2015 provides an ambitious, legally binding framework for global action on climate change with the aim of holding the increase in the global temperatures to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C. To achieve this vision we need to adopt a much greater sense of urgency about reducing our dependence on fossil fuels for energy, heating and transport, radically improving energy efficiency and preparing for the inevitable consequences of climate change such as flooding. Greenhouse gas (GHG) data for the Emissions Trading Sector show that the sector has increased its emissions whereas the trends across Europe are for decreasing emissions. For wider sectors of the economy and society not covered by ETS, which includes transport and agriculture, for the period 2014-2020 GHG emissions are projected to increase. Overall, total emissions are projected to be between 6% and 11% below 2005 levels in 2020. The target is a 20% reduction. This increasing trend does not look encouraging for meeting our national goal to transition to a carbon neutral society and economy. Meeting the 2030 and 2050 greenhouse gas emission reduction challenges which are intended to deliver resilience in our economy and environment will need a significant improved effort and commitment across the relevant sectors.

Ireland's energy systems will need to undergo a major transformation in the coming decades as part of actions to address and limit climate change. Fossil fuels, which make up about 90% of Ireland's current energy profile, need to be phased out and replaced by renewable energy resources such as wind, solar and tidal. There are very clear wins for the public in energy savings by retrofitting older and less energy-efficient housing stock to reach higher energy ratings. This is a national climate change-related project that could be prioritised through more targeted action programmes.

In relation to transport, there needs to be support for a shift from the private car to an efficient sustainable transport system through a more proactive and systematic approach to land use and transport planning. Wider policy measures are needed to promote significant increases in alternative fuels and electric vehicle usage. For larger urban areas, we need to work on many different levels to have a much more integrated network, with right of way given to transport modes that reduce air pollution and GHG emissions.

Implementation of Legislation

Improve the Tracking of Plans and Policy and the Implementation and Enforcement of Environmental Legislation

Despite progress in several areas, including waste recycling and emissions from industrial facilities, Ireland still faces challenges or EU infringements in implementing a number of directives. The areas where compliance needs to improve include Drinking Water, Urban Waste Water Treatment, River Basin District Plans and Special Areas of Conservation. And as outlined in the chapter on climate, urgent work is needed to reduce greenhouse gas emissions.

Environmental enforcement bodies should continue to target the key environmental risks and non-compliances in order to drive environmental improvements. Appropriate odour control and the requirement to have robust and secure financial provisions in place to manage environmental liabilities are two key issues for waste and industrial sites. Continued enforcement, as well as initiatives to promote positive attitudes and behaviours, is required. Citizen involvement in reporting environmental pollution or related environmental issues provides on-the-ground information for public bodies to act on. Various phone lines, apps or web-based systems are now operated by public bodies to make reporting pollution easier and instant.

Establishing and implementing an integrated national land cover, land use and habitat mapping programme is essential to assist in reporting and assessing the impact of different land cover and land use types on the environment. By integrating the National Landscape Strategy into land use planning, sustainable landscape management practices can also be progressed. For the urban environment the challenge is to design a future urban environment with public appeal that incorporates climate-proofing aspects, such as better outcomes to tackle flooding while minimising the impact on the wider environment, along with green areas and wild spaces for wildlife and people, while also meeting the needs of society. Forward strategic planning for land use and new infrastructure is needed to ensure that growth is sustainable and does not add to the environmental pressures that are already evident, such as the gradual loss of wetlands over the past two decades or capacity issues in delivering drinking water and treating urban waste water.

We need to develop new approaches to be able to tackle systemic and emerging environmental risks effectively. Many specific environmental issues are regulated on a site by site basis, for example the licensing of an industrial facility or the management of a protected area. However, across the wider environment there are also systemic risks, such as diffuse water pollution or decline in species populations that need different and new approaches to resolve. The provision of timely environmental data is crucial to the early identification of these wider risks.

Restore and Protect Water Quality

Implement Measures that Achieve Ongoing Improvement in the Environmental Status of Water Bodies from Source to the Sea

Water protection measures are needed to ensure that we continue to have healthy rivers, lakes and estuaries and clean beaches in order to protect human health, to preserve fish and biodiversity and to allow our important water resources to be a driver for sustainable jobs and tourism. We are still a long way from meeting the full legal requirements of the Water Framework Directive, against which water quality is measured. Preliminary results indicate that there has been no overall improvement in water quality over the first river basin cycle (2009-2015). The target of a 13.6% improvement in the ecological status of surface waters (from the 2009 baseline) by 2015 was not achieved. Water quality improvements are required at approximately 50% of rivers, lakes and estuaries that are impacted by pollution or other pressures. The two main suspected causes of pollution in rivers are agriculture and municipal sources, accounting for 53% and 34% of cases, respectively. Physical modifications, such as barriers to fish migration, are also a key pressure that needs to be tackled. While overall the length of unpolluted river channel has remained relatively constant, there has been a substantial loss in the number of highest quality river sites (i.e. Q value of 5). In the most recent monitoring period (2013-2015) only 21 sites were classified as the highest quality river sites (0.7% of sites) compared with 575 between 1987 and 1990 and 82 between 2001 and 2003. This is an area where substantial effort is required to protect the few remaining sites and, where feasible, return impacted ones back to their earlier extremely high quality.

Urban waste water is still one of the principal pressures on water quality in Ireland. There is a need for continued investment in waste water treatment facilities. This investment is needed to provide, upgrade and manage the sewer networks and treatment facilities necessary to treat sewage and industrial water to the standard needed to protect human health, and water quality in our rivers, lakes and coastal areas.

One of the measures being implemented to improve and protect water quality is the use of a new risk-based approach to managing water catchments. This new approach will require much better targeting of interventions to restore and protect water quality as well as a greater community involvement in protecting and managing our water resources.

Ireland's marine environment has remained relatively unpolluted; however, the level of environmental stress both from internal and external sources has increased. The sustainability of fish catches continues to be an issue; 36% are considered to be sustainably fished. Overfished stocks have declined to 26%, and 38% remain at an unknown status. Untreated sewage is discharged at 36 estuarine or coastal locations. Overall, 71% (46 out of 65) of the urban areas that have inadequate treatment or do not meet mandatory EU standards, discharged to estuarine or coastal locations in 2015. Marine litter is now a global issue and the impacts can be seen on even the remotest of our beaches. While litter is a key marine environment and biodiversity challenge, its generation and prevention are linked to a variety of human activities and policy areas. Successful implementation of a comprehensive targeted waste policy is a prerequisite to avoid plastic litter entering the marine environment.

Other stresses on our coastal environment are wider and link to the impacts of climate change. From a climate perspective, rising sea temperature, ocean deoxygenation, rising sea levels and ocean acidification (the effects of which are being seen in Irish waters) are major causes of concern worldwide. The rich coastal marine grasses and kelp forests are significant carbon sinks (as well as important biodiversity reservoirs) that need protection and

enhancement. Issues covered in this report on the marine area point towards the need to protect coastal, estuarine and marine areas through better integration of the actions required under different water, marine and nature directives.[3]

Sustainable Economic Activities

Integrating Environmental Sustainability Ideas and Performance Accounting Across Economic Sectors and Sectoral Plans Should be a Key Policy for Growth

In a world of finite resources and a growing population it has never been more important to evolve our national economy and society to become sustainably competitive. This requires us to become resource efficient and sustainable in how we produce and consume. Ireland has in recent years dramatically reduced the waste consigned to landfill and produced less household waste per capita than the European average. Ireland has pioneered economic initiatives which have changed consumer behaviour and prevented waste including the plastic bag levy. Our National Waste Prevention Programme is well established and an example of best practice. It needs significant resourcing at local level as CSO data published in 2016 would suggest that 500,000 national households do not implement waste prevention in the operation of their homes, and 51,000 households do not participate in legal waste management practices.

Putting the environment at the centre of decision making is a key challenge, given the competing demands placed on our environment by today's society. We must move our material flow economy from a linear to a circular one in which materials are captured for reuse at the end of a product's productive life. This evolution will create opportunity in the green economy and ensure that Ireland can move towards sustainable and competitive prosperity. We could and need to be doing better.

Ireland has some notable waste infrastructure deficits, such as the lack of a hazardous waste landfill, and has limited current available capacity in other infrastructure. Built landfill capacity is at a critical state with potentially less than 1 year's capacity, based on the 2015 fill rate. There was a 10-fold increase in residual waste exported for use as a fuel in the period between 2010 and 2014. Ireland is largely dependent on export market for treatment of our recyclable waste. Consequently we are vulnerable to external forces such as competition, capacity, currency fluctuations and any changes to policy in the EU.

EU policies request that urgent attention be applied to the phasing out, by 2020, of environmentally harmful subsidies at a national level. In Ireland, this requires the identification, and phasing-out (or reformulating), of existing subsidies, transfers, state aids and tax exemptions which offer support for emissions or activities that contribute to harming the environment (i.e. negative environmental externalities).

With the plans for expansion of agricultural output under Food Wise 2025, there is a need to ensure sustainability of the sector for both economic growth and environmental protection. The environmental credentials of agriculture, along with aquaculture, need to be measurable and benchmarked to demonstrate our commitments to expanding in a manner that would not result in long-term degradation of our natural environment. Mitigating greenhouse gas emissions and adaption to climate change will be key considerations for Irish agriculture in the coming years. It is clear that climate change will require adaption to a new reality and this will impact on farmers, as on all sectors of society.

Nature and Wild Places

Protect Pristine and Wild Places that Act as Biodiversity Hubs, Contribute to Health and Wellbeing, and Provide Tourism Opportunities

We need to protect our remaining wild places and high-status water bodies from further deterioration so that they remain a safe place for wildlife and people, and as a legacy for future generations. Conserving what we already have, and restoring habitats such as our damaged boglands, will help provide wild areas that protect biodiversity, contribute to our health and wellbeing and provide significant tourism opportunities.

The current assessment is that habitat and biodiversity loss remain a risk and there is a need to develop initiatives to engage society and incorporate nature protection in decision making. In relation to species and habitats in Ireland that are considered threatened across Europe and protected under the Habitats Directive, 52% of species are in favourable status but only 9% of habitats are in favourable status. One of the species of greatest concern is the pollution-sensitive freshwater pearl mussel. The iconic Curlew is now one of the threatened breeding birds species. There is a need to bring biodiversity into the mainstream through biodiversity action plans, robust biodiversity monitoring systems/mapping and new approaches such as the ecosystem approach/natural capital accounting, where appropriate, in the development of policies, plans and strategies.

3 Water Framework Directive, Bathing Water Directive (2006/7/EC), Urban Waste Water Directive, Marine Strategy Framework Directive (2008/56/EC), Maritime Spatial Planning Directive (2014/89/EU) and Nature Directives (2009/147/EC and 92/43/EEC).

Increased land use change as the economy recovers may lead to further habitat loss and/or fragmentation through, for example, risks to wetlands. The impacts of climate change and the continuing threat of invasive species are areas that also need to be monitored and guarded against.

Efforts to increase public awareness of biodiversity could be strengthened as the appreciation of biodiversity and its link to everyday life is necessary if efforts to protect nature are to be successful.

Community Engagement

Inform, Engage and Support Communities in the Protection and Improvement of the Environment

Information and evidence are key to making effective decisions that place the environment at the core of the decision-making process. A positive development in recent years has been the increase in the provision of information sources. We need to get more involved locally and be informed about environmental issues. We have many good examples to build on in Ireland, such as Tidy Towns, Pride of Place and LIFE Projects. We all own the environment and have a responsibility for its care and protection: after all, our health and wellbeing depend on it.

There are now a number of local community and niche projects that are leading the way in the transition to a more sustainable future. These community-led projects demonstrate that local solutions are one of the ways to change environmental behaviour and offer new ways to approach environmental challenges in the future. There are encouraging signs that more local and community-based projects can act as template projects to maintain and improve biodiversity and river habitats in sensitive farming areas. Programmes such as Eco-UNESCO and An Taisce's Green Schools are successfully engaging our young people. The challenge here is to replicate these types of projects through policy support and incentives elsewhere across the country in order to multiply the benefits for the environment and our wellbeing.

The European Environment Agency (EEA) in their 2015 State of the Environment report for Europe paints a varied picture in relation to achieving the EU's 2050 vision of "living well within the limits of the planet". Overall, the high-level challenges highlighted by the EPA throughout these chapters reflect the challenges set out by the EEA in its State of the Environment report for Europe 2015 and also in the EU 7th Environmental Action Programme (EAP). This attests to the fact that across Europe there are similar challenges in addressing identified environmental issues and ensuring a good-quality environment.

Ireland's economy is beginning to grow again and we must balance our focus on growth with an emphasis on becoming more sustainable and reducing emissions. A sustainable Ireland is an Ireland with a vibrant economy that offers a decent livelihood for all its citizens; people and communities that help and respect each another; and, underpinning this, a protected environment that allows us to live more healthy lives. To become sustainable we all need to change the way we act as consumers, in our homes, our businesses and our public bodies. Our challenge is to do this within the planet's capacity and ecological limits.

Challenges

In summary the key environmental actions for Ireland on the state of the environment in 2016 are as follows:

SYSTEMIC MESSAGES

Environment and Health & Wellbeing

Recognition of the benefits of a good quality environment to health and wellbeing.

Climate Change

Accelerate mitigation actions to reduce greenhouse gas emissions and implement adaptation measures to increase our resilience in dealing with adverse climate impacts.

Implementation of Legislation

Improve the tracking of plans and policies and the implementation and enforcement of environmental legislation to protect the environment.

TOPIC MESSAGES

Restore & Protect Water Quality

Implement measures that achieve ongoing improvements in the environmental status of water bodies from source to the sea.

Sustainable Economic Activities

Integrate resource efficiency and environmental sustainability ideas and performance accounting across all economic sectors.

Nature & Wild Places

Protect pristine and wild places that act as biodiversity hubs, contribute to health and wellbeing and provide sustainable tourism opportunities.

Community Engagement

Inform, engage and support communities in the protection and improvement of the environment.

Section I
Introduction

Chapter 1
Introduction

Chapter 1

Introduction

Introduction

Climate change is one of the key environmental challenges that we face both nationally and globally.

This report is the latest in the EPA State of the Environment series, which is published every 4 years. It is published at a time when climate change is a global issue and a key environmental priority for countries across the planet. New agreements on greenhouse gas emissions targets were reached at the Conference of the Parties (COP21) held in Paris in 2015 (UN, 2015). The pressing need to reduce greenhouse gas emissions, as well as to develop plans to tackle the implications of climate change, has been extensively reported on across the scientific literature, by non-governmental organisations, state bodies and in the media. The World Meteorological Organization (WMO) announced that the amount of greenhouse gases in the atmosphere had reached new record highs, while ocean temperatures also reached their highest levels since measurements began (WMO, 2015; Blunden, J. and D.S. Arndt, Eds., 2016). According to NASA, global temperature records were broken in 2016, with April and May setting new global temperature records, continuing the trend of the preceding 6 months (NASA, 2016). Reports such as these have highlighted the urgent need to tackle climate change.

The State of the Environment report allocates a lot of discussion to climate issues and the key sectors of the economy that generate the majority of greenhouse gas emissions. However, climate change is just one of the environmental challenges that we face both nationally and globally.

The benefit of a clean environment for health and wellbeing is now widely recognised. People should not have to live in an area where local amenities are degraded and cannot be used. Controlling the release of chemicals and pollutants to the environment is probably one of the main concerns which people think about when they hear about health and the environment. But it is increasingly being recognised that having a clean environment in itself is highly beneficial to wellbeing by providing better places to live and local amenities for communities.

Ireland still has many unspoilt areas that are beneficial to people as well as to the economy. The outstanding natural beauty and wilderness of the Wild Atlantic Way is now recognised as a key economic asset that attracts significant numbers of visitors each year.[1] However, even here there are environmental pressures that need to be closely monitored. The protection of water quality is essential, and effective environmental protection measures are needed to ensure that coastlines, beaches, rivers and lakes along the Wild Atlantic Way, and elsewhere, are maintained and protected.

1 Wild Atlantic Way Official Travel Site: *www.wildatlanticway.com/home*

Content of the Report

This report provides an overview of the current state of Ireland's environment. It uses information and data available from the EPA and other organisations. Environmental professionals working in different fields across the EPA have used this information and data to produce this update on the state of Ireland's environment.

Following on from this short introduction section, Section II examines the quality of our environment through assessments covering air, climate, nature, water, waste and land use and soil. Some of the environmental issues discussed here include reducing greenhouse gas emissions and vehicle exhaust emissions, tackling biodiversity loss and the need to reduce the input of nutrients to waters. These issues are also recognised as European and global issues where action is needed.

Human health protection is a fundamental aspect and a driver of much environmental legislation. Section III explores how human health and the quality of the environment are closely linked and how environmental pollution can affect our quality of life. It also covers the wider societal benefits of a good environment and how this can lead to better health outcomes.

Section IV focuses on the environment and economy. It looks at our current generation of products and services and the resulting emissions, waste and residues. It covers the concept of the circular economy, which is a relatively new policy area being implemented in the European Union (EU) that is intended to decouple economic growth from its reliance on scarce resources and to foster innovations that enable us to "do more with less". This would bring benefits to our environment as well as to our economy. This section also delves into the environmental challenges around the economic sectors covering transport, energy and agriculture. It examines the environmental impacts and effectiveness of policies and programmes in these sectors.

Section V rounds off the report by providing an overview of the priorities and main messages for improving the quality of our environment in Ireland. It describes progress made in addressing environmental issues within the context of goals, targets and legislation from the European Commission (EC). Ensuring effective implementation and enforcement of legislation is still a critical factor in ensuring that environmental and health protection standards are achieved.

Mixed Progress in Addressing Environmental Challenges

The 2012 State of the Environment report identified four key environmental challenges for Ireland and these challenges remain as valid now as they were in 2012 (EPA, 2012):

- valuing and protecting our natural environment
- building a resource efficient, low carbon economy
- implementing environmental legislation
- putting the environment at the centre of decision making.

Based on the assessments presented in this latest report, the overall score card 4 years on for these challenges is mixed. Each of these challenges is complex and broad and, although there have been some improvements, we have not yet as a country fully transitioned into developing everyday effective solutions to deal with these environmental challenges. Biodiversity loss is still a real issue. We are still highly dependent on fossil fuels and meeting our 2020 greenhouse gas emissions targets will be very challenging. We are slow in implementing some environmental directives, particularly those linked to the protection of water.

Many sectors of our economy now have plans that include sustainability, but we are finding that reporting systems need to be strengthened to measure through verifiable evidence how these plans are performing over time. Only then will we be able to judge whether the environment is really at the centre of our decision making process, as those plans with sound environmental policies and

actions should result in improving environmental trends and provide positive indicators about the quality of our environment.

On the other hand, there are local community and niche projects that are leading the way in the transition to a more sustainable future. These community-led projects demonstrate that local solutions are one of the ways to change environmental behaviour and offer new ways to approach environmental challenges in the future. This is clearly an area that requires further support and development as we move forward.

The Environmental Protection Agency Strategy for 2016 to 2020 sets out how to protect and improve the environment over the next 5 years. It lists key environmental challenges that will be targeted for improvement, along with a range of other strategic goals and objectives. Several of the objectives in the strategy match closely with the main messages in this report including:

- tackle the challenges to deliver improved water quality in Ireland
- engage with other strategic partners to promote the development of a holistic national response to climate change
- enhance the air and radiation protection framework in Ireland
- engage the public in the protection and improvement of the environment
- promote a greater awareness of the impact of environment quality on human health.

Key Messages for Ireland in 2016

There are many and often complex linkages between our everyday lives and the wider environment. Many linkages are already known, but others are still to be discovered and their effects on our environment investigated. This is where the EPA research programme plays a key role.

Many of the steps needed to deal with known environmental issues in Ireland have already been mapped out, but appropriate buy-in and implementation of these steps across society is often the biggest challenge. The main messages for protecting Ireland's environment arising from the report are as follows:

Figure 1.1 Seven Key Environmental Actions for Ireland on the State of the Environment in 2016

SYSTEMIC MESSAGES

Environment and Health & Wellbeing

Recognition of the benefits of a good quality environment to health and wellbeing.

Climate Change

Accelerate mitigation actions to reduce greenhouse gas emissions and implement adaptation measures to increase our resilience in dealing with adverse climate impacts.

Implementation of Legislation

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Nature & Wild Places

Protect pristine and wild places that act as biodiversity hubs, contribute to health and wellbeing and provide sustainable tourism opportunities.

Community Engagement

Inform, engage and support communities in the protection and improvement of the environment.

Our understanding of Ireland's environment is constantly changing with ongoing monitoring programmes, research and the implementation of polices and legislation. To complement this report the EPA has developed the "Ireland's Environment" section on the EPA website. This site supports the State of the Environment report by providing up-to-date online information that includes environmental indicator data.

Ireland's economy is beginning to grow again and we must balance our focus on growth with an emphasis on becoming more sustainable and reducing emissions. The adoption of the New York Agreement on Sustainable Development Goals and the Paris Agreement on climate change, both in 2015, provide ambitious, legally binding frameworks for global action on sustainability and climate change. In addition, Ireland has taken a national policy position that commits us to reducing 1990 levels of carbon dioxide emissions by 80% by 2050 across the electricity generation, built environment and transport sectors while achieving carbon neutrality in the agriculture and land use sectors.

However, EPA projections indicate that we face considerable challenges to becoming a low-carbon economy. Ireland must follow a pathway to decarbonise energy, transport and heating. We must break our dependence on fossil energy infrastructures. In addition, the agriculture, forestry and land use sectors should achieve effective greenhouse gas emissions (GHG) neutrality by 2050. In effect, GHG emissions neutrality is the same amount of emissions being emitted as being sequestered or captured. So it effectively means net-zero emissions[2]. This will take planning, investment and time but can be achieved in the overall framework of national, EU and global commitments.

We need to mobilise the four and a half million people living in Ireland to place the environment at the heart of their decisions and actions every single day; only by doing this can we build a sustainable future. A sustainable Ireland is an Ireland with a vibrant economy that offers a decent livelihood for all its citizens; people and communities that help and respect each another; and, underpinning this, a protected environment that allows us to live more healthy lives. To become sustainable we all need to change the way we act as consumers, in our homes, our businesses and our public bodies. Our challenge is to do this within the planet's capacity and ecological limits.

The environment and our health and wellbeing are inextricably linked. A thriving, clean environment provides the very basis of good lifestyles and we need to look beyond simply protecting people from threats in their environment to considering how the environment can deliver a much wider range of health benefits.

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2 *www.carbonbrief.org/cop21-experts-discuss-greenhouse-gas-emissions-neutrality*

Section II

Environmental Assessments

Chapter 2
Air

Chapter 3
Climate

Chapter 4
Nature

Chapter 5
Water

Chapter 6
Waste

Chapter 7
Land and Soil

Chapter 2
Air

Air Quality and Transboundary Air Emissions

Introduction

Ireland's air quality currently is good, relative to other EU Member States, but maintaining this standard is a growing challenge. While monitoring stations show that Ireland continues to meet all EU air quality standards, localised air quality issues do arise. Ireland's good air quality is largely thanks to the prevailing clean Atlantic air and the absence of large cities and heavy industry.

In Ireland, air quality has improved significantly over the decades through a number of policy measures at European and national level. The introduction of the smoky coal ban in Dublin in 1990 is a good example of a national policy that led to significant improvements regionally and locally. The phasing out of lead in petrol and improved vehicle emission standards and technologies (where legitimately delivered) are examples of European policy changes that have been aimed at improving the air we breathe.

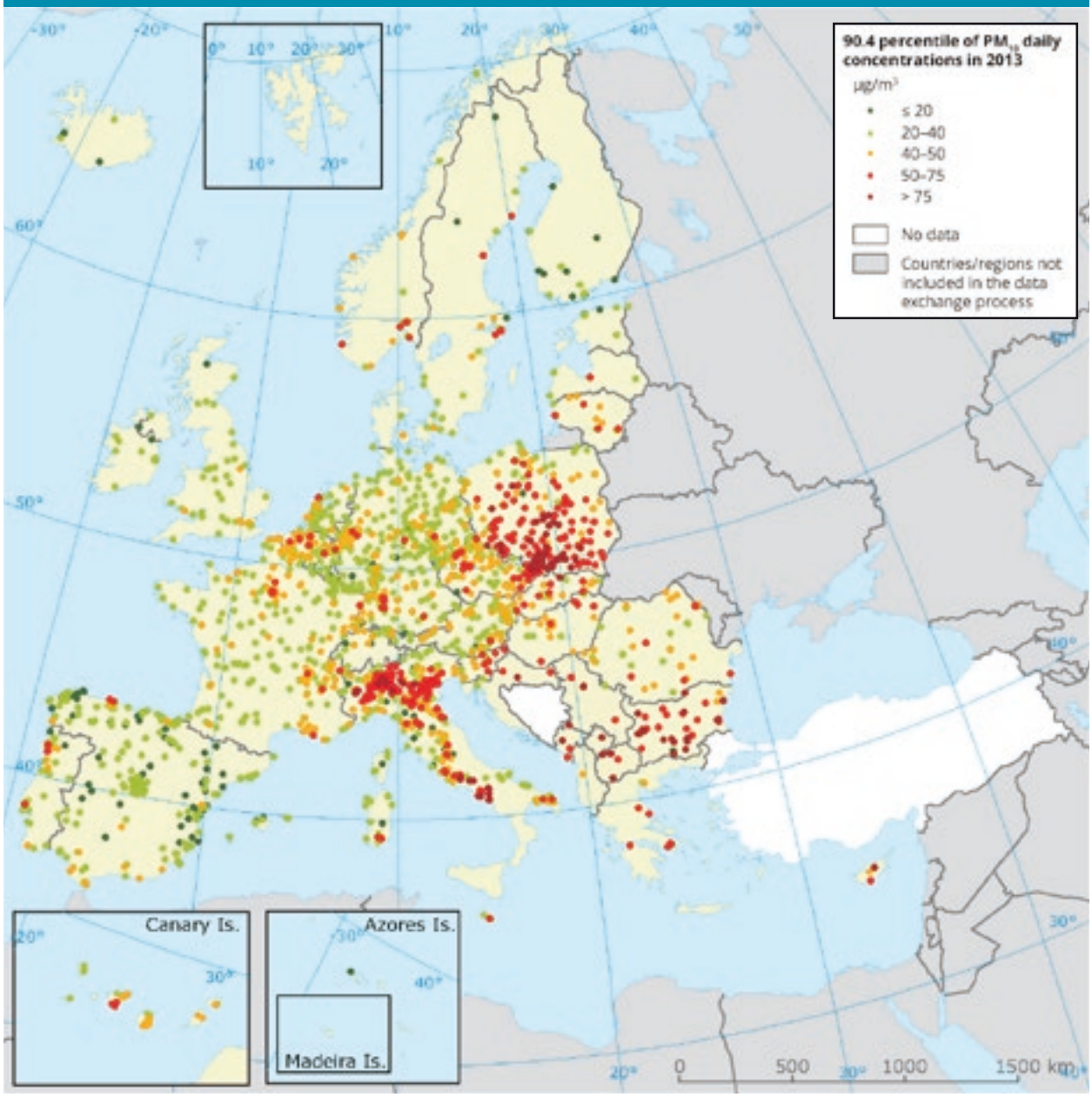
However, in urban areas such as Dublin and Cork, levels of nitrogen dioxide are close to the specified EU limit values for air quality as a result of exhaust emissions from vehicles. Levels of particulate matter (PM) in smaller towns that do not have a smoky coal ban can also be high, sometimes higher than in towns where such a ban is in place.

Vehicle and residential heating emissions also contribute to a higher concentration of greenhouse gases (GHGs) in the atmosphere. This is a global issue which is covered in several sections of this report: the transport sector is covered in more detail in Chapter 10 and the health issues associated with air pollution are highlighted in Chapter 8. Policy action to tackle air quality issues associated with vehicle and residential heating emissions will have co-benefits for GHG mitigation.

Ireland faces many challenges in order to meet new air quality standards for fine particulate matter ($PM_{2.5}$) concentrations by 2020. Concentrations of polycyclic aromatic hydrocarbons (PAHs) also show a concerning trend in Ireland, with the major source being residential combustion of solid fuel. This chapter makes reference to the World Health Organization (WHO) air quality guidelines for particulate matter (PM_{10}), ozone, nitrogen dioxide and sulphur dioxide (WHO, 2005); and also to the WHO air quality guidelines update, which includes $PM_{2.5}$ (Krzyzanowski and Cohen, 2008). These guidelines were developed by the WHO to inform policymakers and provide appropriate air quality targets worldwide, based on the latest health information available. When the updated WHO health based standards (for $PM_{2.5}$) are applied, a significantly higher proportion of the urban population are classed as being exposed to harmful levels of air pollution (EEA, 2014). Ireland should adopt these stricter WHO values, particularly for particulate matter and ozone, as with the increased understanding of the science of air quality and its impact on health has come the realisation that compliance with EU air quality limit values is not enough to protect the health of Irish from the negative effects of poor air quality (WHO, 2016).

A key part of the approach to tackling these issues is better engagement with the public on the topic of air quality. The first step in this process is an increased access to air quality data and information. This is highlighted in the EPA's National Ambient Air Quality Monitoring Programme (AAMP) which proposes three main pillars along with under-pinning supporting actions including, a greatly expanded national monitoring network, increased modelling and forecasting capability and an increase in citizen engagement.

Figure 2.1 PM_{10} Concentrations in Europe in 2013 (Source: EEA, 2013)



For Ireland to continue to comply with its international commitments on air quality and air emissions, industrial emissions of pollutants into the air must continue to be rigorously controlled and policies should be implemented to increase the use of alternatives to the private car and to improve efficiencies of motorised transport. Government departments, national agencies and local authorities need to make air quality an integral part of their traffic management and planning processes. With respect to the levels of particulate matter and PAHs observed across Ireland, households, in particular, need to use more efficient methods to burn fuel, and a shift from solid fuel to cleaner alternatives, including gas, should be promoted and undertaken, where this is feasible.

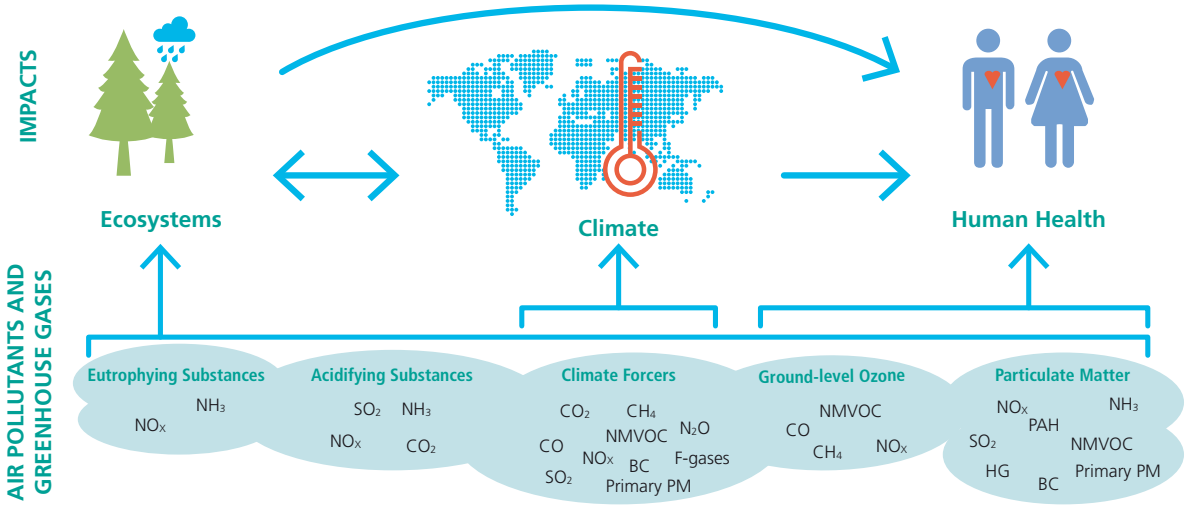
Finally, the clear links between air quality and its effects on health need to be better communicated to the public in a variety of ways, with the provision of more localised information and access to air quality data being paramount. This will allow the public to make informed decisions about their health and it will also provide a policy impetus to make the necessary changes at a local and national level to maintain good air quality and improve it in other circumstances. Ireland will also have to have a greater awareness of the impact of agriculture on air quality, in particular its contribution to emissions of non-methane volatile organic compounds (NMVOCs) and ammonia with the resultant influence on particulate matter (EPA, 2015a). This is particularly important in respect of the planned implementation of Food Wise 2025 which aims to significantly increase agricultural output, in particular from the dairy sector. EPA funded research on ammonia and on critical loads of atmospheric nitrogen show an exceedance of acceptable levels across many habitats due to emissions predominantly from the agricultural sector[1] (*www.ucd.ie/ammonia/*; EPA, 2013; Kelleghan *et al*., 2014; EPA, in press).

Air Quality and Health

Air pollution and health impact: a very significant issue in Europe

Under WHO[2] and EU[3] estimates, more than 400,000 premature deaths are attributable to poor air quality in Europe annually, which elevates air quality to being a policy priority. In Ireland the premature deaths attributable to air pollution are estimated at 1,200 people. The most common causes of premature death attributable to poor air quality are strokes and heart disease. The economic impact is also significant, with the increased costs of healthcare and lost working days. A recent report by the OECD concluded that the economic cost of air pollution (in terms of global economic output) will, by 2060, equate to US$330 per person per annum, or US$176 billion; and the annual number of work days lost is estimated to rise to 3.7 billion (OECD, 2016). What all of this means at a human level is that, across Europe, tens of thousands of people are losing 3–4 years of their lives because of air pollution, years they could have been spending with their families and communities in good health had they

Figure 2.2 Impacts of Air Pollution (Source: EEA, 2014)



1 *www.ucd.ie/ammonia/*

2 *www.euro.who.int/en/health-topics/environment-and-health/air-quality/news/news/2014/03/almost-600-000-deaths-due-to-air-pollution-in-europe-new-who-global-report*

3 *www.eea.europa.eu/media/newsreleases/many-europeans-still-exposed-to-air-pollution-2015/premature-deaths-attributable-to-air-pollution*

not been exposed to dangerous levels of air pollution throughout their lives. It should also not be forgotten that air pollution has significant impacts on ecosystems and buildings (EEA, 2014).

EU Directives on Air Quality

Co-ordination of air pollution monitoring required to protect health

In order to protect our health, vegetation and ecosystems, EU directives have set air quality standards for a wide variety of pollutants. The current standards are contained in the Directive on Ambient Air Quality and Cleaner Air for Europe (the CAFE Directive 2008/50/EC; and the fourth Daughter Directive 2004/107/EC).[4] These directives also include rules on how Member States should monitor, assess and manage ambient air quality. The EPA, as the national competent authority for Ireland, is tasked with co-ordinating and managing this monitoring programme. A nationwide network of 31 monitoring stations measures levels of air pollutants in each zone; the majority of these deliver information in real time to the public.[5] The EPA is currently in the process of developing a new National Ambient Air Quality Monitoring Programme, which will be built on three key pillars:

- national monitoring network;
- modelling and forecasting;
- citizen science/citizen engagement.

The EPA is recommending that the new programme will involve a greatly expanded national monitoring network providing enhanced real-time information to the public and supplemented by an increased local authority capacity to conduct indicative monitoring. The network can be supported and enhanced by increased modelling and forecasting capability, with the aim of providing an ongoing air quality forecast model to the public. Supporting both of these elements will be citizen science initiatives to encourage greater engagement of the public in air quality issues. These changes should greatly improve our national capacity for air quality and public health protection.

Ireland currently participates in an international network of carbon monitoring stations, the International Carbon Observation System (ICOS), with a purpose of improving knowledge of GHG in our atmosphere and harmonising the science[6], and also participates in the European Monitoring and Evaluation Programme (EMEP)[7] for international co-operation to solve transboundary air pollution problems. The national ICOS and EMEP stations are located at Malin Head, Donegal; Mace Head, Galway; Oak Park, Carlow; and Carnsore Point, Wexford.

Transboundary Air Emissions

Air pollution has no borders

Air pollution can be transboundary. Pollution that originates in one country can impact negatively on a neighbouring country. Monitoring at national and international EMEP[6] sites indicates a number of important pathways for transboundary pollution to reach Ireland, e.g from the UK, Europe, North America and from marine sources. Transboundary air pollution is associated with health impacts from fine particulate matter, acidification, eutrophication and ozone formation, which damages ecosystems, vegetation and human health.

The landmark agreements that was intended to control emissions of transboundary pollutants was the 1999 UNECE[8] Gothenburg Protocol under the Convention on Long-range Transboundary Air Pollution (CLRTAP), was given effect in the EU by the National Emission Ceilings (NEC) Directive 2001/81/EC[9].

The NEC Directive sets upper limits, or "ceilings", for national emissions from each EU Member State. The pollutants include sulphur dioxide (SO_2), nitrogen oxides (NO_x), volatile organic compounds (VOCs) and ammonia (NH_3) – which were considered the four key transboundary pollutants.

The amended Gothenburg Protocol now includes targets for 2020 and the NEC Directive will include targets for 2030. Both the Gothenburg Protocol 2020 and the NEC Directive 2030 include ceilings for $PM_{2.5}$ emissions for the first time given the recognition of the health impacts and transboundary nature of fine particulate matter.

4 *www.ec.europa.eu/environment/air/quality/legislation/existing_leg.htm*

5 *www.epa.ie/air/quality/*

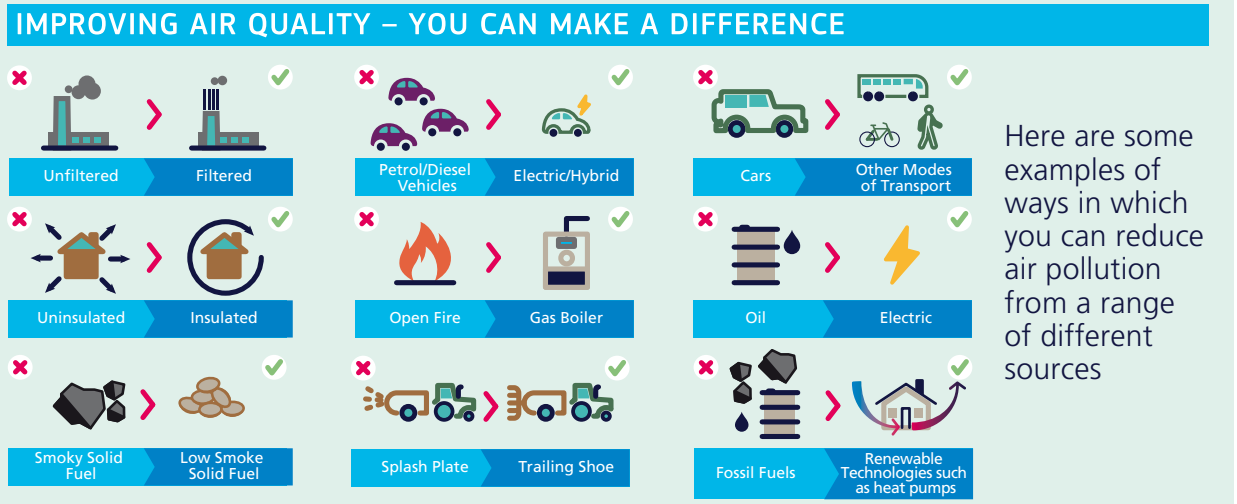
6 *www.icos-ri.eu/*

7 *www.emep.int/*

8 UNECE is the United Nations Economic Commission for Europe, which was established in 1947 and tasked with promoting pan-European economic integration.

9 *www.ec.europa.eu/environment/air/pollutants/ceilings.htm*

Figure 2.3 Air Pollution in Ireland (Source: EPA & DECLG, 2015)



The Current Air Quality Situation in Ireland

Main Air Pollutants

Monitoring is carried out for pollutants that impact on health and vegetation

Air quality monitoring in Ireland is governed by EU legislation which requires the measurement of NO_x, SO_2, carbon monoxide (CO), ground level ozone (O_3), particulate matter (PM_{10} and $PM_{2.5}$), benzene, heavy metals and PAHs. Concentrations of these pollutants are then compared with a set of limit and target values for the protection of human health, ecosystems and vegetation. The pollutants of most concern are NO_x, PM and O_3. Recently, PAHs have also been recognised as a problem pollutant.

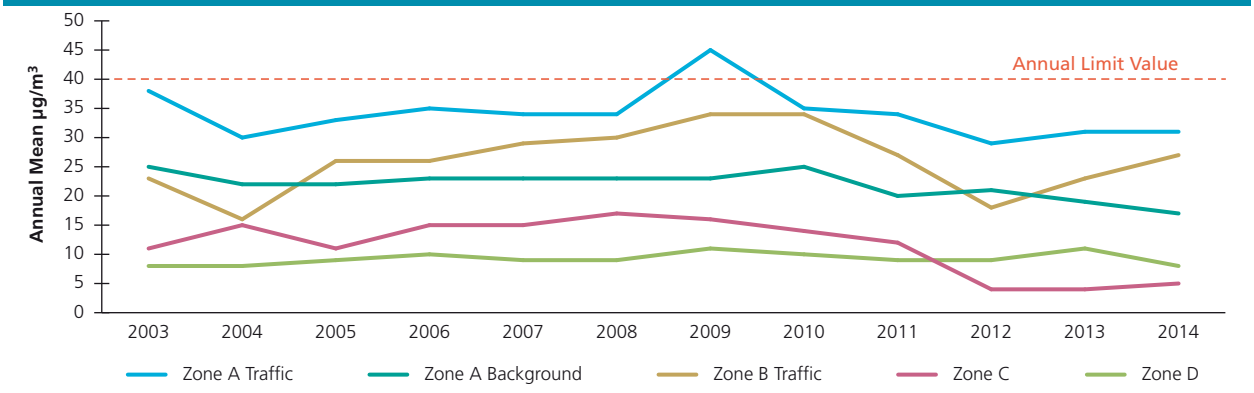
The infographic at Figure 2.3 summarises national air pollution facts and information.

Oxides of Nitrogen (NO_x)

Main source is vehicle exhausts and high temperature combustion sources

NO_x is the collective term for the gases nitric oxide (NO) and nitrogen dioxide (NO_2). The source of NO_x is typically any process of high-temperature combustion, most commonly the burning of fossil fuels in the combustion engines of motor vehicles. Short-term exposure to NO_2 gas is associated with adverse respiratory effects, while NO_x in general contribute to the formation of ground-level ozone and acid rain. NO_2 concentrations in Ireland were static for the period 2008–2014, perhaps because of a combination of the economic downturn and favourable weather. It will be important to remain vigilant to increasing NO_2 levels, particularly from transport, in light of the economic recovery.

Figure 2.4 Annual Mean Nitrogen Dioxide Concentrations 2004-2014 (Source: EPA, 2015)



Particulate Matter (PM_{10} and $PM_{2.5}$)

A priority for action because of health impacts associated with this air pollutant which has both urban and rural sources

PM_{10} refers to particles with a diameter of less than 10 micrometres. These particles can penetrate the lungs, while the related pollutant $PM_{2.5}$ refers to particles with a diameter of less than 2.5 micrometres. This smaller size allows them to penetrate the alveoli of the lungs, where gaseous exchange occurs. In Ireland, the main source of particulate matter in ambient air is agriculture (through secondary formation) (EPA, 2015a). However, in urban settings, domestic use of solid fuel and diesel fuelled vehicular traffic are the principal sources. PM_{10} concentrations have decreased in urban environments since the early 2000s, mainly as a result of the shift from residential solid fuel and developments in diesel particulate filter technology. The picture in smaller towns and villages in Ireland is different, where the predominant source of PM is combustion of solid fuel. Because of the lack of access to cleaner alternative heating sources such as gas, and also the absence of a ban on the burning of smoky coal, there has been no observed decrease in PM concentrations over the same period (EPA, 2015b). As part of the EU CAFE Directive, the National Exposure Reduction Target (NERT) requires a mandatory 10% reduction in the average concentration of $PM_{2.5}$ across Ireland by the year 2020. This is a challenging reduction and will require an integrated approach across a number of sectors including industrial, agricultural, transport and residential emissions. Figure 2.5 shows annual concentrations from 2004 to 2014 for monitoring sites across Ireland, with reference to the EU limit value and the WHO air quality guideline value for PM_{10}. As can be seen from the graph, at certain monitoring locations in Ireland values are above the WHO air quality guideline levels (WHO, 2016).

Polycyclic Aromatic Hydrocarbons (PAHs)

Pollution sources linked to emissions from traffic and household use of solid fuel

PAHs are organic compounds predominantly originating from solid fuel burning, particularly wood burning and, to a lesser extent, vehicle emissions. PAHs in Ireland are measured by monitoring for benzo[a]pyrene (BaP), which acts as a marker for PAHs and is a potent carcinogen (EEA, 2015). PAH monitoring in Ireland began in 2009, with levels at one of the stations coming close to the limit value of 1 ng/m^3 in 2014. A reduction in the use of solid fuel as a home-heating source across Ireland would mitigate PAH impact on air quality into the future.

Ground-level Ozone (O_3)

Not a direct emission but formed as a result of a reaction of a mix of air pollutants during sunny weather

Ozone is a gaseous species that is formed as a secondary pollutant in the ground level atmosphere from the chemical reaction of NO_x, CO and VOCs in the presence of sunlight. Ozone can also be present in the troposphere as a result of downwards flux from the ozone-rich

Figure 2.5 Annual Mean PM_{10} Concentrations 2004-2014 (Source: EPA)

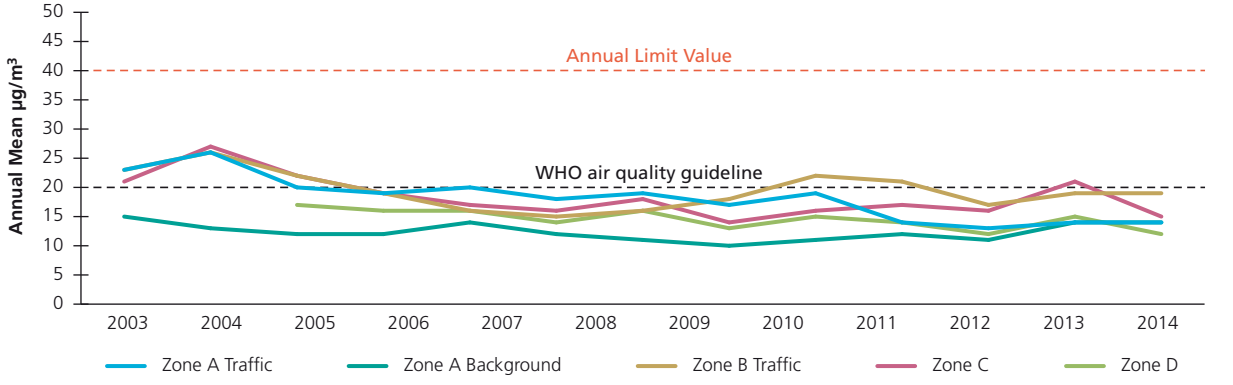
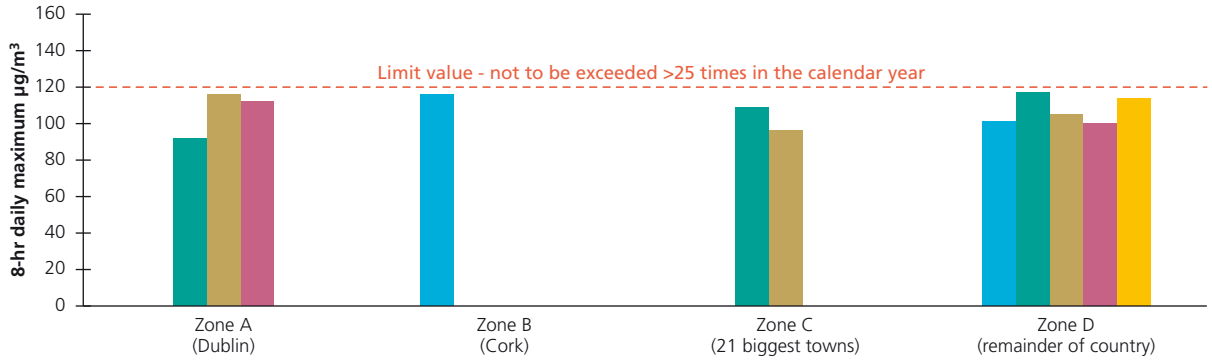


Figure 2.6 Eight-hour Average and Daily Maximum Values Observed at Ozone Monitoring Stations Across Ireland in 2014 (Source: EPA, 2015b)



stratosphere, where it occurs naturally and plays an important role in absorbing harmful UV radiation. Ozone is a powerful oxidising substance whose presence in rural areas damages crops and vegetation. High concentrations of ozone affect the functioning of the respiratory system leading to irritation of the throat and lungs. It is particularly harmful for those who suffer from respiratory ailments such as asthma and bronchitis. Ozone levels in Ireland, which are highly influenced by transboundary sources, are low in comparison with those in mainland Europe. Average concentrations in Ireland are generally below the thresholds for effects on human health and vegetation set down in the CAFE Directive, but can exceed the WHO air quality guideline values for ozone.

Other Pollutants

Most controlled air pollutants show low levels in Ireland

Measured levels for the rest of the legislatively important pollutants are low in Ireland, with concentrations of SO_2, CO, benzene, lead, arsenic, cadmium, nickel and mercury below all relevant limit and target values (EPA, 2015b).

Quantity of Air Pollutants Emitted

Transboundary Air Pollutants

Emissions of transboundary pollutants have been reducing across Europe

Monitoring of transboundary pollutants in Europe is primarily covered by the 1999 UNECE Gothenburg Protocol under the Convention on Long-range Transboundary Air Pollution (CLRTAP) and the EU NEC Directive. Prior to the Gothenburg Protocol the pollutants that were originally of concern were the gaseous species NO_x, SO_2 and VOCs. These pollutants, which cause acidification, eutrophication and ground-level ozone formation, have shown declining concentrations since the introduction of the legislation. Ammonia (NH_3) was later included in the list of pollutants for the Gothenburg Protocol and more recently, with the replacement of the original legislation with the 2020 Gothenburg Protocol and the 2030 NEC Directive, emissions ceilings for $PM_{2.5}$ have also been introduced. The current position in Ireland is shown in Table 2.1.

Figure 2.7 NO_x Emission Sources and Trends 1990-2014 (Source: EPA, 2015b)

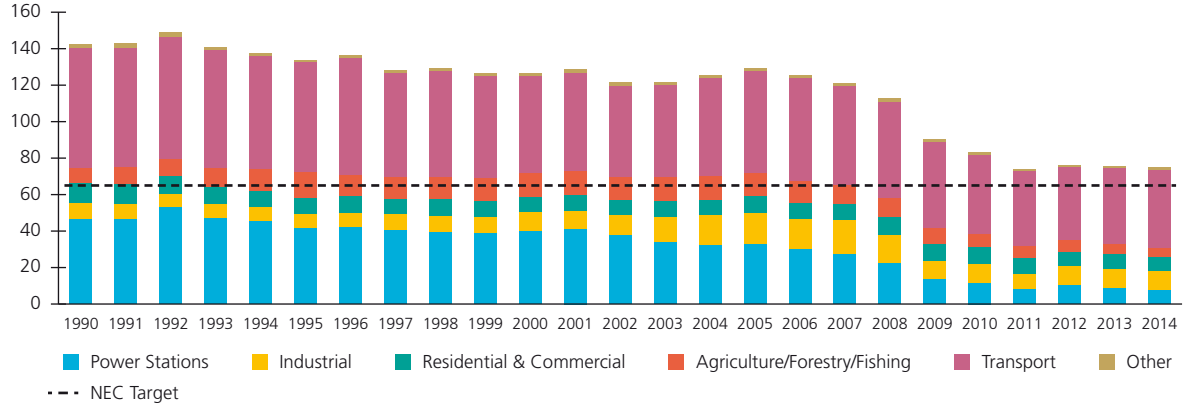


Table 2.1: State of Progress for Limiting Transboundary Air Pollutants in Ireland

Sulphur Dioxide (SO_2)

Overview – Transboundary emissions that can cause acid deposition have significantly reduced in Ireland. SO_2 emissions are linked to combustion processes.

SO_2 is a gaseous species that readily undergoes atmospheric chemistry in water vapour to form sulphuric acid (H_2SO_4) which leads to acidification of ecosystems and damage to vegetation.

Progress against the emission ceiling target

Ireland achieved the 2010 emission ceiling of 42 kilotonnes (kt) in 2009. It is anticipated that Ireland will continue to meet its objectives under the 2020 Gothenburg Protocol and the 2030 NEC Directive.

Key steps towards achieving the target

Fuel switching in the power generation and industrial sectors has aided in the achievement of Ireland's commitments on SO_2. Further reductions in the sulphur content of fuel oil, gas oil, diesel and gasoline, and a decrease in coal and peat use for heating in Irish homes should help maintain this situation.

Oxides of Nitrogen (NO_X)

Overview – Emissions linked to high-temperature combustion. Also relevant to acidification and eutrophication processes.

Any processes that involve high-temperature combustion in the presence of oxygen and nitrogen lead to the production of NO_X as a by-product.

Progress against the emission ceiling target

Ireland is one of the 11 EU Member States that did not meet their 2010 emission ceiling for NO_X.

Key steps towards achieving the target

A reduction in the contribution of transport combustion sources (mainly road transport) will be crucial for Ireland to achieve its commitments under the 2020 Gothenburg Protocol and the 2030 NEC Directive. Technological advances and verified success with real-world applications of Euro 6 emissions standards for vehicles will also be important to achieving the target.

Volatile Organic Compounds (VOC)

Overview – Emissions linked to solvent use and transport.

The main sources of VOC emissions are solvent use, transport and agriculture.

Progress against the emission ceiling target

Ireland's emission ceiling for VOCs is 55 kt and this was achieved in 2009.

Key steps towards achieving the target

Catalyst controls and improved vapour abatement technologies in gasoline vehicles achieved large reductions in VOC emissions. The contribution from solvent use remains relatively constant in absolute terms, although drivers such as population, paint use and pharmachem industrial activity have increased in recent years.

Ammonia (NH_3)

Overview – Emissions risk not meeting EU emissions targets if cattle numbers increase to their pre-2000 levels.

NH_3 emissions can lead to the formation of aerosol particulate matter, and eutrophication.

Progress against the emission ceiling target

The emission ceiling for NH_3 under the previous Gothenburg protocol was 116 kt. Under the revised National Emissions Ceiling Directive, Ireland's targets for 2020 and 2030 have, following EU negotiations, been amended to a 1% reduction for 2020 and a 5% reduction for 2030 (based on a 2005 baseline).

Key steps towards achieving the target

98% of national NH_3 emissions arise from activities in the agricultural sector. This is especially pertinent with the adoption of the planned 2030 NEC target, and Ireland's planned implementation of Food Wise 2025, which will lead to a risk of higher NH_3 emissions.

Other Transboundary Pollutants

Further information on the wide range of transboundary pollutants covered by the Convention on Long-range Transboundary Air Pollution can be found on the EPA website.[10]

Responses

EU Legislation

Limits set for ambient air quality by the EU have not been exceeded

Limit values have been established by the European Union based on contributions by environmental and health experts in order to help mitigate the impact on Member State populations. Upon exceedance of these limit values, Member States must implement air quality plans to assess and combat the problem. Since the last State of the Environment report (EPA, 2012), Ireland has not exceeded any EU legislative limit or target values at the stations in the current monitoring network.

Clean Air Policy Package

A new strategy on air pollution from the European Commission

Following a review of the 2005 thematic strategy on air pollution by the European Commission, a new strategy for air quality was announced in 2013. Under the review, the existing ambient air quality legislation remains unchanged, though the 7th Environmental Action Programme[11] commits to moving towards the WHO guide values by 2020. Overall national emissions are targeted under a revision of the NEC Directive while emission standards from Medium-sized Combustion Plants (MCP) have been agreed and will come into force for new plant from 2017 and for existing plant in 2025 and 2030 depending on size.[12]

WHO Guideline Values

Stricter air quality standards for key parameters developed

The WHO has devised air quality guidelines for particulate matter (PM_{10} and $PM_{2.5}$), BaP, ozone, nitrogen dioxide and sulphur dioxide (WHO, 2005; Krzyzanowski and Cohen, 2008). These guidelines were developed by the WHO in order to inform policymakers and provide appropriate air quality targets worldwide, based on the latest health information available. Since 2012, the EPA's annual reports have been assessing air quality against these much more stringent air quality indicators. There have been exceedances of the guideline values for particulate matter, ozone and PAHs (EEA reference level[13]) and the EPA has called for the adoption of these more stringent WHO guidelines for particulate matter and ozone.

Industry

Emissions of specific air pollutants from industry and power have reduced in recent years

Industrial Emissions (IE) and Integrated Pollution Control (IPC) licensing, enforced by the EPA, help to curb emissions from industry and the power generation sectors of Ireland. This has been effective – trends have shown all pollutants decreasing or holding steady (EPA, 2015a) against a backdrop of increased economic activity, which indicates a decoupling of economic growth and emissions. The introduction of the Medium Combustion Plant Directive will have a positive impact on emissions from industry.

Residential Heating

A significant source of particulates that the extension of the smoky coal ban aims to address

Comparison of national ambient air monitoring results with WHO guideline values for particulates and PAHs shows the need for progress with regard to reducing levels of emissions attributable to residential heating. The ban on the marketing, sale and distribution of bituminous fuel (the "smoky coal ban"), which was first introduced in Dublin in 1990 and extended over the intervening period to 26 other cities and towns, and now also includes a ban on use of such fuels, has proved effective. The implementation of a nationwide smoky coal ban, as announced by Minister

10 *erc.epa.ie/clrtap/*

11 *www.ec.europa.eu/environment/action-programme/*

12 *www.ec.europa.eu/environment/industry/stationary/mcp.htm*

13 *www.eea.europa.eu/themes/air/air-quality/resources/air-quality-map-thresholds*

Kelly at the Clean Air Conference in Dublin in September 2015, should help to improve air quality for all citizens. However, continued use of peat and wood will contribute to air pollution in residential areas. EPA funded research being undertaken by a UCC led group (SAPPHIRE)[14] aims to deliver detailed information on the chemical composition and sources of airborne particulate matter in rural and urban residential areas of Ireland so as to assist appropriate health focused policy interventions.

Road Transport

While exhaust emission limits become stricter, this is offset by increases in the numbers of cars

New EU emissions standards for vehicles, cleaner technology, and a reduction in the number of vehicles using the roads as a result of the economic downturn led to a decrease in NO_2 in our urban centres. However, this is unlikely to continue into the future. Economic recovery will most likely lead to an increase in NO_2 levels. The failure of real-world emissions of NO_x Euro 5 class vehicles to meet the standards set for them has had a disproportionate impact on ambient air (EEA, 2015). Euro 5 class vehicles showed a reduction in NO_2 emissions in laboratory tests; however, these reductions were not observed in real-world driving. As a result, projections of NO_2 emission reductions did not come true and an increase in vehicle numbers actually led to increasing NO_2 levels across Europe. Ongoing non-compliance with NO_x ceiling levels is a concern and needs to be addressed. The actions set out in the Department of Transport's *Smarter Travel – A Sustainable Transport Future*[15] should be implemented to improve air quality. These include actions to reduce travel demand, increase alternatives to the private car and improve the efficiency of motorised transport. Enhanced incentives to encourage vehicle owners to switch to electric options should also be encouraged.

Shipping

Loading and unloading activities at ports can have considerable localised impact on emissions of particulate matter

As an island nation, Ireland is heavily dependent on shipping for the import and export of goods. Sulphur dioxide is a pollutant that is closely linked to shipping. As the economy continues to recover, activity in this sector is likely to increase. In-port activities associated with loading and unloading can also have a considerable local and regional impact on emissions of particulate matter. The 2012 revision of the Directive on the sulphur content of liquid fuels (SI No. 273 of 2014), which ensures that liquid oils and gas oils have a maximum sulphur content of 1% and 0.1% respectively, has had a positive impact on observed SO_2 levels.

Transboundary Air Pollution

Relative to other EU countries, Ireland rarely experiences transboundary air pollution impacts

Although Ireland's prevailing wind direction is from the south-west, bringing in a cleaner North Atlantic air mass, occasionally transboundary air pollution from continental Europe (and, more rarely, pollution from volcanic eruptions in Iceland) and beyond arrives. Springtime transboundary events bringing elevated particulate matter associated with Saharan dust have been a feature. There has also been a number of short-term air pollution episodes associated with European generated ozone, particulate matter and NO_x. These are likely to continue into the future. With regard to ozone and NO_x, a pan-European approach is required to tackle the problem. Recent research has suggested that a portion of the 'Saharan' dust may in fact be due to transboundary ammonia induced particulate matter (Vieno *et al.*, 2016). The European Commission has made a start in this regard by agreeing the "EU Clean Air Policy Package", the main components of which are:

- A Clean Air Programme for Europe, describing the problem and setting out new interim objectives for reducing health and environmental impacts up to 2030. It also defines the necessary emission reduction for the key pollutants and the policy agenda that will be necessary to achieve these objectives
- A revised NEC Directive, containing updated national ceilings (caps) for six key air pollutants (PM, SO_2, NO_x, VOCs, NH_3 and CH_4 (methane) for 2020 and 2030
- A new Directive for Medium-sized Combustion Plants between 1 and 50 MWth
- A ratification proposal for the amended Gothenburg Protocol under the 1979 UNECE Convention on Long-range Transboundary Air Pollution.

14 *www.ucc.ie/en/crac/research/sapphire/*

15 *http://www.smartertravel.ie*

EPA Air Research Programme

Between 2007 and 2015, the EPA funded over 50 air-related research projects, with a total commitment of approximately €11 million. The projects funded include desk studies, fellowships, as well as small- and medium-scale projects.

The air research theme deals with (1) urban and rural air quality, (2) transboundary air pollution, (3) ecological effects, as well as health impacts, (4) emissions inventories and projections, (5) sources of air pollution, notably industrial, agricultural, residential and transport and (6) cross-cutting issues with climate change. The research programme encourages a broad stakeholder engagement including the business community, NGOs, civic society and the public. The outputs of EPA-funded research have informed national thinking, contributed to EU analysis, and have been presented and used in UN forums, including the UNECE LRTAP Convention.

More details are available at: *www.epa.ie/researchandeducation/research/researchpillars/climate/*

Key Achievements of Air Pollution Research

- Development of the EMEP transboundary air pollution monitoring network and support for activities at Mace Head and Valentia (Global Atmospheric Watch sites for the World Meteorological Organization).
- Development of a volcanic ash model (developed after the eruption of Iceland's Eyjafjallajökull volcano). This model has subsequently been adopted by the Irish Aviation Authority as one of its tools to determine the risk to flights in the event of a volcanic eruption.
- Emission inventories for (1) certain combustion parameters from a number of sources including transport, small-scale combustion installations and residential combustion, (2) ammonia from agricultural installations and (3) persistent organic pollutants.
- Integrated modelling – co-benefits and trade-off for air quality and climate change policies (e.g. "dieselification" and increased biomass burning).
- Highlighting that air quality is also an issue outside large towns and cities, especially for those places where solid fuel is prevalent, e.g. off the natural gas grid or outside the ban areas for smoky coal. Identification, using source apportionment techniques, that residential combustion of solid fuels is a significant contributor to air pollution in small towns.
- Development of critical loads for designated habitats under the EU Habitats Directive (92/43/EEC); assessment of the influence of transboundary air pollution on Irish lakes and soils; baseline ammonia deposition rates (and deposition map) for Ireland; assessment of the influence of ammonia emissions from intensive agricultural installations on designated habitats under the EU Habitats Directive.
- Research on bioaerosol monitoring techniques.
- Development of an air quality forecast model.
- Use of source apportionment techniques (monitoring and modelling) for local and transboundary air pollution.

Priority Areas for Air Pollution Research

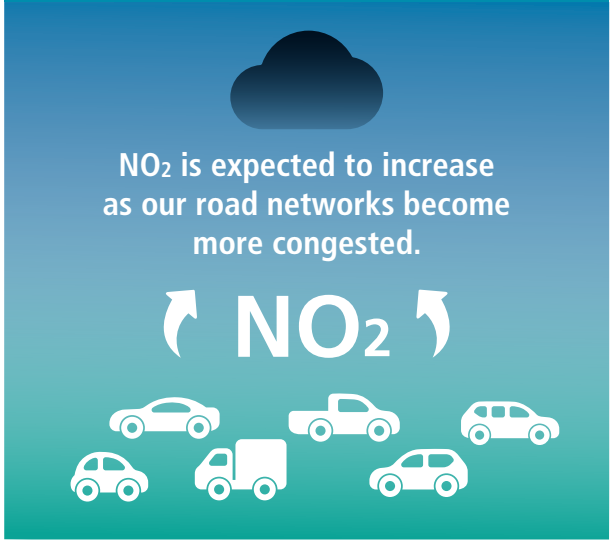
- Supporting the national clean air strategy (drafting in progress), with a particular focus on the CAFE Directive, the WHO guidelines and the LRTAP Convention.
- Ensuring that the policies designed to meet air quality requirements match those policies designed to meet climate change imperatives.

Outlook for Air Quality in Ireland

Reducing particulate matter in air is a key health target that will need wide engagement and sector targets for transport, energy and agriculture

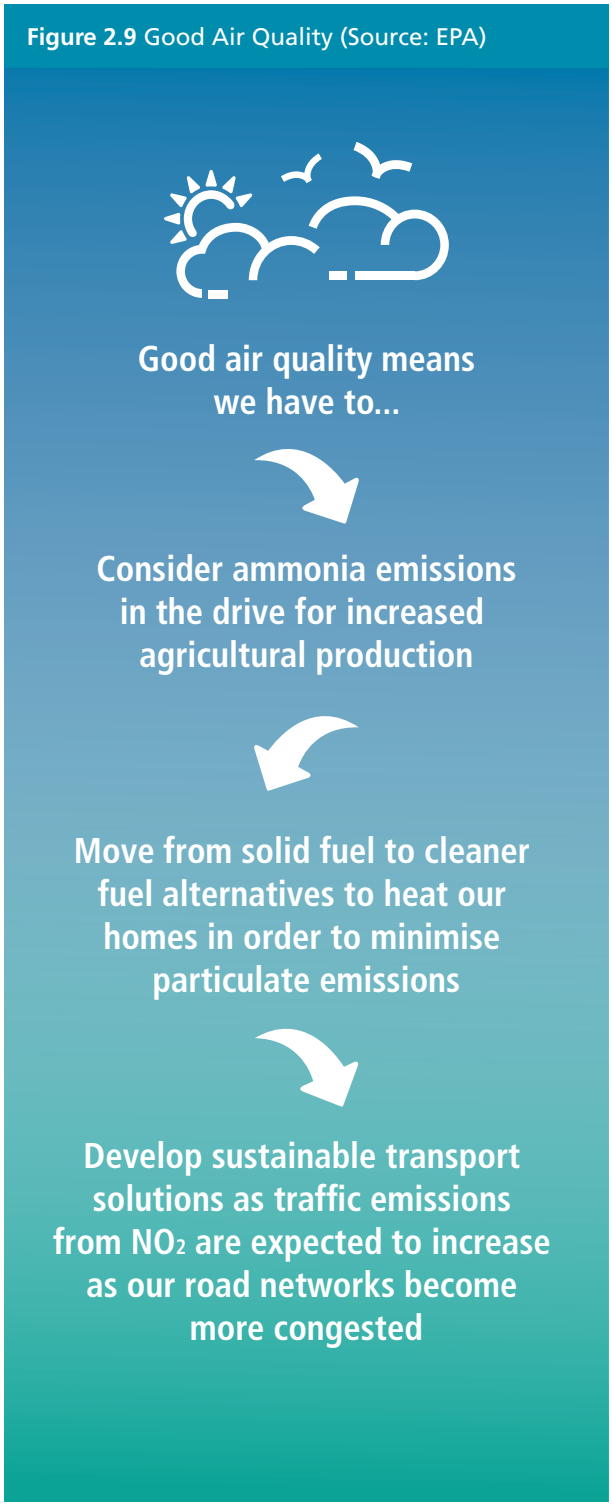
Air quality in Ireland is generally of an acceptable standard. Currently, we are not in exceedance of any EU legislative or target values. However, when compared with the more stringent WHO guideline values and EEA reference level values, ozone, particulate matter and PAHs emerge as pollutants of concern in the short term, while NO_2 is expected to increase as our road networks become more congested. With regard to $PM_{2.5}$, under the National Exposure Reduction Target (NERT) Ireland is obliged to reduce annual average $PM_{2.5}$ levels by 10% before 2020 from a baseline level. This will prove challenging if activity in a number of sectors increases without any consideration of abatement or alternatives.

Figure 2.8 Expected Increase in NO_2 (Source: EPA)



Continuing emissions from domestic solid fuel use are contributing to high levels of particulate matter and PAHs in villages, towns and cities. The nationwide ban on smoky coal due in 2018 will have an impact on levels of particulate matter, particularly in rural towns and villages. However, there is a need for regulation of solid fuel beyond coal. Peat burning is still prevalent in many parts of the country – most particularly in rural areas – and contributes significantly in terms of particulates. Wood and peat burning is emerging as a potentially significant contributor to PAH and particulate matter levels in Ireland, along with a wide variety of other solid fuel products that are on the market. In the case of industry there are mitigation options available, particularly through the use of electrostatic precipitators, for example, and in the residential sector there are non-combustion options for heating.

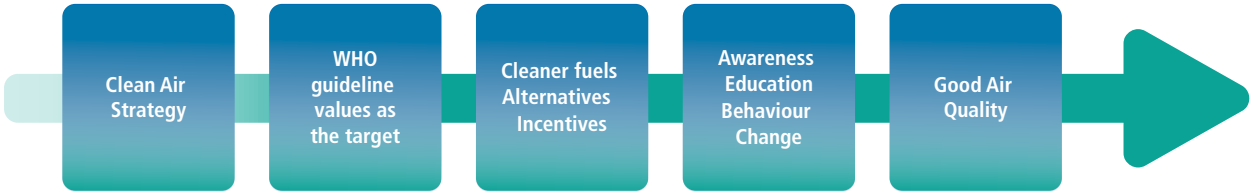
Figure 2.9 Good Air Quality (Source: EPA)



Essential to the goal of improving our air quality will be a shift for Irish consumers from solid fuel to cleaner fuel alternatives, along with an awareness of the impact our choice of fuel for home heating has on the air quality and the impacts on our locality.

Incentives for people to use alternatives should continue to be encouraged at a national level.

Figure 2.10 Clean Air Strategy (Source: EPA)



Air quality pollutant concentrations in Ireland depend on a number of factors, some of which are beyond our control – such as the weather, population size or the economy. However, the most important influence on these levels of concentration, which we very much have within our control, is the quantity of pollutants being emitted by the various sectors – industry, residential, agricultural and transport. Any decrease in quantity of emissions from these sectors, or any shift to cleaner fuel sources, will yield benefits for air quality and, thus, will lead to health benefits for the population.

Conclusions and Future Challenges

To ensure better health status for our population, we should not be complacent about our air quality

In order for all Irish citizens to experience good air quality, a number of steps must be taken in relation to our regional and local emissions of particulate matter, ozone, PAHs and NO_x. First, the passing of WHO guideline values into EU and Irish legislation would provide a real impetus for action in this area. To support this change in legislation, there is a need for increased air quality monitoring. This need is mirrored by a desire from the public for greater access to air quality data and information and a proposed solution is outlined in the EPA's National Ambient Air Quality Monitoring Programme (AAMP). In addition, the Department of Communications, Climate Action and the Environment (DCCAE) is in the process of developing a clean air strategy for Ireland, which should highlight some of these issues and propose some policy solutions. The introduction of the nationwide ban on smokey coal in 2018 is to be welcomed and should help shift the use of solid fuel to cleaner alternatives, including gas. Government incentives for businesses and private home owners should be expanded to encourage a switch to cleaner energy alternatives. Group schemes for gas installations off the national grid should be encouraged, in the same way as already existing water schemes.

Regulation of all solid and biomass fuels, coupled with the introduction of a national fuel testing laboratory service, should be prioritised as a matter of urgency to keep pace with the rate of change in the fuels market. Regulation of stove emissions along with an information campaign on the use and maintenance of various solid fuel appliances, should be implemented. A national campaign for greater energy efficiency in our homes and workplaces would also help, as this would lead to a reduction in energy demand. This in turn should lead to reductions in emissions. Reduced energy demand through greater energy efficiency would also help Ireland meet its climate change targets. The work and programmes of the Sustainable Energy Authority of Ireland (SEAI) and local schemes such as the Tipperary 'Superhomes'[16] are particularly important in this regard.

Pathway to Good Air Quality

Ireland is required to meet its international commitments on air quality and emissions and ensure that industrial emissions of pollutants to air continue to be rigorously controlled. Ireland should also strive to ensure that its industrial sector continues to make use of clean technologies where possible.

The implementation of the revised NEC Directive across Europe, as part of the EU Clean Air Policy Package, will have a positive impact on background levels of pollutants in Ireland, particularly NO_x, and possible future impacts for ammonia. A rise in ammonia through agricultural expansion could lead to an increase in the secondary formation of particulate matter – this issue needs to be monitored carefully in the coming years. Measures such as anaerobic digestion of animal wastes with associated energy recovery and low-emission land spreading practices can have multiple benefits for air quality, water quality and climate change.

Tackling transport sector pollutants will require

16 www.*superhomes.ie*

a combination of secured national investment, advancements in technology, policy developments and, most importantly, a shift in behaviour by us as individuals where we are provided with viable alternatives. While there is hope that technological advancements will yield improved reductions in pollutants from motorised vehicles, or potentially a viable alternative to fossil fuel as a motor fuel, these improvements are aspirational and for an indefinite time in the future. Policy changes can be implemented immediately and will yield results more quickly. Emphasis and priority should be given to public transport or clean transport over conventional internal combustion vehicles in all aspects of society. However, it is the individual choices that people make that will have the most immediate and greatest impact on transport emissions in our urban areas where NO_2 is problematic and where public transport is a viable option.

Ireland's air mass is subject to occasional transboundary impacts of pollutants, in particular ozone and particulate matter. To tackle this problem, an integrated, pan-European approach is needed to reduce the levels of ozone precursor compounds in our air.

To tie all these strands together, education will be of paramount importance, particularly increasing public awareness and understanding of the link between air quality and health. Many of the sources of air pollutants are also the sources of GHGs, so an increased understanding and policy alignment of air quality and climate change is essential. More research is needed into the links between air quality and public health, specifically in order to develop a better understanding of the links between air quality data and the health impacts and mortality rates associated with pollution. This understanding will help to identify the critical issues and help policymakers implement the necessary changes to improve our air quality and associated public health.

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Chapter 3
Climate

Climate Change

Introduction

Climate change is an overarching global challenge.

Responding effectively to climate change is both urgent and long term. It is urgent in that our actions and responses in the next 5–15 years may effectively lock in large-scale and irreversible planetary changes over this and subsequent centuries. The December 2015 Paris Agreement sets the international agenda for addressing this challenge. However, it must be addressed at national and sub-national levels and by cities, businesses and communities. At national level, the National Policy Position (DECLG, 2014) and the Climate Action and Low Carbon Development Act 2015 provide the policy framework for actions. In combination with EU-level emissions targets for 2020 and 2030, these specify the short-term actions and longer-term strategy to advance mitigation and adaptation actions. A brief overview of the science of climate change, the response options and policy context is provided here. The nature and scale of the challenges that Ireland faces in addressing climate change are also outlined.

Scientific Understanding

The scientific understanding of climate change is robust. Warming of the climate system is unequivocal and the human influence on this is clear.

The impacts of changes to the atmosphere on climate are well known. Major volcanic eruptions such as Pinatubo (1991) or Krakatoa (1883) produced plumes of fine particles which shaded and cooled the Earth, reducing subsequent summer temperatures by between 0.5°C and 1.0°C. Similarly, air pollutants typically act to temporarily "cool" the Earth. They also impact on human health and cause environmental damage (see Chapter 2). The accumulation in the atmosphere of relatively stable and inert gases, such as carbon dioxide, that trap energy is the key threat to our climate (Figure 3.1). In 2015, the atmospheric concentration of carbon dioxide reached 400 ppm, a level that has not occurred for at least 800,000 years. It is one of the many changes that the Intergovernmental Panel on Climate Change (IPCC) has described as unprecedented for centuries to millennia (IPCC, 2014a,b).

Climate change is primarily associated with the increase in the global average temperature. The average global temperature in 2015 was 1°C higher than the pre-industrial levels. This record level follows three decades that were successively warmer than any preceding decade since 1850. However, about 90% of the additional energy trapped by greenhouse gases (GHGs) is being absorbed by the oceans. This is contributing to sea-level rise due to thermal expansion (Figure 3.2). On average, global sea level has risen by about 20 cm in the last century. Changes evident in Ireland have tended to follow the global average, with an average temperature increase of just under 1°C over the last century. Since 1993, average sea level has risen around Ireland by just over 3 cm per decade.

The Responses to Climate Change

We Know What to Do to Address Climate Change

There are two linked responses to climate change:

- mitigation of emissions of the GHGs that are driving climate change
- adaptation to reduce vulnerability to the adverse impacts of climate change.

Mitigation of GHG emissions is the primary response to the threat of climate change and each country will need to play its part in taking effective actions. The aim of holding the increase in the global average temperature to well below 2°C, relative to pre-industrial temperature, frames mitigation actions from global to local levels – see topic box on Paris agreement. To achieve this objective, global emissions of carbon dioxide and other GHGs must be brought to near or below zero by the end of this century. Emissions of carbon dioxide must be reduced to net-zero before this time. Ireland's emissions have to follow a similar trajectory on a shorter timeline (see National Policy Statement, DECLG,[1] 2014).

Failure to take effective action is projected to result in dangerous and unmanageable global impacts, including undermining of global food production and major loss of natural ecosystems, and could cause irreversible flooding of low-lying coastal areas and loss of small island states. Projected impacts include major losses of coastal cities, population movement and likely conflicts over resources.

Adaptation is increasingly recognised as an important response to climate change, with an adaptation goal being included in the Paris Agreement (see Box). The aim

1 Note: The Climate Change functions in the former Department of Environment, Community and Local Government were transferred in July 2016 to the new Government department, the Department of Communications, Climate Action and Environment.

Figure 3.1 Schematic of Atmospheric Factors that Determine the Global Energy Balance (Source: Kiehl and Trenberth, 1997)

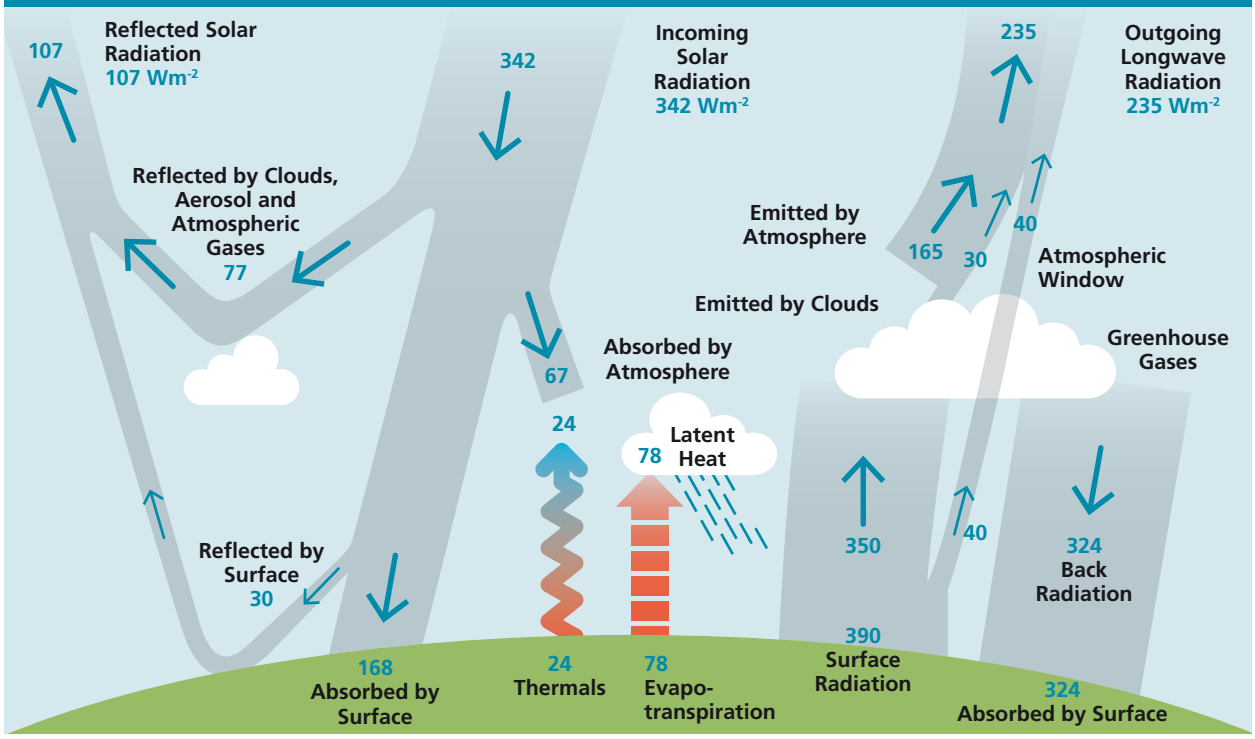
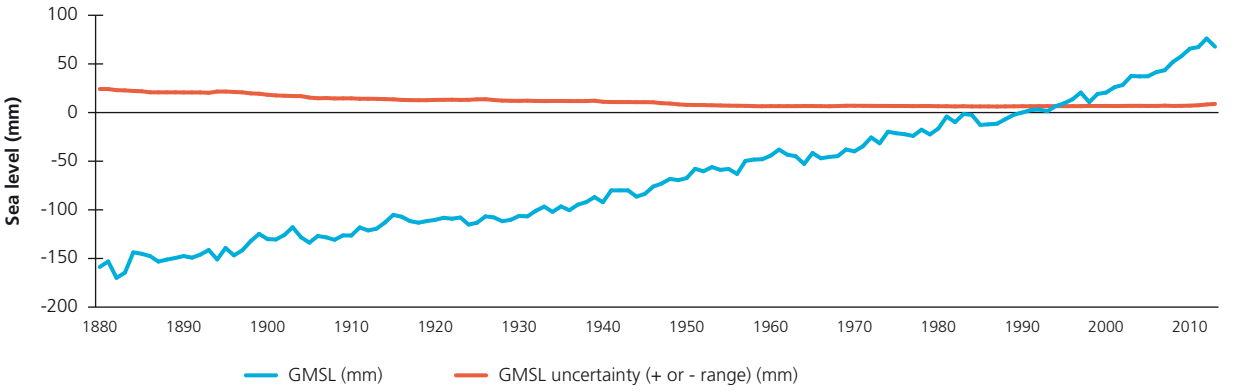


Figure 3.2 Global Sea Level Rise Data (Source: Church and White, 2011)



of adaptation is to reduce vulnerability to the current and projected impacts of climate change and increase resilience. Adaptation also brings opportunity through green growth, innovation, resilience and ecosystem services enhancement. Key steps in adaptation actions are the assessment of current vulnerabilities to weather extremes and the adoption of gradual changes; determining how these vulnerabilities can be reduced in the context of trends and projected changes; and carrying out the actions required to achieve these goals. Adaptation actions can be seen as an effective response only if they are coupled with the required mitigation actions. In this context, sectors and community actors should link mitigation and adaptation planning, investments and actions.

For Ireland, mitigation and adaptation actions are framed and informed by UN, EU and national policy. These include the UNFCC,[2] the Kyoto Protocol,[3] the UN Paris Agreement,[4] the EU Strategy on Adaptation to Climate Change,[5] the EU Climate and Energy Package,[6] the National Policy Position on Climate Change (DECLG, 2014) and the Climate Action and Low Carbon Development Act 2015.

The Paris Agreement

In December 2015, at a meeting of the UNFCCC in Paris, a new global agreement was reached to address climate change (UN, 2015). The agreement aims to:

- hold the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C
- increase the ability to adapt to the adverse impacts of climate change and foster climate resilience and low GHG emissions 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 achieve this, GHG emissions must peak as soon as possible and then be reduced rapidly in order "to achieve a balance between anthropogenic emissions by sources and removals by sinks of GHGs in the second half of this century".

The Agreement establishes a long-term adaptation goal of "enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to contributing to sustainable development and ensuring an adequate adaptation response in the context of the 2°C temperature goal". This makes it clear that, if mitigation activities succeed in limiting the rise in global temperature, less adaptation will be needed.

The Paris Agreement is expected to enter into force in 2020. Progress will be determined by a regular global stocktake, which will assess how collective actions are aligned with the ambitions of the agreement. This will inform subsequent actions.

2 *www.unfccc.int/*
3 *www.unfccc.int/kyoto_protocol/items/2830.php*
4 *www.unfccc.int/paris_agreement/items/9485.php*
5 *www.ec.europa.eu/clima/policies/adaptation/index_en.htm*
6 *www.ec.europa.eu/clima/policies/strategies/2020/index_en.htm*

EU Climate and Energy Package

An Effective Suite of Policies to Address Climate Change is Essential.

The EU is a global leader of actions to address climate change. It is committed to reduce its collective emissions of GHGs by at least 40% relative to 1990 levels by 2030. The 2020 Climate and Energy Package aims to achieve a 20% reduction in total GHG emissions relative to 1990 levels. The required mitigation actions are advanced under two tracks:

- Emissions from large industrial sources such as electrical power generation sources are addressed at an EU level under the EU Emissions Trading System (EU ETS)
- Emissions from other activities, including transport agriculture, heating and waste, are addressed at a Member State level under the Effort Sharing Decision.

The Effort Sharing Decision targets for non-ETS GHG emissions are set at Member State level and, to achieve them, Ireland must reduce emissions of a basket of GHGs (including from Agriculture, Transport, Residential and Waste sectors) by 20% relative to 2005 levels over the period 2013–2020. Member State emissions reductions for the period 2021–2030 were announced in July 2016 and included a 30% reduction target for non-ETS emissions (relative to 2005).[7] The new proposal also includes a provision where Member States who have a large proportion of their emissions from the Agriculture sector can utilise additional flexibilities towards meeting the overall 30% target, in particular removals of carbon through Land Use, Land Use Change and Forestry. For activities covered by the EU ETS, emission caps for the period 2013–2020 will decrease by 1.74% annually. However, as part of a series of measures to address perceived weaknesses in the EU ETS, it has been agreed to increase the annual reduction cap from 1.74% to 2.2% from 2021. This will ensure that these emissions are reduced by 43% relative to 2005 by 2030. Other reforms to address the trading scheme carbon price and to support low-carbon innovation and energy sector modernisation were also agreed in 2015. Additional steps to accelerate decarbonisation of electricity, such as introducing a minimum price in the EU ETS, have been proposed by some Member States and promoted by Ireland's Climate Change Advisory Council.[8] Ireland has linked targets under the UN Kyoto Protocol. Removals associated with forestry and other land uses are included in this target.

Adaptation Action at the EU Level

Enhancing resilience through adaptation.

The EU *Strategy On Adaptation To Climate Change* aims to make Europe more climate resilient by taking a coherent pan-European approach and complementing the activities of Member States; it promotes:

- action by Member States
- better informed decision making
- climate-proofing common EU action: promoting adaptation in key vulnerable sectors.

The EU strategy notes that 'adaptation actions include mainstreaming of climate change (mitigation and adaptation) into EU sector policies and funds, including marine and inland water issues, forestry, agriculture, biodiversity, infrastructure and buildings, but also migration and social issues'. This cross policy dimension represents a significant governance challenge for the EU as well as down to nation, regional and local implementation levels. The EU Climate-Adapt web resource[9] is intended to supply information sharing, knowledge, and tools to assist adaptation actions across the EU.

7 *www.ec.europa.eu/clima/policies/effort/proposal/index_en.htm*

8 *www.climatecouncil.ie*

9 www.climate-adapt.eea.europa.eu/

Impacts of Climate Change in the Marine Environment

Rising sea temperatures and sea levels, and ocean acidification have been identified as some of the key stressors impacting on the state of the world's oceans and coastal environments as a consequence of Climate Change (EPA, 2009; IPCC, 2014). These three factors have the potential to seriously affect the functioning of marine and coastal ecosystems and biogeochemical cycles on global, regional and local scales (Gruber, 2011). These factors acting independently, in combination, or synergistically, are likely to further impact ecosystems which have already been stressed by other factors such as over fishing, chemical pollution and the introduction of alien species.

Temperature changes

Temperature plays an implicit role in many biological processes such as respiration, photosynthesis and remineralisation as well as influencing, along with salinity, the density of seawater and ocean stratification. Over the period 1971–2010 the global sea surface temperatures (surface to 75 depth) has increased by 0.11˚C per decade (IPCC, 2013a). In Ireland, while long-term temperature records are sparse, observations maintained by Met Eireann at Malin Head since 1958 show a progressive warming in the record since the 1990s of approximately 1°C. This warming is partly explained by the natural cycle of variability in the North Atlantic known as the 'Atlantic Multi-decadal Oscillation', but approximately half of the recent warming is attributed to an underlying global warming trend (Dwyer, 2012).

Sea level changes

Global mean sea level has risen by 0.19 m over the period 1901–2010 (IPCC, 2013a). Rising sea levels in combination with increased storm events that are also predicted to happen are likely to impact on many coastal habitats. An average sea level rise of 0.5 to 1 m by the end of the century, in combination with storm surge events, could result in approximately 300 to over 1,000 km^2 of coastal lands around Ireland being inundated by the sea (DeVoy, 2008). A rise of 1 m in sea level would see 30% of existing wetlands disappearing (DeVoy, 2008). The habitats most at risk include low-lying coastal lagoons, saltmarsh and estuaries, and of particular vulnerability are those that are prevented from extending landward because of the presence of some fixed or artificial boundary. Many of the low-lying estuarine sandflats, mudflats and lagoons found along the southeast coast, some of which have been identified as Special Areas of Conservation (SACs), could be threatened. These habitats provide rich feeding grounds for a variety of bird species as well as providing important nursery grounds for juvenile fish.

Coastal erosion

The 2013/2014 winter wave conditions that severely impacted the Atlantic coast of Europe were investigated and demonstrated that this winter was the most energetic along most of the Atlantic coast of Europe since at least 1948. Storm wave conditions such as were encountered have the potential to dramatically change the equilibrium state (beach gradient, coastal alignment, and near shore bar position) of beaches along the Atlantic coast of Europe. One of the consequences of Climate Change will be more frequent and extreme storm events (EPA, 2010).

National Legislation and Policy

Irish climate change policy takes significant step forward in 2015.

The National Policy Statement on climate change (DECLG, 2014) articulates a vision to transition to a competitive, low-carbon, climate-resilient and environmentally sustainable economy by 2050; based on:

- an aggregate reduction in CO_2 emissions of at least 80% (relative to 1990 levels) by 2050 across the electricity generation, built environment and transport sectors
- an approach to carbon neutrality in the agricultural and land use sector.

The Climate Action and Low Carbon Development Act 2015 provides, inter alia, for approval of plans by the Government in relation to climate change mitigation and adaptation for the purpose of pursuing this transition and meeting international obligations and targets to 2020 and 2030. Key provisions of the Act include:

- the preparation and submission to Government for approval of successive 5-yearly National Mitigation Plans, which will specify the policy measures to reduce GHG emissions in Ireland
- the preparation of a National Adaptation Framework, which will reduce the vulnerability of the State to the negative effects of climate change and avail of any positive effects that may occur; it will be reviewed not less than once every 5 years, in keeping with the continued development of the evidence base and actions on adaptation and mitigation.

In addition to the national mitigation plan, there will be development of sectoral plans (e.g. transport, agriculture) and Local Authority plans.

The first National Mitigation Plan and the National Adaptation Framework must be submitted to Government by June and December 2017, respectively. The Minister for Communications, Climate Action and Environment[10] together with other relevant ministers (e.g. for transport, heritage and agriculture) will present annual transition statements to the Oireachtas on progress relating to climate mitigation and adaptation.

The Climate Change Advisory Council[11] was established by ministerial order under the 2015 Act to provide advice and recommendations to ministers and the Government on national responses to climate change. The Council is made up of seven members appointed by the Government and four *ex officio* members, who represent the Environmental Protection Agency, the Sustainable Energy Authority of Ireland, the Economic and Social Research Institute and Teagasc. The primary function of the Council is to evaluate and report on national progress in relation to mitigation and adaptation planning and implementation, as well as progress on international obligations.

Ireland's Greenhouse Gas Emissions

Greenhouse gas emissions have peaked but greater reductions are needed.

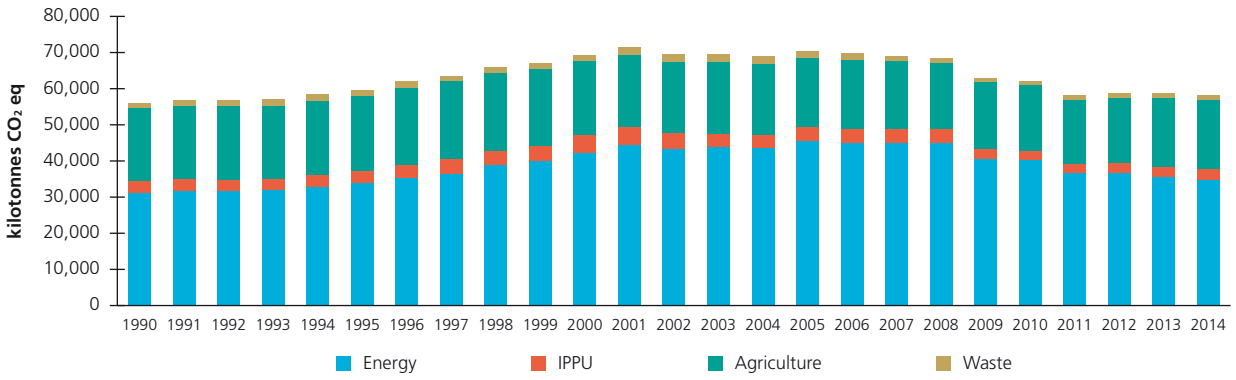
Ireland's GHG emissions peaked in 2001 at 71,394 kt CO_2 equivalent. In 2014, total emissions of GHGs, including indirect emissions from solvent use, amounted to 58,254 kt CO_2 equivalent, which is 18% lower than the peak value but still higher than 1990 emissions (non ETS base year for limits is 2005).

In 2014, the energy sector accounted for 60.1% of total emissions, agriculture for 32.2%, industrial processes and product use for 5.2% and the waste sector for 2.6% (based on the UN IPCC sectoral classification, see Figure 3.3). Carbon dioxide (CO_2) accounted for 62.9% of the total, with methane (CH_4) and nitrous oxide (N_2O) contributing 23.1% and 12.0% as CO_2 equivalent, respectively. The combined emissions of HFC, PFC, SF_6 and NF_3 accounted for 2.1% of the emissions[12]. Figure 3.4 shows the GHG emissions trend by sector and gas.

Fossil fuel combustion is the principal source of emissions and these are addressed in Chapters 10 and 11. The emissions from the agriculture sector, the other main source category, increased during the 1990s but decreased to 6.8% below 1990 levels in 2014.

In 2015, total emissions covered under the EU ETS were 16.83 Mt CO_2 equivalent, which is a 25% reduction on 2005 levels. This is, in part, due to the economic crisis, which had a strong impact on construction (especially cement manufacture). However, the increasing uptake of renewable energy in power generation also played an important role.

Figure 3.3 National Total Greenhouse Gas Emissions by Sector (Excluding Land Use, Land Use Change and Forestry) 1990-2014 (Source: EPA, 2016a)

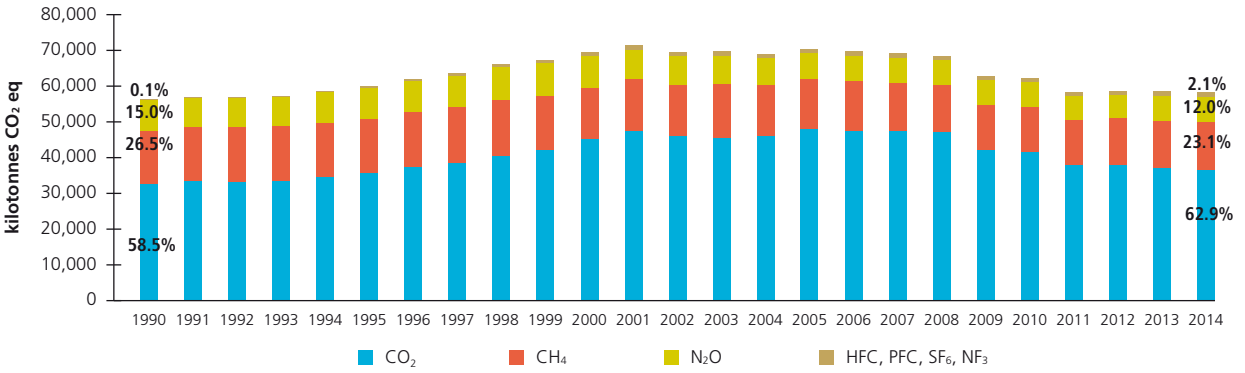


10 Refer footnote 1.

11 *www.climatecouncil.ie*

12 For an introduction to the greenhouses gases see: *www.epa.ie/media/GHG%20Infographic%202016.pdf*

Figure 3.4 Greenhouse Gas Emissions by Gas 1990-2014 (Source: EPA, 2016a)



Per Capita Emissions in Ireland and EU Emissions

Ireland's current greenhouse gas emissions amount to 12.6t CO_2 equivalent per person, 63% (7.9t CO_2 per person) of which emissions come from CO_2. Per capita CO_2 emissions rose to a peak of 12.4t CO_2 per person in 2001 (66% of total GHG per capita emissions), following which, apart from very slight increases in 2005 and 2012, it decreased by 2.8% per annum to the current level of 7.9t CO_2 per person (Figure 3.5).

Figure 3.5 Emissions of Greenhouse Gases (t CO_2 equivalent per capita) in Ireland from 1990 to 2014 and Showing Carbon Dioxide Emissions as a Proportion of the Total (Source: EPA, 2016a)

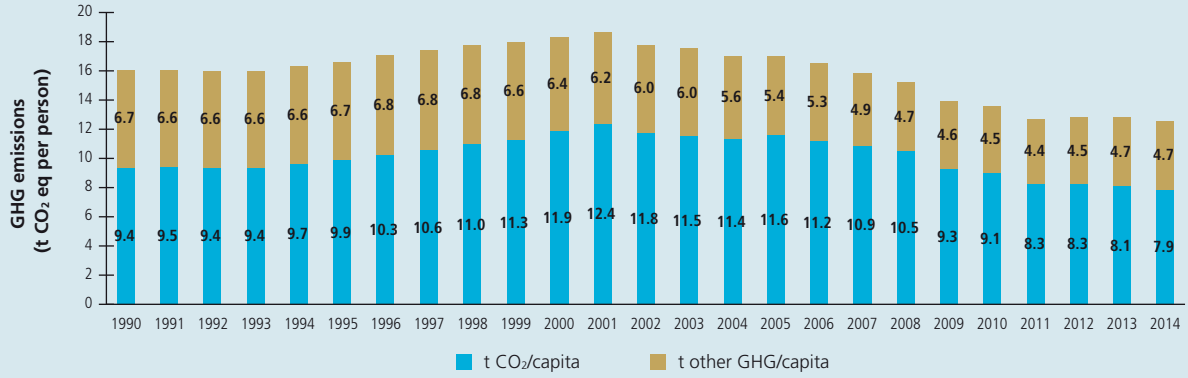
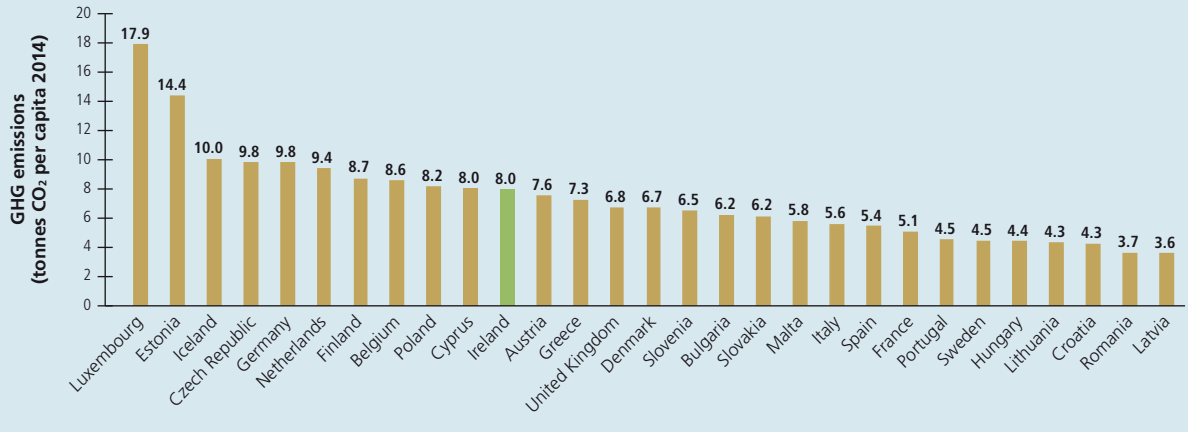


Figure 3.6 Emissions of Greenhouse Gases (t CO_2 per person) in the EU 2014 (Source: EEA, 2016)



Emissions Projections

Projections suggest that Ireland will not meet its emissions reduction targets.

The EU 2020 target is based on a combination of annual targets from 2013 to 2020 to give an overall reduction by 2020. Official projections of GHG emissions to 2020 are provided annually by the EPA based on two scenarios: (1) with current policies, regulations and incentives (i.e. With Measures, WM) and (2) with additional policies, regulations and incentives (i.e. With Additional Measures, WAM). These are depicted separately as blue and red bars in Figure 3.7. This shows that based on current policies, Ireland is projected to exceed its annual limits in 2016 and, even with additional polices, this limit would be exceeded in 2017.

For the period 2014-2020, agriculture emissions are projected to increase by 6–7%. Transport emissions are projected to show strong growth over the period to 2020, with a 10–16% increase on 2014 levels. Based on the two emissions scenarios described above, total emissions are projected to be 6% (scenario 1) or 11% (scenario 2) below 2005 levels in 2020 (i.e. WM and WAM). The target is a 20% reduction.

These projections are therefore a cause for significant concern in the context of the anticipated requirements for further reductions in GHG emissions in the period 2021-2030. Failure to meet the 2020 target would make future compliance challenges more difficult and costly. In addition, the analysis suggests that Ireland is not on track for, or projected to be moving in the right direction, to meet its National Policy Position, which aims to achieve a least 80% reductions in carbon dioxide emissions by 2050 relative to 1990 levels and achieving neutrality in the agriculture and land use sectors.

Further polices, regulations and incentives are therefore urgently needed to meet existing targets and to move to a pathway to achieve the 2050 transformation objective. Increased strategic planning, investment and resources are also needed to achieve this in the overall framework of EU and global commitments.

Land Use, Land Use Change and Forestry

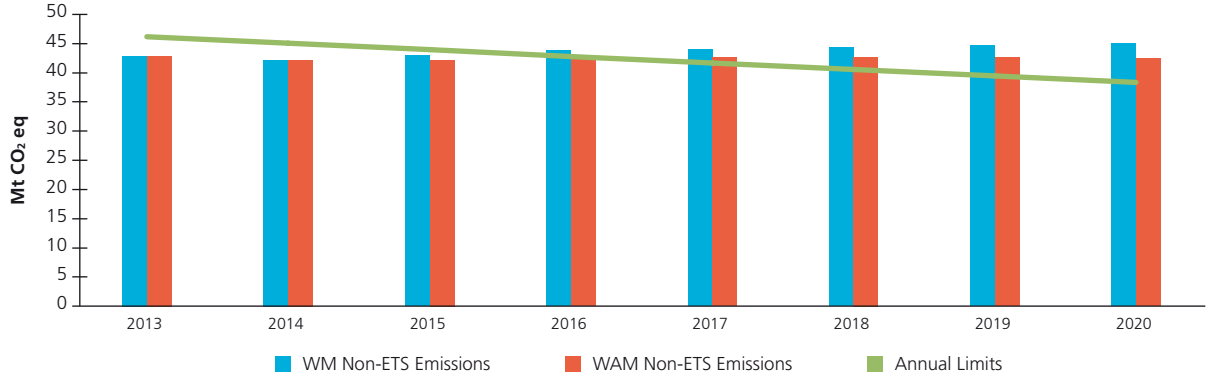
Land management has a key role in the national, EU and global response to climate change. The Kyoto Protocol established a complex set of rules for reporting and accounting for emissions and removals resulting from land use and land use change. Ireland has significant and healthy biosystems, including grassland, hedgerows and forests, which sequester carbon dioxide. Mineral soils and peat make up a large portion of Ireland's land areas and have high carbon content.

Under the Kyoto Protocol, Ireland currently accounts for GHG emissions and removals associated with forest land, cropland and grazing land. Peatlands and wetlands are not yet included but constitute a major area of carbon-rich land that needs to be protected. Since 1990, Ireland's forest area has expanded by approximately 260,000 ha. As these forests grow and mature, they will represent an important carbon dioxide sink and long-term carbon store in biomass and soil. The current national forestry policy addresses these strategic advantages (DAFM, 2014).

In general, well-managed grasslands on mineral soils tend to take up and store carbon in the soil. However, changes from grassland to arable land, in particular, can lead to significant carbon dioxide emissions as a result of the disturbance of the soil and the loss of vegetation above ground. Low-impact management practices can mitigate such effects without significantly reducing productivity.

The management of peatlands is a particular concern with respect to potential for loss of carbon. Peat extraction and change of use of drained peatland to grassland or forestry leads to high rates of carbon loss. In general, land management should aim to preserve or enhance areas that have active carbon uptake in soils and biomass, and reduce or eliminate areas that are a source of carbon emissions. Such altered practices also yield benefits for ecosystem services.

Figure 3.7 Greenhouse Gas Emission Projections Assuming Continuing with Existing Measures (blue bars) and Implementation of Additional Measures (red bars) and Comparison with the Linear Reduction Pathway Required Between 2013 and 2020 (Source: EPA, 2016b)



Climate Change Impacts and Adaptation

The impacts of climate change are evident on all continents and in all oceans.

Observed climate change impacts are most evident in the global temperature record, sea-level rise, loss of glaciers and ice-sheets and changes in the nature and intensity of precipitation events. These have impacted on human health, water resources and management systems, ecosystems, food production and rates and levels of coastal flooding. Global projections indicate that oceans will continue to warm, sea-level rise will continue during this century and sea-ice and glacier volumes will further decrease. Studies have shown that the intensity and frequency of extreme events are increasing and will further increase as a result of climate change (IPCC, 2013a). The character and severity of the impacts of climate extremes depend not only on the extremes themselves but also on exposure and vulnerability to these extremes.

The effects of climate change are projected to further impact on food production systems, water resources, coastal infrastructure, critical services and urban centres, resulting in increased displacement of people, societal stress and loss of land and other assets. Ireland's climate is changing in line with regional and global trends. Further climate change is projected to have diverse and wide-ranging impacts on the environment, society and economic sectors (see Box). Adaptation actions will be required to reduce adverse impacts and increase resilience to these and other impacts of climate change.

Sectoral Impacts of Climate Change for Ireland

- **Agriculture:** the main impacts are expected to result from changes in air and soil temperatures, changes in rainfall patterns and extreme events.
- **Marine environment:** changes in ocean temperature and acidity are projected to continue, resulting in changes to marine ecosystems and species, which will have implications for fisheries.
- **Biodiversity:** increasing temperatures will impact upon the geographical range and phenology (the timing of life cycle events) of native species. Projected shifts in climate, temperature and precipitation may result in the increased occurrence of invasive species and competitive pressures on Ireland's native species.
- **Coastal zones:** sea-level rise is projected to increase coastal erosion and flooding, including effects on major coastal cities.
- **Critical infrastructure:** water, energy, communications, transport and emergency services are at risk from a range of projected changes, including sea-level rise, increasing temperatures, changing rainfall patterns and extreme weather events.
- **Water management:** the projected changes are expected to impact on water management and will exacerbate existing pressures in terms of water supply, quality and flooding.
- **Human health and wellbeing:** increasing temperatures are likely to result in the increased incidence of heat-related mortality. However, an overall decrease in temperature-related mortality is expected because of decreases in levels of cold-related mortality. Increases in extreme events will have significant impacts on psychological health and wellbeing.

(Source: Climate Ireland)

National Policy Development

In December 2009, a carbon tax was introduced at a rate of €15 per tonne on certain uses of fossil fuels outside the EU ETS. This has since increased to €20 per tonne and, since April 2014, applies to all fossil fuels, including coal and peat. The carbon tax is estimated to reduce emissions by about 0.3 Mt CO_2 equivalent per annum. There are a number of other schemes and incentives to increase energy efficiency. These are outlined in Chapter 11.

National Climate Science Research

Advancing understanding and solutions.

The EPA has led on the development and co-ordination of climate change research in Ireland. The vision is to inform a carbon-neutral, climate-resilient Ireland by 2050. The approach has been to develop national capacity in co-operation with other state agencies and government departments and to advance research along four linked thematic areas:

- GHG emissions and removals data management systems aim to improve quantification/reporting of emissions and removals of GHGs. The focus is on those activities that are critical components of Ireland's emissions profile, especially those associated with land use, agriculture and bioenergy. This research supports and informs mitigation actions and their inclusion in national GHG inventories and projections
- Research carried out under the theme of 'Ireland and future climate, impacts and adaptation' aims to provide analysis of ongoing and future climate change and to use this to support the analysis of impacts-associated risks and vulnerabilities. The goals are to inform decision making on adaptation actions at the national, sectoral and local levels. Outputs from this research are central to risk assessment and adaptation planning at various levels
- Socio-economic and technological solutions and transition management aims to advance socio-economic analysis and modelling of sectoral and cross-sectoral transition pathways over medium to longer time horizons, for example to 2050; this research is solutions focused, with the aim of promoting cross-disciplinary analysis of effective technological and behavioural solutions at a range of scales. A key outcome from this research has been the identification of pathways to a carbon-neutral Ireland by 2050
- Air science research aims to address the crossovers between air pollutants and climate change. It includes research on ambient and local air quality and cross-cutting issues, including the linked processes and source activities responsible for air pollutants that are sources of GHG emissions and influence climate.

Since 2007, the EPA has supported over 108 climate change research projects to the value of €25 million. This investment has produced research that has been highly influential on national policy development, supported national engagement with EU and UN bodies and is estimated to have provided savings of €50 million in relation to improved analysis of GHG emissions.

Outlook and Conclusions

Determined actions are the key to the transition to a low-carbon future.

Both in Ireland and globally, 2015 was an important year for advancing actions on climate change. The nature and extent of the challenge are well described by the work of the IPCC and others. The policy structures are in place. The key challenge is moving to take effective actions. The first National Mitigation Plan and the National Adaptation Framework should provide the basis for the required transition to a low-emissions, climate-resilient economy and society, as outlined in the National Policy Statement, while meeting shorter-term emissions reduction targets.

Ireland is vulnerable to weather extremes and sea-level rise. Its coastal assets, transport and energy infrastructure are also vulnerable. Their vulnerability has been exposed by recent weather extremes, which are expected to become more frequent over the coming decades. It is in Ireland's interest to take effective actions to address climate change.

Ireland also needs to play an effective part in contributing to EU and global efforts to ensure that the global temperature increase relative to pre-industrial temperatures stays well below 2°C. Ireland is well positioned to provide leadership in key areas including the monitoring, reporting and verification of GHG emissions and removals from agriculture and land use.

Coherent cross-government engagement in, and support for, strategic and effective local and global actions to address climate change is in Ireland's interest.

Key Messages

Climate Change

Strategic planning and investment are required for Ireland to make an effective contribution to global actions to avoid dangerous and irreversible impacts of climate change and to benefit from the multiple opportunities that arise from required actions.

Ambitious and effective global actions are required to prevent the large-scale dangerous and irreversible impacts of climate change, and Ireland must play its part in advancing these actions.

Globally, emissions of carbon dioxide must be reduced to net-zero early in the second half of this century, and other GHG emissions must be balanced before the end of this century; Ireland's emissions have to follow a similar trajectory on a shorter timeline.

Considerable opportunities arise from the required transformation in global energy, transport and land use systems, and it is in Ireland's interest to lead in key areas of this transition.

There is an urgent need for further polices, regulations and incentives if Ireland is to meet existing EU targets and to move onto a pathway to decarbonising energy, transport and heating and to achieve effective GHG emission neutrality in the agriculture and land use sectors by 2050.

Ireland is vulnerable to adverse impacts of climate change, which are projected to become more frequent over the coming decades; effective adaptation actions are needed to reduce vulnerabilities and increase social, economic and environmental resilience.

Coherent cross-government engagement with, and support for strategic and effective local and global actions to address climate change is in Ireland's interest.

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Chapter 4
Nature

Nature

Introduction

The terms "nature" and "biodiversity" are interchangeable. Human beings are an intrinsic part of biodiversity and interact with it on a daily basis. Our interactions with nature range from the mundane to the sublime but are generally taken for granted. Our activities change and shape the landscape in which we live. These human-mediated environmental and land use changes can have wide-ranging influences on biodiversity which need to be considered and managed.

Biodiversity

Its importance to individuals and to the country as a whole is often underestimated.

The Convention on Biological Diversity (CBD) defines 'biological diversity' or biodiversity as the variability among living organisms from all sources including, among other things, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.[1] Biodiversity underpins our economy, health and wellbeing and plays a key role in the functioning of ecosystems, their resilience and their continuing ability to provide ecosystem services. Biodiversity provides us with clean air, water, food, materials, medicines, health and recreation. It supports pollination and soil fertility, regulates climate and protects us from extreme weather (EC, 2015).

Habitats and Species

Ireland has legal obligations to protect habitats and species that are under threat and need protection across Europe.

A high proportion of Europe's most endangered and vulnerable habitats and species are considered to have "unfavourable" conservation status (60% of protected species and 77% of protected habitats across Europe) (EEA, 2015). The European Agency's report states that Europe will not meet its overall target of halting the loss of biodiversity by 2020; a similar conclusion has also been drawn in a global context (Secretariat of the Convention on Biological Diversity, 2014). It is also forecast that climate change impacts will intensify in the future and the underlying causes of biodiversity loss will persist.

Ireland has international and legal obligations to protect biodiversity. Protection of biodiversity within and outside protected areas is necessary, and this will require greater integration of biodiversity concerns in sectoral policy development and implementation, at local and national levels. Ireland's second National Biodiversity Plan (2011-2016) includes a programme of measures aimed at meeting Ireland's biodiversity obligations (DAHG, 2011). The linkages between biodiversity policies, from a national to a global scale, are outlined in Figure 4.1.

1 Article 2: *www.cbd.int/convention/text/*

Figure 4.1 Linkages Between Biodiversity Policies from a National and Global Scale (Source: NPWS)

Current Status and Trends

Habitat Trends

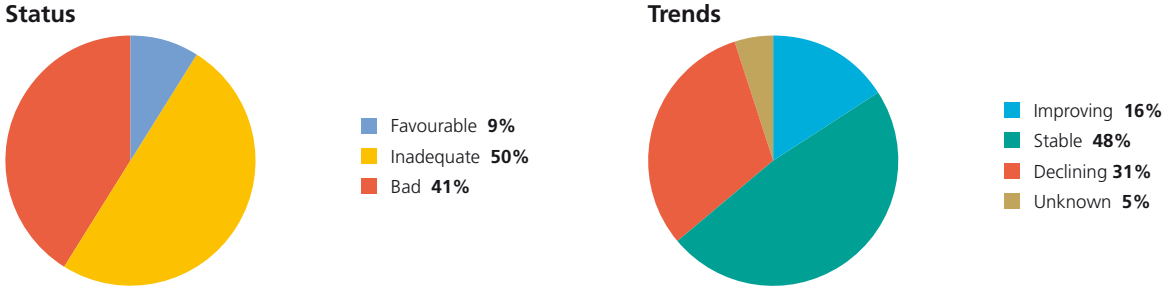
Raised bogs and species-rich grasslands are under threat in Ireland.

Owing to Ireland's geographical isolation and recent geological history, it has a lower diversity of non-marine flora and fauna than is found on continental Europe. Nevertheless, our aquatic systems and wetlands support internationally significant populations of birds, fish and invertebrates. Ireland is also relatively rich in bryophytes, algae, lichens and non-marine molluscs.

Member States are required to monitor habitats and species that are considered threatened across Europe and 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 Special Areas of Conservation[2] (SACs). The most recent report of the National Parks and Wildlife Service (NPWS, 2013) provides an overview of the status of Ireland's 58 natural habitats and 61 native species.

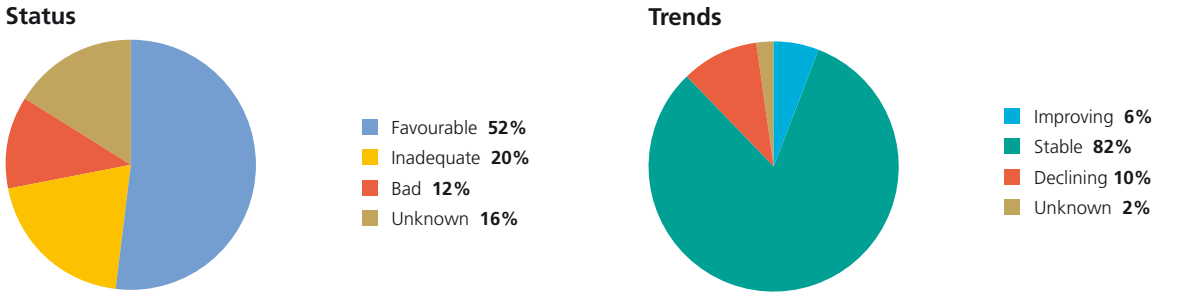
The current status and trends of Ireland's habitats are presented in Figure 4.2 (NPWS, 2013). Baseline surveys are still required to supplement our knowledge of habitats, particularly lakes and fens. The habitats of most pressing concern are those that have reduced range and/or area, notably raised bogs and species-rich grasslands.

Figure 4.2 Overall Assessment Results for the Status and Trends in Habitats Protected Under the EU Habitats Directive in Ireland 2007-2013 (Source: NPWS)



2 SACs are prime wildlife conservation areas, considered to be important on a European as well as a national level.

Figure 4.3 Overall Assessment Results for the Status and Trends in Species Protected under the EU Habitats Directive in Ireland 2007-2013 (Source: NPWS)



Species Trends

Species most under threat include those linked to wetlands, uplands or sensitive to water pollution.

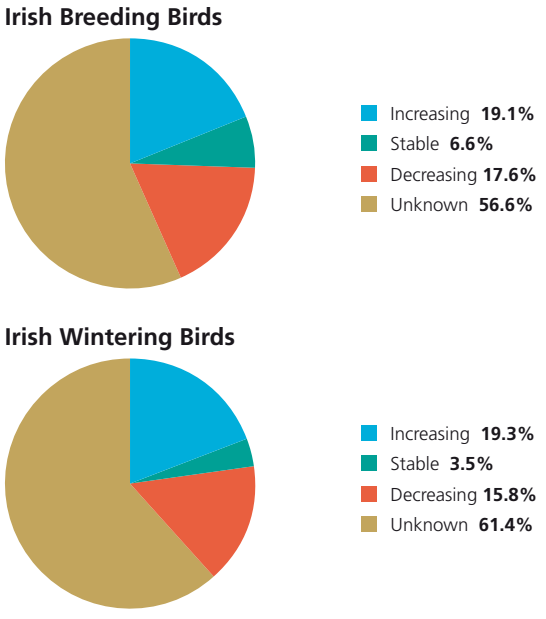
The current status and trends of Ireland's species are presented in Figure 4.3 (NPWS, 2013). Levels of many species are reported to be stable, but a number of key or iconic species are declining. One of the species of greatest concern is the pollution-sensitive freshwater pearl mussel, as only a few rivers have populations with even near-adequate recruitment (NPWS, 2013).

Birds

Changing long-term trends in breeding and wintering birds.

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 the implementation of the directive. This requires reporting on aspects of the status of all regularly occurring bird species in the Member States' territories. Ireland reported to the EU on trends in bird populations in 2013 (EEA, 2015). The long-term trends of Ireland's breeding and wintering bird populations are illustrated in Figure 4.4.

Figure 4.4 Long Term Trends in Ireland's Breeding and Wintering Bird Populations (Source: EEA)



The Bird Atlas and Citizen Science

The Bird Atlas 2007-2011 mapped the occurrence of Ireland's and Great Britain's birds during winter and breeding seasons (Balmer *et al.*, 2013). The Atlas was a collaborative project involving BirdWatch Ireland, the Scottish Ornithologists' Club and the British Trust for Ornithology. In Ireland the project received funding from the National Parks and Wildlife Service (NPWS), the Northern Ireland Environment Agency (NIEA), the Heritage Council and the Environmental Protection Agency (EPA). The Atlas is an excellent example of citizen science in action, presenting analyses of records submitted by over 40,000 volunteer birdwatchers in Great Britain and Ireland. Nearly all of the 300 species covered by the Atlas have experienced changes, such as range contractions or expansions, location shifts or subtle changes in abundance. Key findings for the island of Ireland are that, over the last 40 years, the breeding ranges of 47% of species have contracted, whereas 18% of species have expanded to new areas.

Two main "new" groups of concern highlighted are breeding waders and upland birds. Large range contractions are noted for the curlew, which has declined dramatically in recent years, and also lapwing, common sandpiper, golden plover, merlin, ring ouzel, snipe and teal. Further research is necessary to determine whether there is an overriding driver for observed range changes, but climate change has been implicated in some cases (Balmer *et al.*, 2013). The ranges of several farmland birds declined before the end of the last century and the distribution of these birds remains restricted today, for example corncrake, grey partridge, twite, whinchat and yellowhammer. On the other hand, a large increase in the range of the blackcap has been noted (Figure 4.5), and 12 other species have increased in abundance, including the bullfinch and buzzard.

Figure 4.5 The Blackcap has Experienced a 249% Increase in Range Since the Breeding Atlas 1988-1991 Report (Source: BirdWatch Ireland)

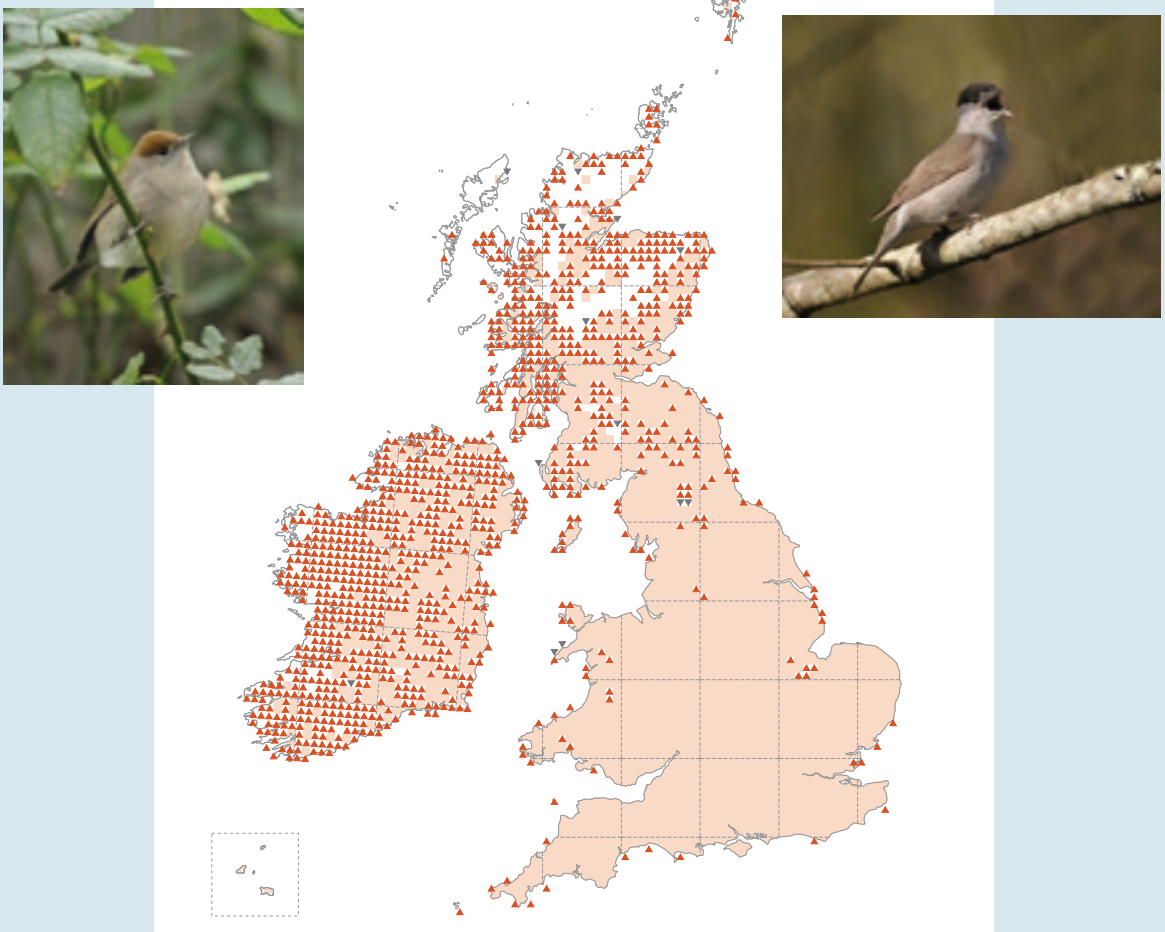
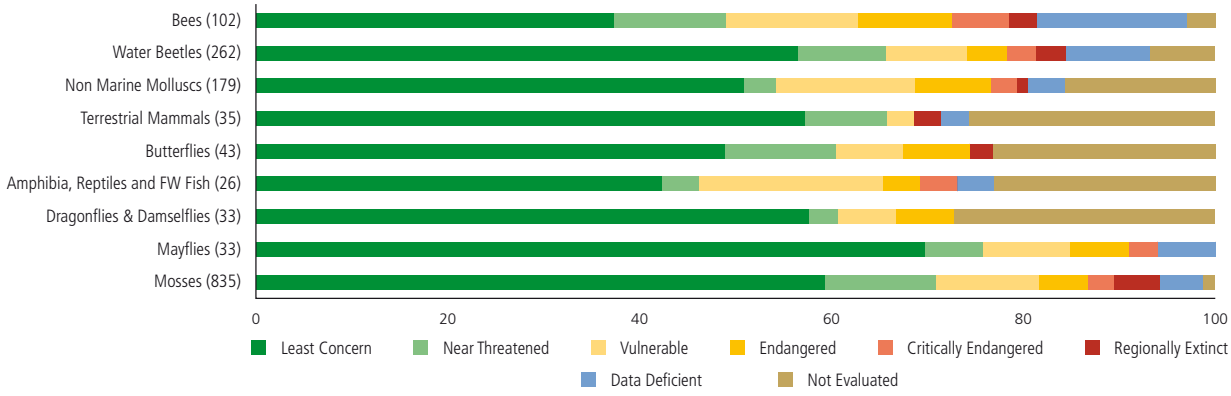


Figure 4.6 Conservation Status of Ireland's Red List Species; Number of Species Assessed in Brackets (Source: NPWS)



Red Lists Species

Identification and protection of species is aimed at protecting those most at risk.

Red Lists provide an objective assessment of species using the International Union for the Conservation of Nature (IUCN) categories and criteria. They identify species in most need of conservation interventions. The NPWS and NIEA co-ordinate Red Lists in Ireland, and these lists are available on the NPWS website.[3] Current assessments of Irish Red List species are outlined in Figure 4.6. According to the latest Red List, Macro-moths (Lepidoptera), 43 species of Irish macro-moth are assessed as threatened to some degree (i.e. vulnerable, endangered or critically endangered), which represents 8% of the current Irish list. Fourteen species are considered to have become regionally extinct as they had not been recorded in the 50 years prior to 31 December 2012 (Allen *et al*., 2016).

In 2014, BirdWatch Ireland and the Royal Society for the Protection of Birds (Northern Ireland) (RSPB NI) collaborated in producing a revised Birds of Conservation Concern in Ireland (BoCCI) list. Of 185 birds that breed and/or winter in Ireland, 37 were placed on the Red List and 90 on the Amber List, based on conservation status. Red-Listed breeding species include the barn owl, corncrake, grey partridge, grey wagtail and red grouse. Red-Listed breeding and wintering species include the curlew, dunlin, golden plover and Bewick's swan. Two birds of prey that have recently been reintroduced, the white-tailed eagle and the golden eagle (see topic box "Reintroducing Birds of Prey to Ireland"), are both Red Listed.

Drivers and Pressures

Key Pressures on Ireland's Habitats and Species

Changing land use, direct impact and unsustainable exploitation pressures evident across different habitats.

The key pressures on Ireland's habitats and species include direct habitat damage from peat cutting, wetland drainage/reclamation, over- and under-grazing, water pollution, unsustainable exploitation (e.g. over-fishing), invasive alien species (IAS) and recreational pressures (NPWS, 2013). An example of an indirect pressure is human population growth, the effects of which are exacerbated by limited public awareness of biodiversity and its benefits and economic value to society. Climate change is also likely to have some effect on Irish species and habitats (EPA, 2009). Pressures from urbanisation, fertiliser use and road building have reduced since the first assessment of Ireland's habitats and species (2001-2006) (NPWS, 2013). However, in a recovering economy, it is foreseeable that future land use changes will further threaten Ireland's habitats and species. The continuing deterioration of high quality rivers is of great concern, particularly as species such as salmon, trout and the declining freshwater pearl mussel require and depend on high quality water and river habitat (NPWS, 2013).

3 *www.npws.ie/red-lists*

Invasive Alien Species

Deliberate or accidental introduction of species can have a negative impact on the economy, wildlife or habitats and require a national response.

Invasive alien species are species that have been introduced to the island of Ireland, deliberately or accidentally, by humans and have a negative impact on the economy, wildlife or habitats. The Invasive Species Ireland project was a joint venture between the NIEA and NPWS that co-ordinated Ireland's activities in relation to IAS. The project is no longer operating but the website[4] remains live. There is a need for a co-ordinated and centralised all-island approach for tackling IAS to be re-established.

Regulations on the prevention and management of the introduction and spread of IAS came into force in the EU in 2015 (Regulation (EU) No. 1143/2014; EU, 2014). These regulations seek to protect native biodiversity and ecosystem services from damage caused by IAS, as well as minimising and mitigating the effects they can have on human health and the economy.

The Regulations require Member States to implement early warning and eradication systems for listed species as well as establishing border controls and licensing systems to manage trade. Individual countries are also required to prepare management plans for the eradication or containment of listed species. Included on the initial list of 35 species, and of particular relevance to Ireland, are the grey squirrel, the muntjac deer, and the curly-leaved pond weed (*Lagarosiphon* sp.).

The National Biodiversity Data Centre (NBDC) has developed an online invasive species database and an early warning system. In 2014, a report entitled *Ireland's Invasive and Non-native Species – Trends in Introductions* was published by the centre (O'Flynn *et al.*, 2014). This report found that 13% of invasive alien species recorded in Ireland are high-impact IAS. The percentage of high impact species in Ireland is similar to that reported for other European countries.

Local groups are now tackling IAS in their communities across Ireland; for example, the Sraheens/Kildownet campaign to control/eradicate invasive species is a local community-led project in the Achill area concerned with investigating ways of removing giant rhubarb (*Gunnera* sp.) and Japanese knotweed infestations.

The safe disposal of IAS material, including soil infested with seed, is problematic and needs to be further addressed.

Raised Bogs and the Abbeyleix Bog Project

The Habitats Directive aims to protect active raised bog and restore degraded raised bog still capable of natural regeneration to active condition. The National Peatlands Strategy aims to give direction to Ireland's approach to peatland management and guidance on how to optimise the ecosystem services provided by our peatlands for the future (NPWS, 2015). The EC is currently co-financing a LIFE project entitled "LIFE Irish Raised Bogs" to improve the conservation status of active raised bogs through restoration measures in 12 Natura 2000 sites in the Irish midlands.

On a local level, Abbeyleix Bog Project is an example of a community initiative that stemmed from a local action group (Abbeyleix Residents for Environment Action). The project was established to provide stewardship for Abbeyleix Bog in County Laois. Abbeyleix Bog Project is also a member of Irish Rural Link's Community Wetlands Forum. In 2010, a 50-year lease agreement was signed with Bord na Móna giving management responsibility to the Abbeyleix Bog Project. A Board of Trustees and technical advisory group (made up of local business community representatives, Bord na Móna, NPWS, Irish Peatland Conservation Council and Laois County Council) is tasked with ensuring that the site is managed for conservation, education and local amenity purposes. The project is actively engaged in the restoration and management of the bog. Community engagement projects undertaken to date include the installation of a boardwalk and bog bridge, invasive rhododendron clearance and butterfly surveys.

4 *www.invasivespeciesireland.com*

Responses

Natura 2000 Network

Habitats and species are legally protected by a network set up under nature directives.

Implementation of the EU Habitats and Birds Directives has resulted in the creation of a comprehensive network of sites for habitat and species protection, the Natura 2000 network. Details of Ireland's protected sites can be found on the NPWS website.[5] Steps required to legally protect Ireland's terrestrial network of SACs under the Habitats Directive and Special Protection Areas (SPAs) under the Birds Directive are largely complete. Of the 154 SPAs in Ireland, 140 are protected by a Statutory Instrument. Six new marine SACs were submitted by the Department of Arts, Heritage and the Gaeltacht (DAHG) to the European Commission in 2014, bringing the total to 430. A final formal designation of SACs is under way, although legal protection is already in place. In April 2016, the European Commission called on Ireland to step up its efforts to designate SACs and to establish conservation objectives and measures for all of them.[6] Progress towards marine SPA designation has been slow, but will be based on data produced following baseline ecological surveys in offshore areas carried out by the Department of Communications, Energy and Natural Resources in collaboration with the DAHG in 2015-2016.

Prioritised Action Framework for Natura 2000

Appropriate management regimes should be the driver for protecting our Natura sites and protected species.

The Prioritised Action Framework for Natura 2000 (PAF)[7] was approved by 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.

Action 15.2 of the National Biodiversity Plan includes a commitment to "prepare and implement site-specific conservation objectives, management advice and/or plans on Natura 2000 sites, Nature Reserves and National Parks". Detailed site-specific conservation objectives, which define the most favourable conservation condition for the particular habitats and species on a site by site basis, have been published for 129 SACs and 37 SPAs (as of July 2016).

5 *www.npws.ie/protected-sites*

6 *www.europa.eu/rapid/press-release_MEMO-16-1452_en.htm*

7 *www.npws.ie/sites/default/files/general/PAF-IE-2014.pdf*

Brown Bog SAC (002346) – Site-specific Conservation Objectives

Brown Bog SAC is located 5 km north-west of Longford town. The site comprises a raised bog that includes areas of high bog and cutover bog. The site is designated as an SAC under the Habitats Directive for the following habitats that occur there: Active Raised Bog, Degraded Raised Bog and *Rhynchosporion* Vegetation (which occurs on wet peat on pool edges and in hollows).

A site-specific conservation objective aims to define favourable conservation condition for a particular habitat or species at that site. The maintenance of habitats and species within sites at favourable condition will contribute to the maintenance of favourable conservation status of those habitats and species at a national level. Conservation objectives for habitats and species are defined using attributes and targets that are based on parameters as set out in the Habitats Directive for defining favourable conservation status.

Targets have been set for attributes for each of the three habitats listed for Brown Bog according to the best information available. For example, for Active Raised Bog, a target to 'Restore the area of active raised bog to 13.2 ha, subject to natural processes' has been set (NPWS, 2016). The Active Raised Bog habitat in this SAC has 17 attributes that define favourable conservation condition. Separate conservation objectives have not been set for Degraded Raised Bog and *Rhynchosporion* Vegetation as they are inherently linked to Active Raised Bog.

Threat Response Plans

Threat Response Plans establish a system of strict protection for species and habitats listed in the Habitats Directive.

The NPWS has prepared Threat Response Plans[8] to establish a system of strict protection for the species and habitats listed in Annex IV of the Habitats Directive, including otter, bats and cetaceans. These plans continue to be implemented with future appraisal and expansion to other species currently under consideration (National Biodiversity Working Group, 2014).

A Red Grouse Species Action Plan was published in 2013, as a collaborative project between the Irish Grey Partridge Conservation Trust, National Association of Regional Game Councils, Golden Eagle Trust, Irish Kennel Club, BirdWatch Ireland and NPWS. The plan provides guidance for the conservation and management of red grouse and its habitats and suggests a framework for actions and recommendations to achieve this.

Updating the Water Framework Directive (WFD, 2000/60/EC) freshwater pearl mussel sub-basin management plans and the effective implementation of measures within these plans will be essential in improving the status of this endangered species.

Group Species Action Plans for the Protection of Birds

Plans for priority, migratory and dispersed birds based on their habitat requirements.

BirdWatch Ireland developed a series of 10 Group Species Action Plans for Ireland's "priority, migratory and dispersed" birds based on their habitat requirements. These plans encompass those species that are found on the BoCCI Red and Amber Lists, including some regularly occurring birds in Ireland that are on Annex I of the Birds Directive, along with some additional bird species requiring protection. The Action Plan for Upland Birds in Ireland 2011-2020 is an example of such a plan (BirdWatch Ireland, 2010). Uplands are considered to contain important areas of semi-natural habitats in Ireland. The plan covers 22 bird species, of which seven are Red Listed and 13 are Amber Listed. Seventeen targets and associated actions are categorised by themes with some specific actions for species that require them; e.g. a target has been set to establish the size of the breeding curlew population, a Red-Listed species that has undergone a dramatic decline in Ireland.

8 *www.npws.ie/publications/species-action-plans*

Reintroducing Birds of Prey (Raptors) to Ireland with Mixed Success

A programme to reintroduce three large raptor species into the wild in Ireland has had mixed success. Current monitoring indicates that a number of birds have been subjected to illegal poisoning.

Of the 61 golden eagles released in Donegal up to 2012, seven were found dead, three of these confirmed as having been poisoned. There are three known breeding pairs surviving, one pair having produced the first Donegal-bred golden eagle in 2014. However, there are concerns regarding the appropriate management of upland habitats and availability of prey to sustain a viable population of golden eagles (IWT, 2015).

One hundred white-tailed sea eagles were released in Kerry from 2007 to 2011. Of these, 30 died (including 12 confirmed poisonings). In 2015, eight pairs nested, and four of these nests produced young. The nest site of a breeding pair in Mountshannon, Co. Clare, which can be viewed by the public attracted over 17,000 visitors in the 2013-2014 period. In 2016, white-tailed sea eagles successfully bred on an island on Lough Leane in Kerry for the first time in over 100 years.

Thirty-one of the 158 red kites released in Dublin and Wicklow from 2007 to 2011 were found dead (including 23 confirmed poisonings and one shooting). Overall, however, the red kite reintroduction project has been largely positive; breeding has been successful and translocation of Wicklow donor stock into Munster is being considered for the future (National Biodiversity Working Group, 2014).

National Biodiversity Plan – Actions for Biodiversity 2011–2016

Good reasons for the further integration of biodiversity initiatives into land use planning and agriculture.

Various initiatives have been put in place to mainstream biodiversity protection in areas such as planning and development, agriculture, and peatland and woodland management. The NBDC's online data portal 'Biodiversity Maps'[9], provides a mechanism for validated biodiversity data to be available for decision making in areas such as conservation management and land-use planning.

The legal strength of the EU Birds and Habitats Directives is instrumental in promoting sustainable development in planning decisions. The increasing attention on biodiversity issues in development control and forward planning because of requirements under the Habitats Directive is helping to integrate species and habitat protection into land use and marine policies and is increasing awareness amongst key stakeholders at the national level.[10]

The National Biodiversity Plan 2011-2016 (DAHG, 2011) outlines the following vision for Ireland's biodiversity: "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." The draft interim review of the plan (National Biodiversity Working Group, 2014) found that, of the 102 actions, 24 were completed, 67 are ongoing and 11 still need to be progressed.

Action 1.1 of the National Biodiversity Plan states that relevant Government departments and state agencies should prepare sectoral Biodiversity Action Plans in line with the National Biodiversity Plan to ensure and promote the conservation and sustainable use of biodiversity. Bord na Móna recently launched its Biodiversity Action Plan (BAP) 2016-2021 (BNM, 2016) to build on the objectives and actions of its first BAP, 2010-2015 (BNM, 2010), for managing and rehabilitating peatlands under its ownership (*biodiversityactionplan.bordnamona.ie/index.html*). The new plan incorporates a natural capital accounting system whereby losses and gains to ecosystem services (e.g. pollination) by the company's activities will appear on its balance sheet. There is ongoing work on rehabilitation of high-quality bog sites, mainly through drain blocking.

Action 1.7 of the National Biodiversity Plan states that each local authority should publish a Local Biodiversity Action Plan or review existing plans. Implementation of Local Biodiversity Action Plans and/or heritage plans will ensure that biodiversity and green infrastructure issues are taken into account in land use planning. This will also promote habitat connectivity through the maintenance of regionally and locally important wildlife sites linked by ecological corridors.

National Agri-environment Scheme – GLAS

European and national funding for the Rural Development Programme up to 2020 demonstrates a strong commitment to rural development and the national agri-environment scheme, GLAS (Green, Low-Carbon, Agri-Environment Scheme). A number of biodiversity actions have been included within GLAS, including specific priority actions targeted at vulnerable habitats and threatened species, as well as general actions which will have wider biodiversity benefits. "GLAS Plus" gives additional rewards to farmers for exceptional environmental commitment on farms that have been identified as habitats of endangered birds. For example, if farmers have breeding curlews on their land, they will become a priority for access to GLAS.

The National Biodiversity Plan states that high-nature-value (HNV) farming is a new and evolving approach to farming based on the growing awareness that biodiversity is usually higher on farmland that is managed at a lower intensity (DAHG, 2011). HNV farming has been gaining recognition across EU Member States and, in recent years, there have been efforts to ensure that the importance of HNV farmland is appreciated and supported by appropriate policy instruments. The Heritage Council, in particular, has championed the identification and description of what constitutes HNV farmland and how it might be supported under Common Agricultural Policy (CAP) reform (McGurn and Moran, 2013).

Action 5.7 of the National Biodiversity Plan (DAHG, 2011) recommends continued promotion of the Native Woodland Scheme (NWS). The NWS was launched by Woodlands of Ireland in conjunction with the Forest Service under the Forestry Programme 2014-2020. The scheme targets the management of ancient, old and emerging (scrub) native woodland and the establishment of new native woodlands on greenfield sites.

9 *maps.biodiversityireland.ie/#/Home*

10 *www.npws.ie/sites/default/files/publications/pdf/Fitness%20Check%2015%204%2015.pdf*

All-Ireland Pollinator Plan 2015-2020

The All-Ireland Pollinator Plan 2015-2020 (NBDC, 2015) is a voluntary plan of action supported by 68 organisations from the public, private and NGO sectors. The overall aim of the plan is to tackle pollinator decline, caused mainly by the loss of natural and semi-natural habitats, and to make Ireland's landscape one where pollinators can survive and thrive, providing invaluable pollination services to both crops and wild plants. The plan has five objectives: (1) to make Ireland pollinator-friendly, (2) to raise awareness of pollinators and how they can be protected, (3) to manage pollinators by supporting beekeepers and growers, (4) to expand our knowledge on pollinators and their services and (5) to collect evidence to track change and measure success.

The plan can be downloaded at *www.biodiversityireland.ie/pollinator-plan*, with a junior version at *ark.ie/downloads/Junior_Pollinator_Plan_for_Web2.pdf*. Guidelines (NBDC, 2016) on how to make gardens more pollinator friendly are available at: *www.biodiversityireland.ie/wordpress/wp-content/uploads/Gardens_actions-to-help-pollinators-July-2016.pdf*.

The declining bee population is also an early warning of the wider systemic risk posed by habitat loss and pesticide use.

Knowledge Base

National Biodiversity Data Centre

The collection of data on our natural world is critical to allow informed decisions on nature protection.

The effective management of biodiversity in Ireland is dependent on having accurate information on the condition of ecosystems of interest and importance, as well as information on trends over time. The National Biodiversity Data Centre (NBDC) is a national organisation that collates, manages, analyses and disseminates data on Ireland's biodiversity.[11] The NBDC currently maintains in excess of 3.8 million records relating to over 15,000 species in Ireland, a large proportion of which are records from NPWS and verified records submitted by the public. The NBDC also hosts a suite of biodiversity indicators (*indicators.biodiversityireland.ie*) which inform the public and policymakers on biodiversity status, trends and pressures and the effectiveness of policy measures outlined in the National Biodiversity Plan.

Research

A driver for nature protection through knowledge generation and pilot programmes.

Ireland recently submitted an evidence-gathering questionnaire through the NPWS to the European Commission as part of its fitness check of the Birds and Habitats Directives. Appendix I of that document[12] outlined relevant biodiversity research undertaken on species and habitats listed in the Habitats Directive in Ireland.

Much information and knowledge about ecosystems is generated from research projects and demonstration projects. These projects help to pilot management measures to show how effective management can be in improving conditions for biodiversity. The EU provides funding for nature/biodiversity, environment and climate action under the LIFE programme. A number of Irish projects incorporate a significant element of nature/biodiversity research in their remit.

- Burren LIFE and its successor, Burren Programme, aim to protect and support the heritage, environment and communities of the Burren (*burrenlife.com* and *www.burrenprogramme.com)*

11 *www.biodiversityireland.ie*

12 *www.npws.ie/sites/default/files/publications/pdf/Fitness%20Check%2015%204%2015.pdf*

- Aran LIFE (2014-2017) seeks to develop best conservation management practices of local farmers on designated Natura 2000 sites on the Aran Islands[13]
- Kerry LIFE aims to support local communities in the Caragh and Kerry Blackwater areas to help restore populations of freshwater pearl mussel[14]
- The Raised Bog Restoration LIFE project 2011-2015 focused on demonstrating best practice in bog restoration in Ireland.[15] The LIFE Irish Raised Bogs project 2016-2020 will focus on restoring 12 active raised bogs within Ireland's SAC network[16]
- The EPA Research Programme has funded over 30 research projects between 2007 and 2015, with a total commitment from the EPA of approximately €6 million. The range of projects funded includes desk studies, scholarships, fellowships and large-scale multi-annual and multi-partner awards.

The Natural Capital and Ecosystem Services sub-pillar of the EPA Research Programme has a strong focus on policies for biodiversity conservation and protection. It has been driven by national plans, strategies, European directives and regulations, and international obligations.

Key achievements of the EPA Research Programme

- The Ag-Biota project outputs represented a significant contribution to Ireland's obligations under the United Nations Convention on Biological Diversity and will assist in the national aspiration to halt and reverse the decline in biodiversity in the wider countryside
- The BOGLAND report provided large-scale analysis and findings demonstrating that the Irish State needs to change the way in which the peatland resource is currently viewed and managed if it wishes to secure the multiple benefits offered by these natural ecosystems and avoid the costly consequences of further unsustainable management of peatland
- Outputs from the BIOFOREST project have been used in the development of the Forest Environment Protection Scheme
- The SIMBIOSYS project quantified impacts on biodiversity of key activities (bioenergy crops, road landscaping and aquaculture) and identified some win–win situations where both biodiversity and sectoral outputs can be maximised
- The HYDROFOR project investigated the impacts of forestry operations on Ireland's aquatic ecology and will inform forest policy review and WFD implementation, environmental considerations in the development of forestry programmes, the refinement of forest and water quality guidelines and guidance on best practice in relation to forest operations and appropriate mitigation measures (e.g. aquatic buffer zones and sediment traps) aimed at reducing pollutant inputs. The latter is especially relevant in the development of measures to protect endangered species such as the freshwater pearl mussel.

Priority areas for nature research

- Furthering our knowledge base on the role of the natural environment, its resources and ecological limits and our understanding and protection of ecosystems, along with their role in sustaining the economy and human wellbeing. In particular, this will enable us to increase our understanding of peatlands (ecosystem services and mapping) and support the management of invasive species
- Engaging the public in the protection and improvement of the environment via a rolling programme of citizen science projects.

13 *www.aranlife.ie*

14 *www.kerrylife.ie*

15 *www.npws.ie/sites/default/files/general/Project%20Brochure%20for%20LIFE09%20222.pdf*

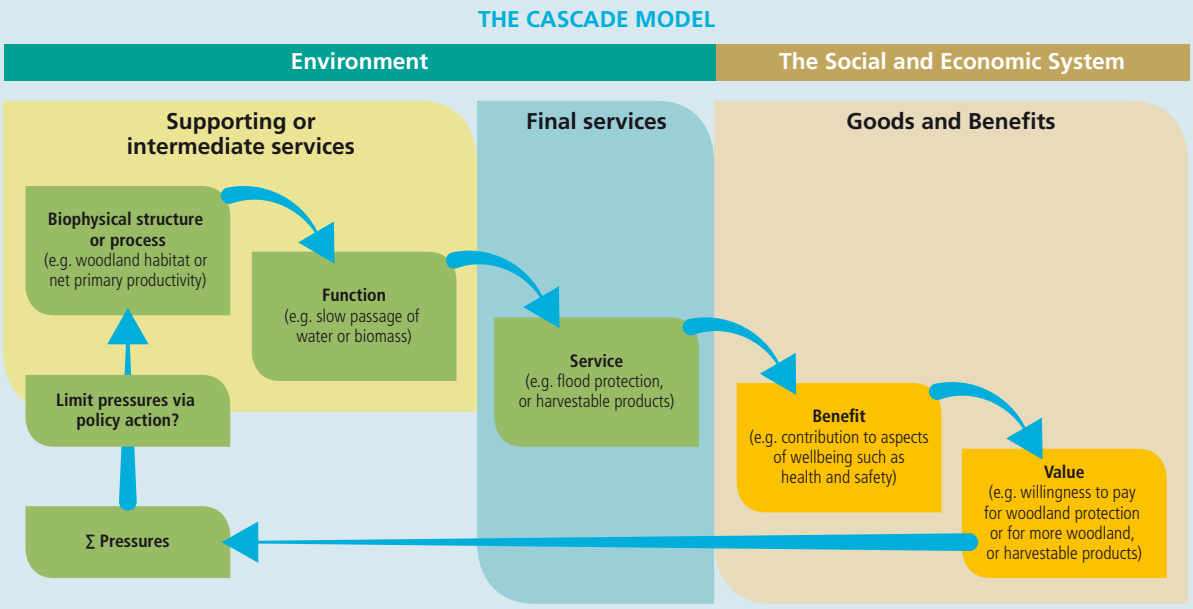
16 www.ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=5321

Natural Capital and Ecosystem Services – A New Approach to How We Value Biodiversity

Biodiversity management initiatives undertaken to date have had limited success in addressing the ongoing loss and fragmentation of habitats, as indicated by the current conservation status of Ireland's habitats and species. The main challenge in protecting and restoring biodiversity has been raising sufficient awareness of the benefits and value of diverse ecosystems to society. The ecosystem approach, incorporating natural capital accounting, seeks to redress this by ensuring that biodiversity is recognised as part of a wider socio-economic ecological system (Figure 4.7) 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 (*www.cbd.int/ecosystem/).*

Natural capital consists of the world's stocks of physical and biological resources, including air, water, minerals, soils, fossil fuels and all living things. Natural capital accounting (NCA) involves attributing a measurable economic and/or ecological value to the ecosystem goods and services that provide benefits to society. NCA is required in all EU Member States by 2020 under Action 5 of *The EU Biodiversity Strategy to 2020* (EU, 2011). This process is under way in Ireland through the Mapping and Assessment of Ecosystem Services (MAES) project, commissioned by NPWS, which aims to map a suite of prioritised ecosystem services based on available data. This project will contribute towards the production of a National Ecosystem and Ecosystem Services map (*www.npws.ie/research-projects/ecosystems-services-mapping-and-assessment/project-details).*

Figure 4.7 The Link Between Biophysical Structures, Ecosystem Services and the Socio Economic System as Shown by the Cascade Model (Source: DAHG, 2015; after Potschin and Haines-Young, 2011)



The Irish Forum on Natural Capital (IFNC) administered by a part-time secretariat jointly funded by NPWS and EPA, brings together a diverse range of organisations and individuals from academic, public, private and NGO sectors who are interested in the development and application of the natural capital agenda in Ireland.

NCA has the potential to better inform policies that effectively promote, enhance and restore ecosystems and the human wellbeing that depends upon them (National Biodiversity Working Group, 2014). It is envisaged that standardised NCA methodologies will increasingly be used by businesses to identify risks and opportunities and ensure their sustainability in a world of ever-diminishing resources (CIMA *et al.*, 2014).

Outlook for Habitats and Species

Most pressures on habitats and species are set to continue unless we rethink how we manage our natural resources and tackle climate change.

In Ireland there is no evidence that there will be any major reduction in pressures impacting negatively on habitats and species listed in the Habitats Directive over the next decade, although some potential improvements have been noted (NPWS, 2013). These include a decline in invasive infestation of woodlands as a result of improved forestry management; and a reduction in pollution from household waste and sewage. However, it must be noted that initiatives such as Food Harvest 2020 and Food Wise 2025 may threaten to reverse any gains made in pollution reductions from the agriculture and aquaculture sectors if the plans are not implemented in a sustainable way. This is covered in more detail in Chapters 5 and 12.

There is evidence that climate change is negatively impacting on coastal habitats. Predictions indicate that degraded upland habitats, in particular, will become less resilient to the impacts of climate change in the immediate future. Predicted drier summers and higher levels of more intense rainfall are likely to result in bog bursts and landslides which may indirectly impact other habitats such as lakes.

Pressures and threats to the environment arising from the energy, transport and agriculture sectors have potential to adversely impact biodiversity. Agricultural practices have a high impact on protected species that occur within agricultural systems, e.g. the *Vertigo* species of snail and the marsh fritillary butterfly. Pollution is considered a significant pressure and threat to the conservation status of some species, for example those species that need good or excellent quality water to survive such as the remaining limited populations of the freshwater pearl mussel.

Overall, it is likely that the cumulative impacts of a growing economy will be more evident in the wider countryside rather than the protected Natura network (SACs and SPAs), as this is afforded considerable legal protection under EU and national environmental legislation.

Public Awareness and Education on Biodiversity

The 2016 Barometer survey, commissioned by the Heritage Council, on consumer awareness, understanding and interest in biodiversity found that there is a real shift in awareness which is particularly evident in Dublin and urban areas generally. Nationally, awareness and understanding of biodiversity has grown from 18% to 31% between 2010 and 2016. However, Ireland is still well behind the EU average (2013) of 44%. Overall 33% of Irish people feel that they are well informed about the loss of biodiversity, compared to 20% in 2010. Again, however, we lag behind the European average (45%), recorded in 2013 (EC, 2013).

The National Biodiversity Plan recommends the inclusion of biodiversity to a greater extent in secondary and third-level education and the implementation of a communications campaign. While a wide range of activities are undertaken at a local level by local authorities, the Heritage Council and NGOs, there is a need for an overall strategy to take account of landowner dissatisfaction with biodiversity regulation and to enhance the appreciation of biodiversity and ecosystem services amongst the wider public as per Action 4.3 of the National Biodiversity Plan (DAHG, 2011).

The Department of Arts, Heritage, Regional, Rural and Gaeltacht affairs and other organisations such as the Irish Environmental Network celebrate National Biodiversity Week annually through a number of awareness-raising events. The EPA sponsors media promoting biodiversity conservation and sustainability such as the TV series *Eco Eye* and *Ireland's Ocean* and provides educational materials for primary – and secondary-level students such as identification keys for some common species and educational modules on wetlands biodiversity. Organisations, such as ECO-UNESCO, Ireland's Environmental Education and Youth Organisation, provide educational materials, training and organise events that promote awareness of wildlife and habitats.

Citizen science is the involvement of volunteers in scientific research conducted, in whole or in part, by members of

the public. Citizen science is included in the EPA Strategic Plan 2016-2020 (EPA, 2016). The EPA's objective is to engage the public in the protection and improvement of the environment. The National Biodiversity Data Centre greatly enhances public awareness through its online biodiversity recording service and via an extensive programme of workshops specifically targeting capacity building within the citizen science sector. Other popular citizen science projects include the garden bird survey and the Bird Atlas (see topic box "The Bird Atlas and Citizen Science") run by BirdWatch Ireland, bat monitoring projects run by Bat Conservation Ireland (Aughney *et al.*, 2012) and coastal projects run by Coastwatch and An Taisce. Much of the data received by the NBDC is also generated through citizen science, such as the Mammal Atlas project which has accumulated over 120,000 records of Irish mammals since 2010, mostly from the general public, towards the production of a new Atlas of Irish Mammals.[17] Funding opportunities exist for community initiatives via LEADER (e.g. catchment initiatives), Local Agenda 21 and Heritage Council grants, but there are still challenges in stimulating community involvement and sustaining public engagement in such initiatives.

Conclusions and Future Challenges

Land use changes and the planned intensification of agriculture may lead to further habitat loss.

Some future challenges are emerging alongside the list of current pressures. Increased land use change as the economy improves may lead to further habitat loss and/or fragmentation, through the draining of wetlands, for example. The implementation of initiatives such as Food Harvest 2020 and Food Wise 2025 will have to be scrutinised to ensure that they are implemented in a sustainable way.

Climate Change

Climate change is intensifying and the current underlying issues will persist. Species and habitat ranges may expand and contract in reaction to pressures from climate change. Such changes will facilitate a range expansion in some invasive alien species, for example. The impacts of climate change and the continuing threat of invasive alien species are areas that need to be constantly monitored and guarded against, where possible.

The mainstreaming of biodiversity into economic and development decisions would be of benefit to nature protection.

There is a real need to increase efforts at all levels to bring biodiversity into the mainstream using measures such as Biodiversity Action Plans, thorough environmental assessments and the ecosystem approach/natural capital accounting (NCA), where appropriate, in the development of our policies, plans and strategies. This will ensure that evidence-based decisions are made and unforeseen negative consequences for biodiversity are mitigated and avoided, where possible.

There is room for improved co-ordination on nature issues across linked directives and regulatory bodies.

There is a need for increased clarity in the roles and responsibilities of our government agencies with regard to biodiversity protection. Continued co-ordinated implementation of existing measures to protect biodiversity within protected areas and in the wider countryside is required. One step towards this would be better co-ordination of the relevant EU directives that protect biodiversity, namely the WFD, Habitats and Birds Directives and the Marine Strategy Framework Directive (MSFD, 2008/56/EC), as outlined by the EU Biodiversity/Nature Directors and Water/Marine Directors (Annex III in *circabc.europa.eu* or *https://circabc.europa.eu/*). In addition, improved integration of sectoral policies by applying the ecosystem approach and NCA principles to the economy will be necessary to protect and restore Ireland's biodiversity.

Robust baseline biodiversity monitoring systems and comprehensive ecosystem services mapping systems are needed to highlight and protect nature in Ireland.

There is a pressing need to follow the approach of the Mapping and Assessment of Ecosystem Services (MAES) project and put in place robust baseline biodiversity monitoring systems and comprehensive ecosystem services mapping. Ideally, these initiatives should be co-ordinated and regularly updated by a single lead organisation with ring-fenced funding.

Increased public awareness is vital.

Ongoing collaborative efforts to increase public awareness of biodiversity must be continued and augmented. Public awareness and appreciation of biodiversity and its intrinsic link to everyday life is vital if measures to protect our environment are to succeed.

17 *www.mammals.biodiversityireland.ie*

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Chapter 5

Inland and Marine Waters

Inland and Marine Waters

Introduction

Ireland has abundant surface water resources, with over 70,000 km of river channel, 12,000 lakes, 850 km^2 of estuaries and 13,000 km^2 of coastal waters.[1] Groundwater is also abundant, occurring almost everywhere and supplying 20-25% of water supplies nationally.

The state of Ireland's groundwater and surface waters is assessed based on a comprehensive and representative water quality monitoring programme designed to support the implementation of the river basin planning process under the Water Framework Directive (WFD) (2000/60/EC). The network consists of over 3500 monitoring sites covering groundwater, rivers, canals, lakes, estuaries and coastal waters. The Environmental Protection Agency (EPA), local authorities, Inland Fisheries Ireland, the National Parks and Wildlife Service, Waterways Ireland and the Marine Institute are responsible for implementing the programme.

The aims of the WFD are to maintain high and good status waters where they exist, prevent any deterioration in the existing status of waters, manage water bodies based on river basins or catchments to achieve at least good status in accordance with the environmental objectives set out in River Basin Management Plans (RBMPs) and involve the public.

This will be achieved by identifying key threats to water quality on a catchment basis, improving implementation of existing directives and developing new evidence-based measures for mitigation of threats supported by national and local level schemes and initiatives.

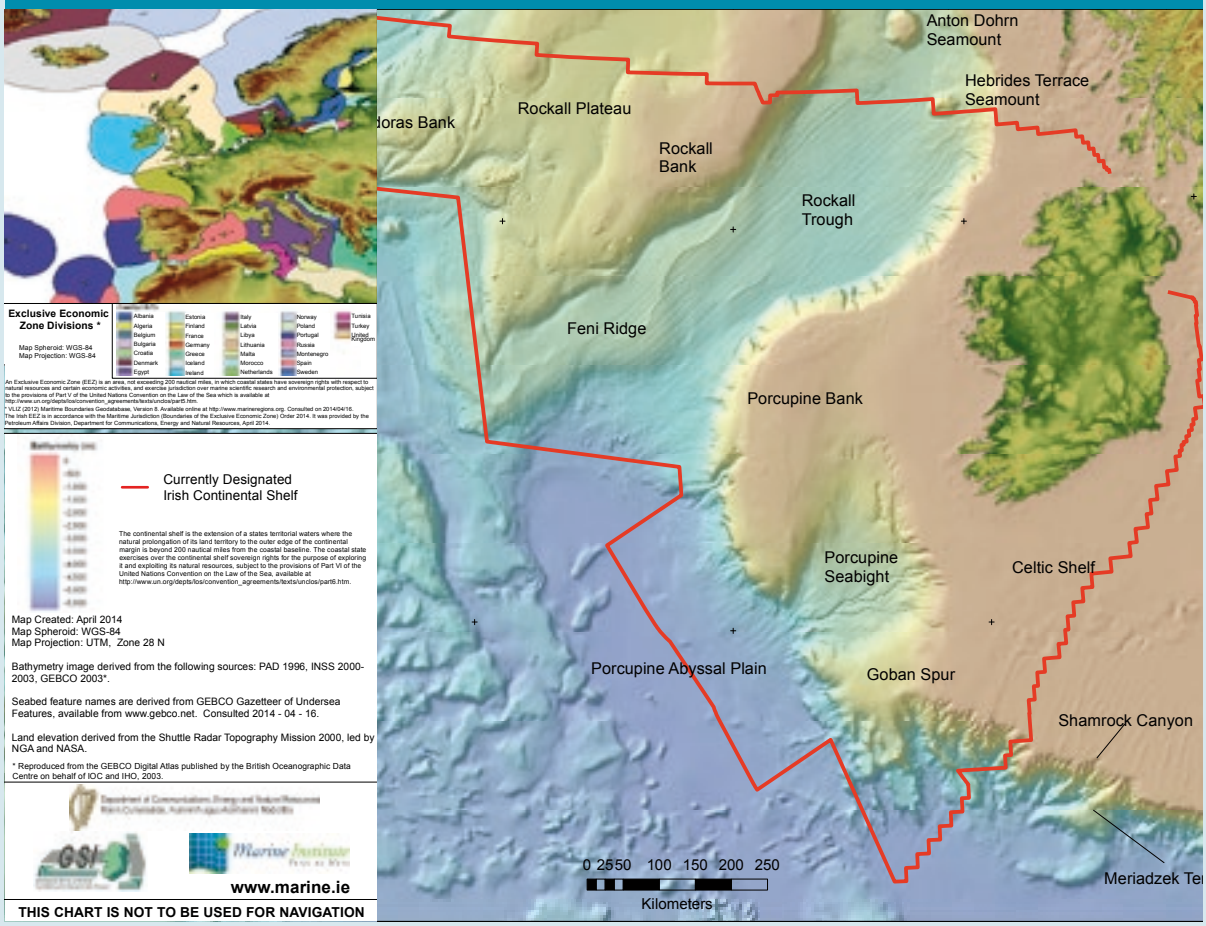
The Marine Strategy Framework Directive (MSFD) has similar aims to the WFD for the protection of the marine environment beyond the areas considered under the WFD. It requires the application of an ecosystem-based approach to the management of human activities, enabling a sustainable use of marine goods and services. It requires Ireland to describe, monitor and assess what are clean, healthy and productive seas, i.e. Good Environmental Status, and ensure that appropriate action is taken by 2020 to maintain or achieve this status. The Department of Housing, Planning, Community and Local Government is the lead body for the implementation of the MSFD and is supported by a number of other departments and state agencies, including the Marine Institute (MI).

1 Coastal waters refer to waters within 1 nautical mile of the coastline.

Ireland's Marine Environment

Ireland's marine environment is one of the largest in the European Union (EU) and is nearly 10 times its land area. The coastline is at the interface between the land and sea, with shallow estuaries that extend into the coastal zone and out to the continental shelf to the west, which plunges to depths of over 4000 metres.

Figure 5.1 The Real Map of Ireland (Source: Marine Institute)



The temperate waters that surround Ireland are highly productive and provide a sustaining foundation for a rich mosaic of marine life, including hundreds of species of invertebrates and fish, 24 species of whales and dolphins, breeding colonies of both the common and grey seal and some of the largest breeding populations of seabirds in western Europe.

Ireland's location in the Atlantic Ocean on the edge of the European continent has meant that, in comparison with many other European countries, its marine environment has remained relatively unpolluted. In recent years, however, the level of environmental stress, from both internal and external sources, has increased. Coastal development and industrialisation, particularly during the 1990s, has resulted in an increase in the range and magnitude of pressures that have the potential to impact negatively on the quality of Ireland's tidal waters.

Pressures have also come from the intensification of agriculture and commercial fishing. The application of inorganic fertilisers and changing farming practices have caused nutrient enrichment of inshore surface waters, and, in the fishing sector, the use of new technologies and larger modern trawlers has allowed the capture of unsustainable quantities of fish. The continued release of untreated sewage into the marine environment from several large towns is a major cause of concern for coastal communities and ecosystems. In addition, the impacts of climate change pose a significant and not yet fully understood threat to this environment.

In this chapter, the results from various monitoring programmes are used to assess the impact of human activities on the tidal water environment (as well as the freshwater environment). The key pressures assessed include the discharge of nutrients and other contaminants, dredging, marine litter, commercial fishing, aquaculture and the effects of climate change. Information on these specific pressures and impacts is presented to provide an overview of the general environmental status of estuarine, coastal and offshore waters around Ireland.

Current Situation

Overall assessments show significant challenges ahead in bringing all waters up to a satisfactory level and to protect waters already in good condition.

The quality of Irish groundwater and surface waters is among the best in Europe[2] (Figures 5.2 and 5.3).

Figure 5.2 Proportion of Classified Surface Water Bodies (Rivers and Lakes) in Different River Basin Districts Holding Less Than Good Ecological Status or Potential (Source: EEA, 2015)

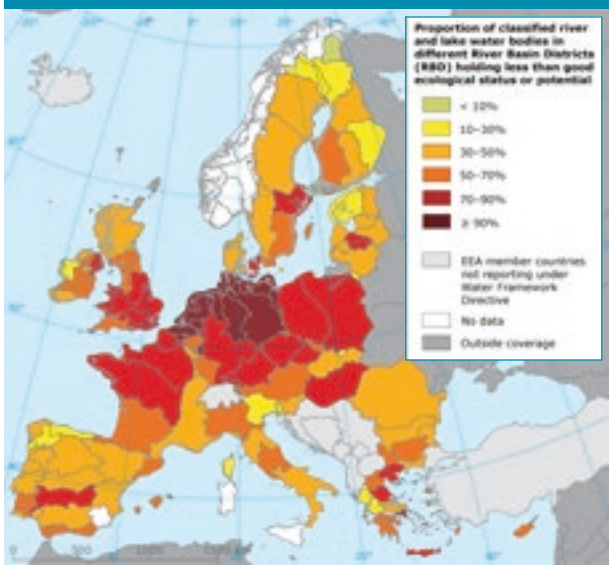
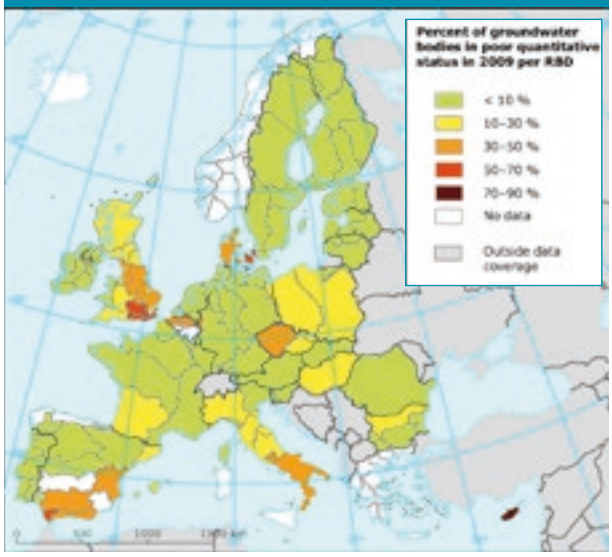


Figure 5.3 Percentage of Groundwater Bodies in Poor Quantitative Status in 2009 per River Basin District (Source:EEA, 2015)



However, there are many impacts that need to be addressed to bring all waters up to a satisfactory level and to protect waters already in good condition. Ireland is fortunate to have such good-quality waters in comparison with many of our European neighbours, and our future wealth and prosperity is very dependent on us maintaining and strengthening this position. With regard to biodiversity, species considered to be most under threat are those linked to wetlands and those that are sensitive to water pollution (see Chapter 4).

Preliminary results indicate that there has been no overall improvement in water quality over the first river basin planning cycle.

Rivers

Substantial loss in the number of highest quality river sites.

Under the Water Framework Directive a substantial number of chemical and biological elements are assessed to determine the overall status of waters. One of the key elements for rivers is the macroinvertebrate fauna found within the waters and this is monitored and assessed in Ireland using the EPA Q value method. The macroinvertebrate Q value method has been employed in the assessment of Irish rivers over a long period and it enables trends in the quality of river waters to be viewed over the last two decades. In the Water Quality in Ireland Report covering the period between 2010 and 2012 (EPA, 2015b) a welcome improvement was found in the length of unpolluted channel increasing by 4%. Unfortunately this improvement has not been maintained and the length of unpolluted channel has reverted to the levels found between 2007 and 2009. Despite minor variations in each monitoring period overall levels of pollution remain relatively constant since the beginning of the 1990s (see graph below). Some improvements have been made with the length of seriously polluted channel being reduced to just over 6 km in the 2013 to 2015 period compared with 17 km between 2010 and 2012 and 53 km between 2007 and 2009.

While overall the length of unpolluted river channel has remained relatively constant there has been a substantial loss in the number of sites where the highest quality river sites are found (i.e. Q value of 5). In the most recent monitoring period (2013-2015) only 21 sites were classified as the highest quality rivers (0.7% of sites) compared with 575 between 1987 and 1990 and 82 between 2001 and 2003. This is an area where substantial effort is required to protect the few remaining highest quality rivers and, where feasible, return impacted ones back to their earlier extremely high quality.

Further assessment is required to determine the overall status of river waters to take account of all other elements including other biological, chemical ones. This full assessment will be provided in the next water quality in Ireland report (covering 2013 to 2015).

2 *www.eea.europa.eu/themes/water*

Figure 5.4 Trends in the 13,300km Baseline for Rivers Nationally in the Four EPA Biological Quality Classes Based on the Macroinvertebrate Q Value Method Results (Source: EPA, 2016a)

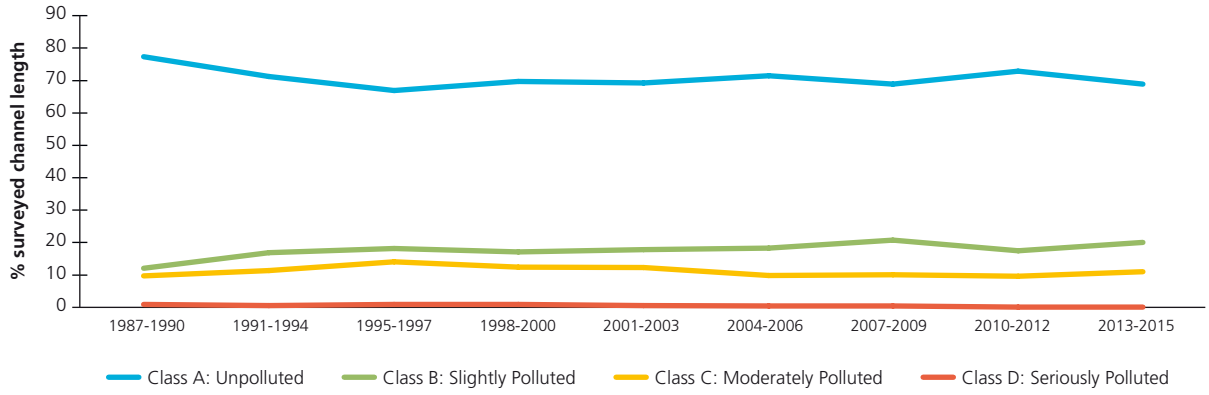
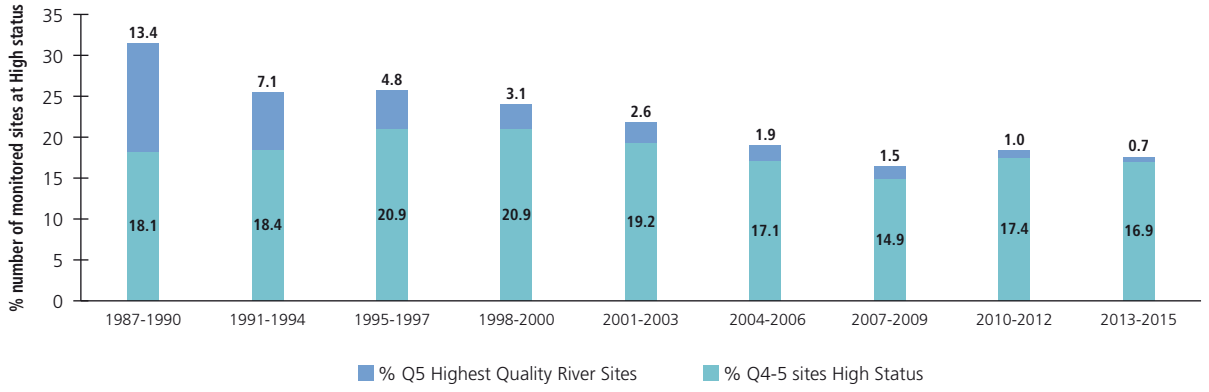


Figure 5.5 Long Term Trends (1987-2015) in the Percentage Number of High Ecological Quality (Macroinvertebrate) River Sites (Q5 and Q4-5) in Each Survey Period (Source: EPA, 2016a)



Transitional (Estuarine) and Coastal Waters

Ecological assessment covering the period between 2010 and 2015 indicate little change in the quality of our transitional (estuarine) and coastal waters.

Preliminary results from a full 6-year ecological status assessment covering the period between 2010 and 2015 indicate little change in the quality of our transitional (estuarine) and coastal waters. A preliminary assessment using information from all transitional and coastal monitored water bodies was used to extrapolate the results to unmonitored ones. For coastal waters, the number of water bodies at High or Good status has increased from 68% in 2012 to 76% in 2015 due to the recovery of certain water bodies from algal bloom impacts. In terms of surface area assessed there has been no change with 93% of coastal water area at high or good status. In transitional waters, 47% of water bodies remain at moderate or worse status which is the same as was found during the last assessment.

Lakes

An increase of 3% in the moderate or worse category for lakes.

Preliminary results for 2013-2015 water status assessment show 54% of monitored lakes are impacted (moderate or worse ecological status) (EPA, 2016a). This represents an increase of 3% in the moderate or worse category for lakes compared with the baseline of 2007-2009.

Groundwater

Only 1% of groundwater bodies have poor chemical status because of elevated phosphorus levels or historical contamination from mining activities and industrial development (EPA, 2015b).

Overview of Water Quality Findings

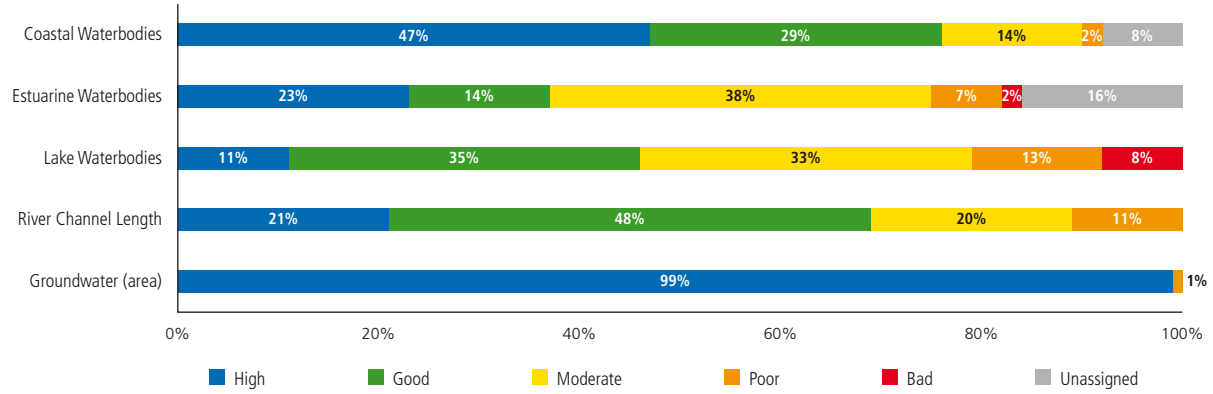
Elevated nutrient concentrations (phosphorus and nitrogen) continue to be the most widespread water quality problem in Ireland, arising primarily from human activities such as agriculture and waste water discharges to water from human settlements, including towns, villages and rural houses. The level of pollution from hazardous substances is low.

In summary, based on preliminary analysis of the most recent datasets, there has been no improvement in river water quality (based on Q values) or transitional and coastal water quality over the past six years (Figure 5.6). Lake water quality has gotten slightly worse with a 3% reduction in the number of monitored lakes at satisfactory status. While a full WFD assessment will not be available until later in 2016 it is clear that insufficient progress is being made with improving Ireland's surface water quality.

Preliminary results for 2013-2015 and other key findings in the EPA water quality report (2010-2012) were:

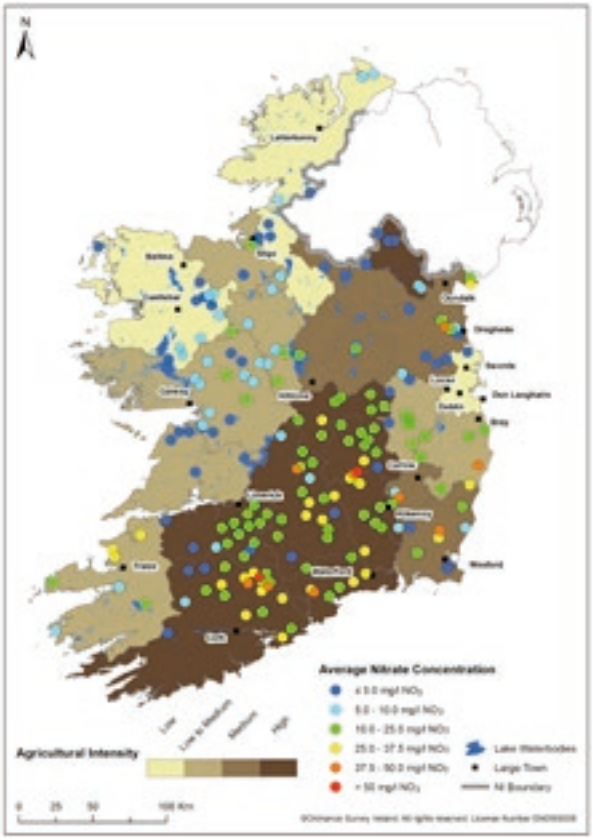
- There has been a gradual decline in high-status river sites across Ireland. Numbers halved in the 22-year period between 1987 and 2015 (Figure 5.5) with the most dramatic losses occurring in the highest quality sites (Q5 sites). These sites represent the best-quality rivers across Ireland, and therefore their continuing loss is a very significant concern.
- Seriously pollution of rivers has fallen to just over 6 km compared to 17 km in 2010-2012 and 53 km 2007-2009.
- Reported fish kills have declined to an all-time low of 70 between 2010 and 2012 (EPA, 2015b).
- Water quality in canals remains very high, with over 90% of canals rated satisfactory in 2012.
- The south and south-east of the country continue to have the largest proportion of groundwater and rivers with elevated nitrate concentrations over 10 mg/l NO_3. This contributes to eutrophication in certain downstream estuaries.
- In 2012, 18% of monitored rivers and 27% of monitored lakes were less than good status due to fish status. Preliminary assessment suggests that barriers to fish migration and physical deterioration of habitats may be partly to blame.
- In 35% of designated shellfish waters with elevated faecal contamination, additional measures to improve quality and achieve higher objectives are required.

Figure 5.6 Water Assessment for Rivers, Lakes, Estuaries Coastal Waters (2013-2015) and Groundwater (2010-2012)[3] (Source: EPA, 2016a)



3 For this figure river water quality is solely based on Q values. Lake data only covers monitored lakes.

Figure 5.7 Nitrate Concentrations in Groundwater in 2014 (Source: EPA, 2016b)



A recent assessment found that there continues to be a very clear spatial pattern of elevated nitrate and phosphorus concentrations in groundwater (Figure 5.7), rivers, lakes and estuarine waters, giving rise to water quality problems across Ireland (EPA, 2016b). Concentrations of both nitrate and phosphorus tend to be elevated in the north-east, south-east and south of the country and lower towards the west, north-west and south-west. There is a clear correlation between the areas with the highest nitrate and phosphorus concentrations in waters and areas with the most intensive agriculture and highest human population densities.

Drivers and Pressures

Eutrophication

Eutrophication caused by excessive nutrients is the main threat to the quality of our waters.

Eutrophication, which is caused by nutrient enrichment, remains the most significant issue for surface waters. Excessive nutrient concentrations can lead to eutrophication impacts, including accelerated growth of algae and plants, leading to ecological impacts in rivers, lakes and marine waters, such as reduced oxygen levels and loss of sensitive aquatic species. Phosphorus tends to drive eutrophication impacts in freshwaters, while nitrogen tends to drive eutrophication impacts in coastal waters, although there are exceptions. Eutrophication remains the most significant pollution issue for surface waters in Ireland.

Excessive loads of nitrogen and phosphorus can arise from a number of sources. The two most important suspected causes of pollution in rivers are agriculture and municipal sources, accounting for 53% and 34% of cases, respectively (EPA, 2015b).

Levels of nitrogen and phosphorus in groundwater and rivers have been mostly stable and decreasing since 2007. Riverine inputs to transitional waters and coastal waters have also shown declines. Nutrient inputs to rivers, particularly from the agriculture sector, have fallen: nitrogen levels have fallen by 18.7% and phosphorus levels by 37.7%. Anticipated increases in pressures due to human population growth and increase in agricultural output will need to be carefully managed to build on these trends.

Threats to Improving Water Quality

Improvements in water quality will not be seen if agricultural pressures are not adequately managed.

The ongoing and planned expansion in the agricultural sector under Food Harvest 2020[4] and its successor, Food Wise 2025,[5] may threaten improvements in water quality, if not adequately managed. The dairy sector has been set a target of increasing milk production by 50% by 2020. Under the expansion plans, increased application of nitrogen and phosphorus to agricultural land is likely to happen in areas of the country where the concentrations of these nutrients in water are already elevated. The challenge is to target management measures to prevent any increases in nitrate and phosphorus concentrations in waters. Both Food Harvest 2020 and Food Wise 2025 acknowledge that there is a risk to water quality if the expansion of agricultural sector is not managed in a sustainable manner.

Urban Waste Water

Our treatment of sewage and industrial waste water (water that is discharged to sewers) continues to be one of the principal pressures on water quality in Ireland.

A recent report found that urban waste water continues to be one of the principal pressures on water quality in Ireland (EPA, 2015a). With regard to the impact of receiving waters, the number of seriously polluted river sites where pollution is attributed to urban waste water discharges fell from nine in 2009 to one in 2014. Of the total number of incidents reported to the EPA, 72% related to breaches of discharge quality standards. 42% of these incidents were attributed to insufficient treatment capacity and 21% of incidents were attributed to operational and management practices. Raw sewage discharges from 45 urban areas were highlighted as a priority issue to be eliminated by 2019. By the end of 2015 the number of raw sewage discharges was reduced to 43 locations. The report concluded that continued investment in infrastructure and a reversal in the recent decline in capital expenditure are essential to provide the waste water treatment necessary to protect receiving waters and meet obligations under EPA authorisations and European Directives. Waste water discharges also contributed to poor water quality at 6 of Ireland's 137 identified bathing waters (EPA, 2016c).

Inland Fisheries Issues

Fisheries resources deliver economic and social benefits to the Irish economy.

Despite the ever-increasing pressures on our fisheries, Ireland still possesses a wealth of inland and sea fisheries resources. Apart from their innate value, these fisheries resources also deliver economic and social benefits to the Irish economy in the form of job creation, social inclusion and tourism revenue. Recreational angling in Ireland is estimated to contribute approximately €836 million to the Irish economy every year (Inland Fisheries Ireland, 2015).

The long-term conservation of our national fisheries resources requires the maintenance of healthy and ecologically viable ecosystems. There are a number of key concerns that are undermining the ecological integrity of water bodies and the national fisheries resources (King *et al.*, 2011). These include poor water quality, barriers to fish migration (particularly for a number of protected species), land management practices causing adverse physical changes to fisheries habitat (instream and bankside), changes in the quantity and dynamics of water flow caused by flow regulation and abstraction, invasive alien species that impact on native fish populations and the collapse of eel populations seen across Europe.

Marine Litter

Not only does litter spoil the beauty of our coastlines but the impact on marine life can be far more serious and insidious.

While marine litter can have a very obvious impact on the aesthetic quality of coastal amenities, the impact on marine life can be far more serious and insidious. It is estimated that plastic litter kills an estimated 100,000 marine mammals and turtles worldwide every year, including 30,000 seals, and up to one million seabirds, through either entanglement or ingestion. Litter on the Irish coast comes from a variety of sources, both land and sea.

The Department of Housing, Planning, Community and Local Government undertakes an annual longitudinal litter survey at four locations, four times every year in accordance with OSPAR methodology. Marine litter is one of the descriptors (10/11) to prove Good Environmental Status (GES) in the Marine Strategy Framework Directive (MSFD) (2008/56/EC).

According to the latest OSPAR annual report (OSPAR, 2015), over 16 beach surveys have shown no improvement in litter levels over previous years. Details of historical surveys can be viewed on the OSPAR Marine Litter Database.[6] Tackling marine litter requires an integrated response, but key to this will be solutions governing waste management practices. This is covered in more detail in Chapter 6.

4 *www.agriculture.gov.ie/publications/2011/annualreviewandoutlookforagriculturefisheriesandfood20102011/nationaldevelopments/foodharvest2020/*

5 *www.agriculture.gov.ie/foodwise2025/*

6 *www.mcsuk.org/ospar/*

Dredging of Marine Harbours and Marinas

Material that is dredged and dumped at sea has to be licensed and monitored.

The removal of seabed material for maintenance and navigational purposes is a common occurrence in harbours and marinas around Ireland. In 2013, approximately 350,000 tonnes (dry weight) of material was dredged and deposited at four licensed disposal sites around the Irish coast (OSPAR, 2015). As part of the licensing process, sediment chemistry of dredged material must be analysed to ensure that release of harmful contaminants at the disposal site is minimised. The quantity of dredged material dumped at sea each year is reported to the OSPAR Commission by the Marine Institute.

Marine Fisheries and Aquaculture

An important sector for the economy in Ireland, but there are a number of key environmental pressures to resolve to ensure sustainability.

In 2014, the value of commercial fish and shellfish landings was just under €346 million, with landings of demersal (bottom feeders) and pelagic (openwater feeders) species contributing just over €250 million of the total (Source: SFPA[7]). In the aquaculture sector, the value of production in 2014 was €116 million; this is less than the peak value of €131 million achieved in 2012.

The most obvious pressure on the environment from fishing is the harvesting of target species and the unintentional catching of non-target fish species and other species such as cetaceans, seals, seabirds and benthic organisms. Fishing activities such as trawling and dredging can injure or kill benthic organisms and can result in damage to and destruction of habitats.

The main issues in relation to aquaculture are the effects of discharges of uneaten fish-food material and fish waste from fish farms, the introduction and spread of disease and parasites and the use of chemotherapeutics and anti-fouling agents. Other issues include the introduction of alien species, the impact of escaped farmed salmon on the genetic integrity of wild stocks and the visual impact of aquaculture facilities on the aesthetic quality of the environment.

Impacts of Commercial Fishing

It is estimated that 36% of commercial fish stocks are sustainably fished, but 26% of stocks are overfished.

Fishing impacts are assessed every year in the Marine Institute's annual Stock Book.[8] This collates information on fishing pressures and the biological state of commercially exploited species.

The 2015 Stock Book reports that, of 72 commercial stocks, 36% are considered to be sustainably fished. Overfished stocks have declined to 26%, and 38% remain at an unknown status. Nineteen per cent of commercial species are considered to have been depleted.

The International Council for the Exploration of the Seas (ICES) recently published (Source ICES, 2016[9]) an ecosystem overview of the Celtic Sea, which includes a large part of the Irish Exclusive Economic Zone (EEZ) (see Figure 5.1). It found that:

- Overall fishing pressure on the commercial fish and shellfish stocks in the Celtic Sea ecoregion has decreased since its peak in 1998.
- Overall biomass of commercial fish and shellfish stocks in the Celtic Sea has increased since the late 1990s.
- The fishing footprint and the average number of times the seabed is trawled per year have reduced.

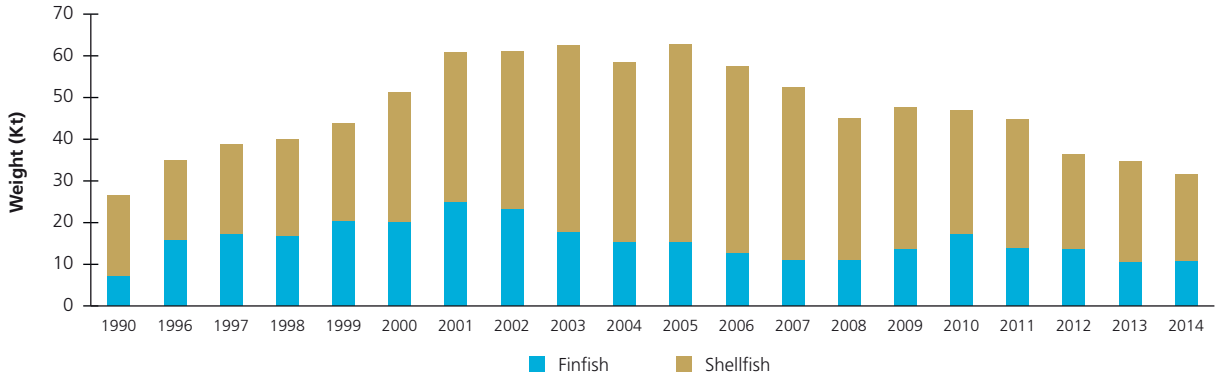
However, there are still a number of species with very low spawning stocks in some areas, particularly cod, whiting, sole and herring. According to the ICES ecosystem overview: "Several fish species have been depleted by fishing in the past and are now on the OSPAR list of threatened and declining species, including spurdog *Squallus acanthias*, common skate complex *Dipturus* spp., angel shark *Squatina squatina*, porbeagle *Lamna nasus*,

7 *www.sfpa.ie/Sea-FisheriesConservation/FisheriesStatisticsandQuotaUptake/AnnualLandingStatistics.aspx*

8 *oar.marine.ie/handle/10793/1121*

9 *www.ices.dk/sites/pub/Publication%20Reports/Advice/2016/2016/Celtic_Sea_Ecoregion-Ecosystem_overview.pdf*

Figure 5.8 Aquaculture Production Between 1990 and 2014 (Source: BIM)



and some deep-water sharks. Although there are zero Total Allowable Catches or prohibited listings for these species, several of them remain vulnerable to existing fisheries."

Sea Fishing By-catch

New controls are in place to try to end the practice of discarding fish back into the sea.

The landing obligation was introduced under the Common Fisheries Policy (CFP) to try to end the practice of discarding fish back into the sea if they are too small or are not the targeted species or if the fisherman had no quota for them. This was put in place for pelagic species in 2015 and, since January 2016, this obligation is being phased in for certain demersal fisheries, including Norway lobster (Nephrops), hake, cod, haddock, whiting and saithe, common sole and plaice, each subject to catch limits.

Once a stock falls under the landing obligation, all catches must be landed and counted against quota. Catches of fish below minimum size cannot be sold for direct human consumption, but may be sold for other purposes, such as bait or fish meal, and are still deducted from quota. Here the intention is to discourage the catches of such fish in the first instance through improved selectivity or avoidance.

Impacts of Marine Aquaculture

Protecting wild fisheries and preventing pollution of the seafloor and associated impacts on benthic communities near fish cages are two key environmental challenges facing the sector.

In 2014, aquaculture production of shellfish and finfish species was 34,469 tonnes and had a value of €116 million (Source: BIM[10]). Ongoing development and an increase in production are key parts of the Food Harvest 2020[11] strategy, and potential increases in aquaculture production volumes of 78% have been estimated. Inputs to the aquatic environment associated with this industry include feedstuffs, veterinary medicines and anti-fouling agents. A certain portion of these may be lost to the waters and sediments in the vicinity of the fish farms.

One of the most contentious issues in relation to the aquaculture of salmonids is the suggested link between the production of sea lice (*Lepeophtheirus salmonis*) on fish farms and the decline in wild sea trout populations in the west of Ireland. Research carried out in Ireland and Scotland suggests that sea lice from salmon farms are a major contributory factor in the collapse of wild sea trout populations (McKibben and Hay, 2002; Penstan *et al.*, 2002; Gargan *et al.*, 2003).

The initiation of sea lice monitoring and the adoption of a number of measures (e.g. annual fallowing of sites, synchronous treatment) based on a single bay management (SBM) approach saw an initial downwards trend in the levels of sea lice on salmon farms between 1991 and 2001. This trend was reversed between 2002 and 2007, before levels declined sharply again between 2008 and 2013, with lice levels in 2013 being the lowest on record (O'Donoghoe *et al.*, 2015). In 2014, levels increased substantially, but it is not possible to comment on the significance of an increase based on the findings in just one year.

The release of organic material in the form of fish waste and uneaten foodstuffs from fish farms in shallow-water environments has been shown to have an impact on the benthos in the vicinity of cage structures. While low levels of organic loading can encourage increased benthic productivity, the high levels associated with fish farming can result in reduced biodiversity and a proliferation of bacterial growth. Increased bacterial activity can lead

10 *www.bim.ie/media/bim/content/publications/BIM%20Aquaculture%20Survey%202014.pdf*

11 *www.agriculture.gov.ie/publications/2011/annualreviewandoutlookforagriculturefisheriesandfood20102011/nationaldevelopments/foodharvest2020/*

to hypoxic (low oxygen) or even anoxic (no oxygen) conditions directly below the cages. Of the licensed marine finfish sites surveyed during 2012, 2013 and 2014, 79%, 88% and 66%, respectively, were considered compliant with the environmental standards identified in the benthic monitoring protocol[12] for the status of the seafloor and benthic communities in the vicinity of finfish operations (F. O'Beirn, Marine Institute, June 2016, personal communication).

Responses

River Catchment Planning

Implementation of locally based river catchment planning is the key to protecting water quality.

A key theme identified by the Blueprint to Safeguard Europe's Water Resources was the need for those responsible for managing water resources to improve governance (EC, 2012). There is general acceptance that the governance arrangements put in place in Ireland to deliver the first cycle of RBMPs were not effective. Arrangements were overly complex and responsibilities were poorly defined, with no single body having overall responsibility for developing the plans and overseeing delivery of the programmes of measures.

This has been remedied by a new three-tier governance structure[13] (Figure 5.9), the merging of the River Basin Districts through legislation to form one national River Basin District and a single national approach for the development of RBMPs for the second cycle (Figure 5.10). In relation to the North Western and Neagh Bann International River Basin Districts, a single administrative area is being established in the south for the purpose of co-ordinating water management with authorities in Northern Ireland. A Local Authority Water & Community Office (LAWCO) has now been established operating from three regional locations. Key to delivery is a focus on local level action centred on catchments.

Underpinning the new water governance arrangements for managing water is the integrated catchment management approach, which complements the river basin planning process. It approaches sustainable resource management from a catchment perspective, in contrast to a piecemeal approach that artificially separates land management from water management. Other supporting initiatives include the establishment of a National Implementation Group, a Water Policy Advisory Committee and a Catchment Management Network to promote information sharing and collaboration across all organisational bodies and consistent implementation of the plans.

Figure 5.9 New Governance Structure for Managing Water Resource in Ireland[14]

Tier 1: National Management and Oversight

- Led by the Department of Housing, Planning, Community and Local Government
- Policy, regulations and resources
- Sign-off of River Basin Management Plans

Tier 2: National Technical Implementation and Reporting

- Led by EPA
- Monitoring, assessment and reporting
- Evaluation and implementation of measures
- Template for River Basin Management Plans
- Monitoring of enforcement tasks and environmental outcomes

Tier 3: Regional Implementation via Water Networks

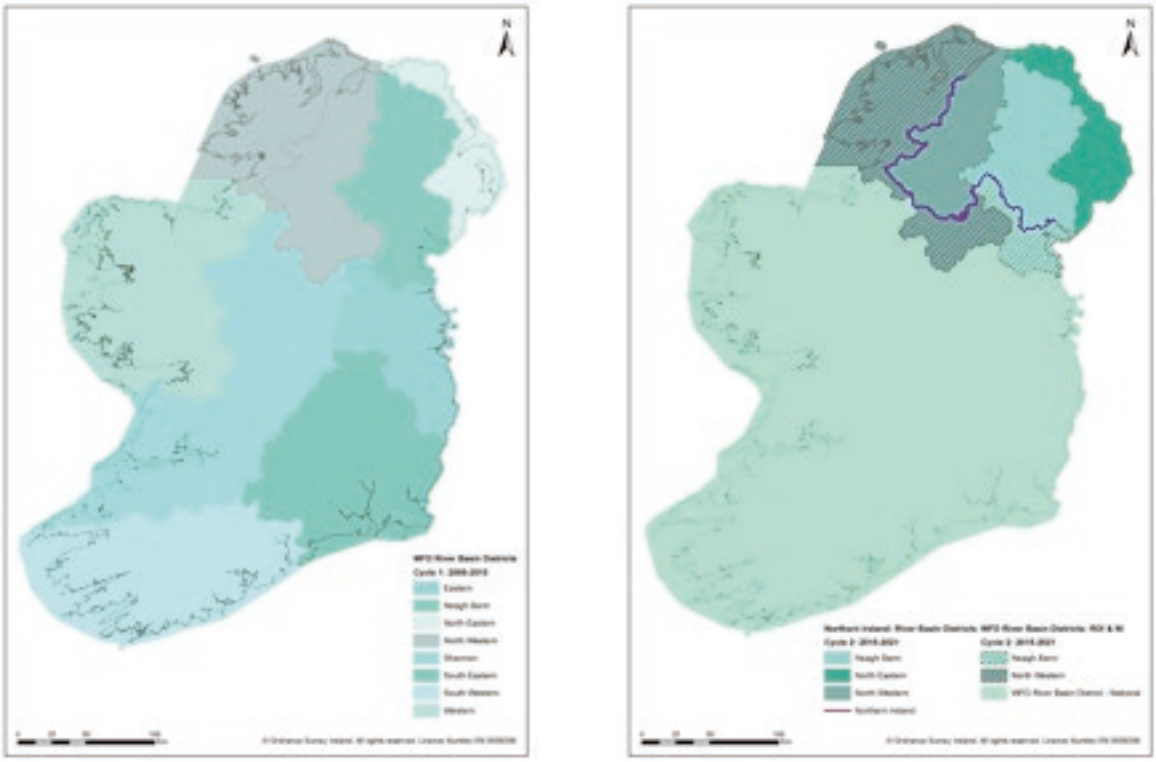
- Led by the lead Coordinating Authority
- Local authority monitoring, licensing and enforcement actions
- Detailed River Basin Management Plans
- Implementation of Programme of Measures by relevant public bodies, tracking and reporting, in consultation with EPA

12 *www.agriculture.gov.ie/media/migration/seafood/aquacultureforeshoremanagement/marinefinfishprotocols/Benthic%20Monitoring.pdf*

13 The Minister for Housing, Planning, Community and Local Government has now established a new three-tier governance structure, the basis of which is set out in statute in the European Union (Water Policy) Regulations 2014 (SI 350 of 2015).

14 Environ.ie – *www.environ.ie/water/water-quality/water-framework-directive/water-framework-directive*

Figure 5.10 Changes in the Number of River Basin Districts in the Republic of Ireland Between (a) Cycle 1 (2009-2015) and (b) Cycle 2 (2016-2021) (Source: EPA)



Tackling Diffuse Pollution

Diffuse Pollution

Diffuse pollution is pollution that arises from a variety of non-point sources.

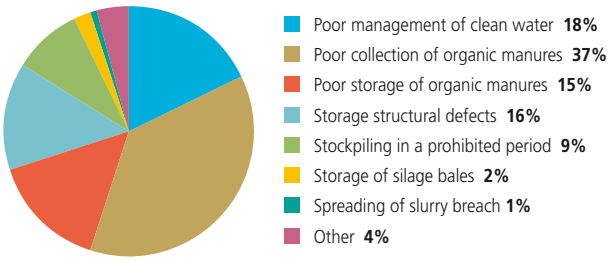
Diffuse pollution occurs when potentially polluting substances leach into surface waters and groundwater as a result of rainfall, soil infiltration and surface runoff. The source of this pollution, usually a result of recent or past activity on land, is the widespread input of diverse types of contaminants. Typical examples of diffuse pollution include the use of fertiliser in agriculture and forestry, pesticides from a wide range of land uses, contaminants from roads and paved areas and atmospheric deposition of contaminants arising from industry.

Agriculture

Farm inspections highlight key areas in need of improvement to protect water quality.

In 2012, 53% of suspected cases of pollution in rivers were attributed to agriculture (EPA, 2015b). Farm inspections carried out by, or on behalf of, local authorities under the good agricultural practices regulations have fluctuated around 3500 per year between 2007 and 2014. Among farms selected for inspection based on risk, over 30% each year were found to have breached the good agricultural practice regulations. In comparison, a random sample found breaches in between 18% and 21% over this period. Of the breaches found in 2014, 52% were due to the poor management of livestock manures and other organic fertilisers (Figure 5.11), while 16% were due to manure storage structural defects. Based on these figures, there is clearly room for improvement in the management of manures and organic fertilisers on a significant proportion of farms. A further 18% of breaches were simply due to poor management of clean waters. Many of these issues can be solved by reasonably straightforward changes in the management of farmyards.

Figure 5.11 Reasons for Breaches of The Good Agricultural Practices Regulations in 2014 (Source: Agricultural Inspections Working Group)



Assessing the Impact of Cattle Access to Streams

Cattle access to riparian areas and watercourses is often considered a pressure which can increase both nutrient and sediment input to streams (Figure 5.12). There is increasing evidence that siltation of river beds is a significant contributor to deterioration in the ecology of rivers in Ireland. Fenced riparian buffer measures to exclude cattle have been included in most European Agri-Environmental Schemes, including the Green Low-Carbon Agri-Environment Scheme (GLAS) in Ireland (see below). However, although riparian mitigation measures (including fencing) are commonly implemented, few studies have evaluated their effectiveness. The EPA has commissioned the research project Cosaint to investigate the issue. The aim of this project is to assess the environmental, ecological and socio-economic impact of existing and potential measures that prevent cattle access to watercourses.

The Agricultural Catchments Programme (ACP)[15] led by Teagasc has been operating since 2007. Its purpose is to provide a scientific evaluation of the effectiveness of the EU Nitrates Directive National Action Programme measures and underpin the basis for any modifications of the measures that might be required to achieve water quality objectives. It will continue to run at least until 2019.

Rural Development Programmes

Rural development programmes are an important means to address specific water protection issues.

Three schemes or initiatives with the potential to contribute to the protection and enhancement of water quality are the new national agri-environmental scheme, GLAS,[16] the new national LEADER initiative (2014-2020) for the protection and sustainable use of water resources and the planned introduction of Locally Led Agri-Environment Schemes (LLAES).

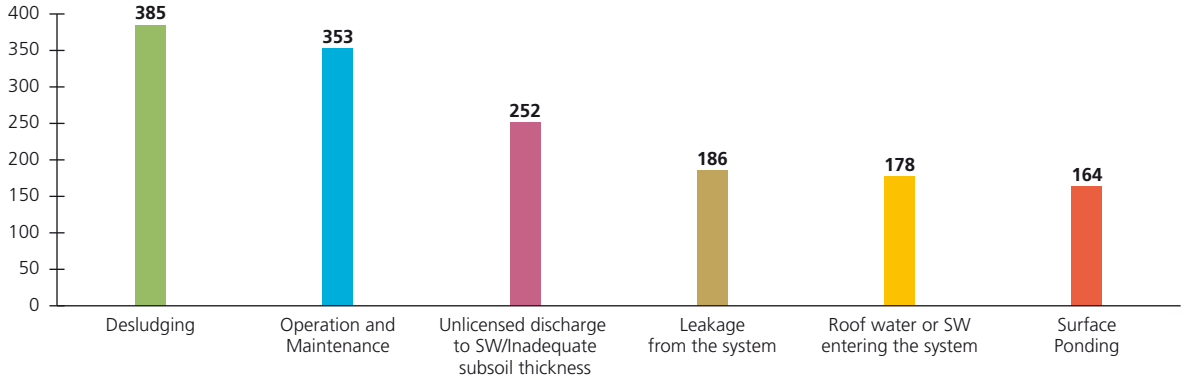
GLAS promotes agricultural actions which introduce or continue to apply agricultural production methods that aim to address issues including water quality (Chapter 12). Key to its design is the identification of a number of Priority Environmental Assets (PEAs), including high-quality watercourses. The presence of one or more of these assets on any farm guarantees priority access to the new scheme but, in return, all required actions to protect and enhance these assets must be undertaken.

LEADER is a method of mobilising and delivering rural development in local rural communities. LEADER uses a bottom-up or community-led local development approach to rural development. One of the LLAES under consideration is for the protection of designated freshwater pearl mussel populations, which are under significant threat.

15 *www.teagasc.ie/agcatchments/*

16 Green Low Carbon Agri Environment Scheme

Figure 5.12 Reasons for Failures of Inspections of Domestic Waste Water Treatment Systems (July 2013 to December 2014) (Source: EPA)



Domestic Waste Water Treatment Systems

A national inspection programme for septic tanks highlights room for significant improvement in how people manage domestic waste water treatment systems.

Following the introduction of legislation dealing with the registration and inspection of septic tanks in 2012 a national inspection plan has been implemented [Water Services (Amendment) Act, 2012]. By the end of 2014, a total of 1,559 inspections had been carried out (EPA, 2015c). One of the main findings from the inspections is the lack of general routine maintenance of systems. The low level of de-sludging of tanks and issues surrounding the operation and maintenance of systems were the main reasons for inspection failures (Figure 5.12). A reversal of this trend in many cases requires simple actions by homeowners rather than a structural change to the waste water treatment system. Of relevance to water protection is that 16% of all systems inspected failed because either they were unlicensed discharges to surface water or because they had inadequate soil thickness for attenuating pollutants. These types of situations are difficult and/or expensive to correct.

Tackling Point Source Pollution

Urban Waste Water Treatment

Despite ongoing improvements in urban waste water treatment plants and the effluent discharged is not up to standard in many locations.

Waste water must be treated prior to being released back into the environment in order to remove contaminants that could otherwise pose a risk to the environment or public health. The EU Urban Waste Water Treatment Directive of 1991 (91/271/EEC) sets out requirements for the collection, treatment and discharge of urban waste water, with the objective of protecting the environment from the adverse effects of waste water discharges.

The EPA is the environmental regulator responsible for the licensing, authorisation and enforcement of urban waste water discharges. The EPA has issued over 1,000 waste water discharge authorisations to date[17]. Irish Water/Uisce Éireann is the national water utility responsible for the provision and development of water services, including the collection, treatment and discharge of urban waste water. These responsibilities, together with duties to comply with the requirements of all waste water discharge authorisations issued by the EPA, were transferred from the local authorities to Irish Water at the beginning of 2014.

17 EPA Licence or Permit Document Search Facility: EPA: Environmental Protection Agency, Ireland

In 2014, a total of 12 (7%) large urban areas did not meet the Urban Waste Water Treatment Directive requirement to provide secondary (biological) treatment (EPA, 2015a). Seven large urban areas did not comply with the Directive's requirement to provide infrastructure to reduce nutrients and discharged effluent that did not meet nutrient quality standards. Untreated sewage was discharged from 45 areas, mostly estuaries or coastal areas. Twenty-seven of these are located in counties Cork, Donegal and Galway. Three of these raw sewage discharges were treated by the end of 2015, but one extra location was added to the list. In terms of effluent quality, 143 (82%) large urban areas complied with the mandatory EU effluent quality and sampling standards. Just 24% of the waste water load discharged into sensitive areas from large towns and cities complied with mandatory EU nutrient quality standards, up from 17.5% in 2013. This is well below the EU average of 88% compliance for nutrients (EC, 2016). Dublin and Cork were the major contributors to this low rate of compliance.

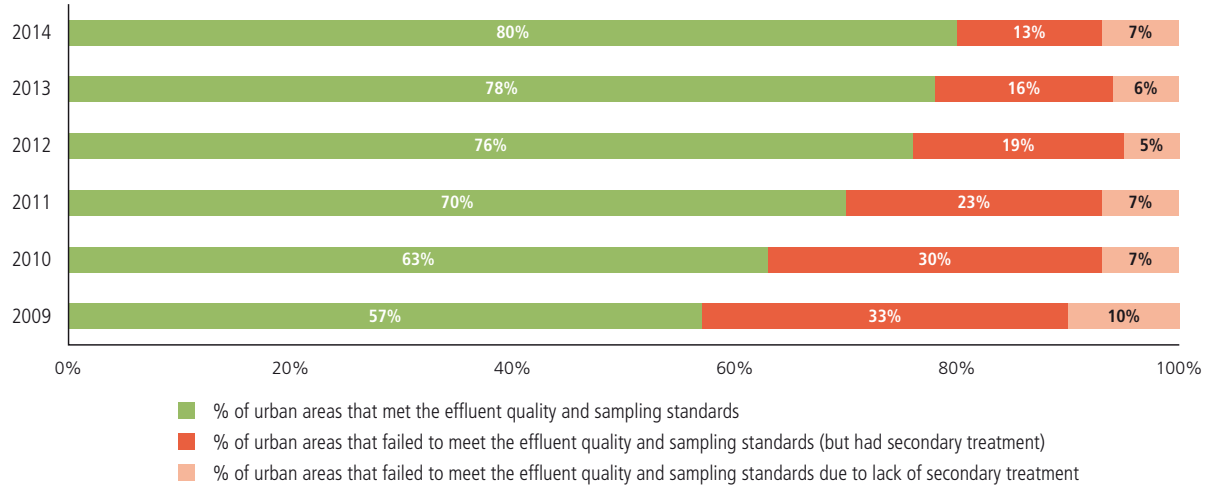
Although BOD (biological oxygen demand), COD (chemical oxygen demand) and TSS (total suspended solids) are still far from compliance with effluent quality and sampling standards in the Directive, the recent trend of improving compliance continued in 2014, as illustrated in Figure 5.13, which shows national compliance rates at large urban areas for the years 2009 to 2014.

When the performance of waste treatment plants is examined, it is apparent that treatment of waste water at coastal and estuarine locations needs improvement, as investment in these areas has lagged behind discharges to freshwater surface waters. Updated data for 2015 shows that 36 of the urban areas discharging untreated sewage and 10 large towns or cities (with some type of treatment) that failed the Directive's effluent quality standards discharge to estuarine or coastal locations (EPA, 2016d).

EPA Water Research Programme

The EPA Water Research programme has a strong focus on policy and has been driven by national regulations and European directives. A sustained Water Research Programme is an essential component of Ireland's role in protecting its water resources and meeting its

Figure 5.13 Compliance of 174 Large Urban Areas with BOD, COD and TSS (Source: EPA)



requirements under water-related EU directives and national policies. The EPA has funded over 100 research projects with a total commitment of approximately €20 million for 2007-2015 under its Water Research Pillar, which covers groundwater, surface water, and transitional and coastal water, as well as waste water, drinking water, bathing water and shellfish waters.

Ireland is funding emerging policy and implementation research in relation to the WFD, as well as marine research, to support the formulation and implementation of policies. More details are available online on the EPA website.[18]

Key Achievements

- Novel methodologies have been developed for the characterisation of water bodies in accordance with the WFD and determination of reference baseline conditions.
- Ireland's Ocean Noise Register and the related monitoring protocol have been established.
- Scientific data have been provided to support appropriate measures or actions for use in the implementation of national policy for reducing phosphorus and nitrogen losses to waters from agricultural sources.
- A state-of-the-art experimental waste water treatment plant at Tuam, Co. Galway, has been established through EPA funding with the co-operation of the National University of Ireland, Galway and Galway County Council. The facility is advancing the development of environmental protection measures nationally and facilitating the testing of novel technologies and practice-based training and education.
- Increased knowledge on the transport and attenuation of pollutants through the landscape (PATHWAYS project) has led to the development of Catchment Support Management Tools (CSMTs), which are now informing the second cycle of WFD characterisation of water bodies and the tailoring of appropriate programmes of measures.
- A national Water Research Coordination Group has been established, with the aim of enhancing synergies and collaboration with other national funders and avoiding duplication.
- An output from this inter-agency collaboration is the DROPLET interactive interface, which provides a database of water-related research funded nationally (i.e. covering awards from other agencies).
- The EPA co-chairs the prestigious EU Joint Programme Initiative on Water "Challenges for a Changing World" and has been successful in three project applications with our European partners in the past 3 years.[19]

18 *www.epa.ie/researchandeducation/research/researchpillars/water/*

19 *www.waterjpi.eu*

Outlook

Progress with Water Framework Targets

The slow progress in improving the ecological status of surface waters means that new approaches are needed.

The target of 13.6% improvement in ecological status for surface waters from the 2009 baseline by 2015 included in the first cycle RBMPs has not been achieved (EPA, 2015b, 2016a). Instead, the overall situation has not changed during the first river basin planning cycle. A radically different approach is required to target management measures to where they are needed. There is an opportunity to improve implementation under the new water governance structures recently put in place and by using the integrated catchment management approach supported by better evidence and science.

Agricultural Policy and Water Protection

It is doubtful whether current agricultural initiatives will offer the solutions needed unless adjustments are made.

The reform of the Common Agricultural Policy (CAP), particularly the greening aspect and link to payments, is welcome. However, there has been some criticism that the policy proposals from the Commission were weakened extensively during negotiations and do not effectively meet the standards necessary to combat environmental degradation by the agricultural sector (Hart *et al*., 2016). The effectiveness of the reform will need to be monitored and further reform may be necessary following the next review.

The national farm inspection regime is currently focussed on the farmyard. However, a significant proportion of pollution can arise from agricultural land. The new risk-based approach to identifying potential Critical Source Areas (CSA) of pollution, which is being promoted by the EPA, will greatly assist in focusing management measures where they will be most effective. This will be particularly critical to ensuring that agricultural expansion plans under Food Wise 2025 are achieved in an environmentally sustainable manner and not at the expense of water quality.

The National Action Programme under the Nitrates Directive is due to be reviewed again in 2017. This will provide an opportunity to evaluate the need to amend existing farm management measures under the programme. Critical inputs to informing this review will come from, among others, the ACP led by Teagasc, the environmental risk assessments currently being undertaken and led by the EPA and the findings of the Cosaint research project investigating the impact of cattle access to waters.

Local Community Initiatives

Community involvement has the potential to contribute significantly towards effective catchment management.

The approach to catchment management to date has consisted largely of top-down regulation. To deliver significant improvements in the condition of waters it will be important to generate and harness bottom-up community involvement and ownership of the environmental issues, for example through the formation of River Trusts. The Sustainable Water Network (SWAN) has called for action at local level as well as a stakeholder forum at national level – a National Stakeholder Forum that would facilitate policy input.[20] Funding available under the new sub-theme "Protection and Sustainable use of Water Resources" under LEADER will potentially provide one valuable means of kick-starting communities to initiate local catchment projects. Local authorities in the context of their revised role in the new water governance arrangements are tasked with providing support and advice to communities through a team of water community officers to be established in 2016.

Local community initiatives, with the support of the LAWCO, have the potential to tackle threats to water protection and restoration more effectively by examining the risks and developing tailored solutions at a local level.

Domestic Waste Water

Initiatives to improve the stock of septic tanks and sludge management need to continue.

A recent research project highlighted the management of domestic waste water sludge and, in particular, the inadequate infrastructural provision as significant issues of concern (EPA, 2014b). These issues need to be addressed by policymakers and in Irish Water's Capital Investment Programme, through its Water Services Strategic Plan and the Strategic Sludge Management Plan.

Urban Waste Water

Investment and operational improvements in urban waste water are needed.

With regard to the auditing and monitoring of urban waste water discharges, the EPA carried out over 300 audits and found that a programme for maintenance and operation of all plant and equipment was not in place in 26 of the areas audited. The EPA also conducted independent effluent monitoring at 263 treatment plants, and found that 71 failed to comply with effluent quality standards set in EPA licences. Clearly, in order to protect water quality, improvements in these areas are needed, as well as in the more obvious areas where raw sewage is being discharged without treatment.

20 *www.swanireland.ie/download/SWMI%20consultation%20SWAN%20Response.pdf*

Environmental Quality Standards for Hazardous Substances

Targeted investigative monitoring is needed to detect hazardous substances which may be of concern in the aquatic environment.

Overall, the level of non-compliance with Environmental Quality Standards for hazardous substances (e.g. pesticides, endocrine disrupters and other synthetic chemicals) is low in groundwater, rivers, lakes, estuarine and coastal waters apart from two ubiquitous persistent, bioaccumulative and toxic substances (PBTs) (mercury and PAHs) (EPA, 2015b). A number of pesticides, including Mecoprop, MCPA and 2,4-D, have also been detected at low levels in a significant number of rivers (26–56%) during routine monitoring. These require further investigation to establish and eliminate the source. Further candidate priority substances/priority hazardous substances are currently being considered in a review at EU level including a number of pharmaceuticals. The likely presence and level of these substances in Irish waters needs to be established.

Marine Waters

Key Developments for the Protection of Marine Waters include the implementation of the Marine Strategy Framework Directive

The Marine Strategy Framework Directive, in conjunction with the WFD in estuaries and near-shore coastal waters, is the main legal instrument in place to ensure that the marine environment is sufficiently protected and the ecosystem goods and services provided by the marine environment are being used sustainably. This Directive aims to achieve good ecological status (GES) of the EU's marine waters by 2020 and to protect the resources on which marine-related economic and social activities depend. In order to achieve GES by 2020, each Member State is required to develop a strategy for its marine waters. As mentioned in the Chapter 4, there is room for further co-ordination between the water directives (WFD, MSFD and Floods Directive) and the directives that protect biodiversity.

In terms of implementation, Ireland has already reported on the state of the marine environment,[21] what it considers to be GES and on the targets and objectives that must be met to reach GES by 2020. Ireland has also established a national monitoring programme to assess GES and is currently in the process of developing measures that must be put in place to achieve GES by 2020.

A reformed Common Fisheries Policy came into effect in January 2014 with the main objective to restore and maintain harvested stocks above levels that can produce maximum sustainable yield. The maximum sustainable yield exploitation rate shall be achieved for all stocks by 2020. This aligns with the objectives of the MSFD, one of which is that marine waters of the EU are at GES within the same timeframe.

Another important piece of new legislation in this area is the Maritime Spatial Planning Directive (2014/89/EU), adopted by the EU in 2014. The main purpose of the Directive is to develop maritime spatial plans that promote sustainable development and identify the most suitable maritime space for the operation of different human activities. These activities include the installation of renewable energy devices, oil and gas exploration, maritime shipping, commercial fishing, conservation of habitats and species, tourism and aquaculture. The plans should provide an integrated management approach that aims to reduce conflicts in the use of maritime space while, at the same time, encouraging multi-purpose uses. The plans should also have due regard to the significant pressures associated with the various activities to ensure that the ecosystem services provided by marine waters are not degraded. This legislation is currently being transposed into Irish law in line with the deadline in the Directive of September 2016.

21 *www.environ.ie/water/water-quality/marine-strategy/marine-strategy-framework-directive-msfd*

Impacts of Climate Change on the Water Environment

Rising sea temperatures, ocean acidification, ocean deoxygenation and rising sea levels have been identified as four of the key stressors impacting on the world's oceans and coastal environments.

The key impacts of climate change for Ireland are described in Chapter 3. With regard to inland water ecosystems, the most obvious and direct impacts predicted include changes in river flows. Robust increases are expected in winter and spring, in the order of 20% in winter by the mid to late twenty-first century, while reductions in the summer and autumn months of over 40% are likely in many catchments. Flood events are likely to become more frequent with extreme flood events, currently expected once in every 50 years, likely to occur once every 10 years by the second half of this century (Murphy and Fealy, 2010; Coll and Sweeney, 2013).

With regard to marine waters, rising sea temperatures, ocean acidification, ocean deoxygenation and rising sea levels have been identified as four of the key stressors impacting on the state of the world's oceans and coastal environments (EPA, 2003; Devoy, 2008; Diaz and Rosenberg, 2008; O'Boyle *et al*., 2009, 2013; Gruber, 2011; Dwyer, 2012; Duarte *et al*., 2013; IPPC, 2013; Bates *et al*., 2014; ICES, 2014; Wallace *et al*., 2014; Bradley *et al*., 2015; McGrath *et al*., 2015).

Coastal erosion along the Atlantic coast of Europe was particularly severe and extensive during the 2013/2014 winter period owing to extreme storm conditions. Storms of this severity had not been experienced since 1948 (Masselink *et al*., 2016). These factors have the potential to seriously affect the functioning of marine and coastal ecosystems, and Irish waters are not immune from these global effects. Increases in water temperature have already been observed and, although these are partially attributable to natural cycles, the rate of change is of concern. Ocean acidification effects are being observed in our offshore surface waters (ICES, 2014) and these changes in ocean chemistry could potentially be very damaging to marine organisms, particularly to those with carbonaceous structures, such as corals, crustaceans, certain species of plankton and seaweeds, such as the coccolithophorids, which often bloom in Irish waters (Figure 5.14). The milky turquoise swirls off the south and west coasts of Ireland, visible from space, are made up of a large bloom of phytoplankton. These harmless microscopic plants are members of a group of plankton known as 'coccolithophorids'. Each tiny cell is covered in chalky plates and when the conditions are favourable the large blooms of these species turn the sea a milky white colour. These blooms are part of the natural marine food web but are susceptible to environmental disturbance such as ocean acidification.

Figure 5.14 Coccolithophorid bloom[22] (Source: © ESA)

Impacts of Climate Change in the Marine Environment

The example of Coastal Erosion

Masselink *et al*. (2016) reported that studies of coastal vulnerability due to climate change tend to focus on the consequences of sea-level rise, rather than on the complex coastal responses resulting from changes to the extreme wave climate. The 2013/2014 winter wave conditions that severely affected the Atlantic coast of Europe were investigated and it was found that this winter was the most energetic along most of the Atlantic coast of Europe since at least 1948. Along exposed open-coast sites, extensive beach and dune erosion occurred as a result of offshore sediment transport. More sheltered sites experienced less erosion, and one of the sites even experienced accretion as a result of beach rotation induced by alongshore sediment transport. Storm wave conditions such as were encountered during the 2013/2014 winter have the potential to dramatically change the equilibrium state (beach gradient, coastal alignment and nearshore bar position) of beaches along the Atlantic coast of Europe.

22 *www.esa.int/var/esa/storage/images/esa_multimedia/images/2012/10/algal_bloom_off_ireland/11888154-3-eng-GB/Algal_bloom_off_Ireland.tif*

Seaweed Harvesting

The proposals for large-scale seaweed harvesting will require careful scrutiny and regulation to prevent damage to intertidal biodiversity, to maintain sustainability and to protect the marine environment.

Current proposals for a review of the licensing of activities on the foreshore have the potential to impact on the use of coastal marine resources. Traditional seaweed harvesting has generally fallen into a legal grey area, with the rights of coastal landowners and the state's claim to the foreshore sometimes in conflict.[23]

A number of applications for large-scale seaweed harvesting rights have brought these issues to the fore, and a recent Oireachtais committee review suggested that a thorough review of the licensing regime needs to be undertaken (Oireachtas, 2015). Given the importance of the intertidal seaweed communities for biodiversity and coastal protection and as nursery grounds for a wide variety of marine life, any future development in this area needs to be well regulated to ensure maximum sustainability and protection of the marine environment.

Catchment and Ecosystem Services

Raising awareness of the benefits and services to society from water catchments will assist in their management.

The benefits received by ecosystems and humans from resources and processes which are supplied by water catchments have been termed "catchment services" (Daly, 2015). These include ecosystem services (the benefits that are derived from ecosystems), geosystem services (the values and services associated with geodiversity) and human–social system services (social and cultural services that contribute to the life environment). These benefits include the provision of water for consumption and agriculture use, the assimilation and purification of pollutants, flood regulation and water based recreation and tourism.[24] Raising awareness of the services that catchments and marine ecosystems provide for society will assist in managing water catchments.

The ESManage[25] project, which runs until 2018 and is funded by the EPA, aims to harness the knowledge and tools required to embed the ecosystem services approach into policymaking and decision making for sustainable management of water resources, as required by the WFD. The Department of Arts, Heritage, Regional, Ruraland Gaeltacht Affairs has commissioned ecosystem services mapping and assessment for an initial suite of prioritised ecosystem services in Ireland. This project is due for completion in 2016. It is developing Irish indicators for potential ecosystem services mapping, based on available national data, using methods developed in the UK and the EU. A follow-up project will look at how to operationalise the ecosystem services concept in Ireland through policy and legislation.

Economic Policy Instruments

Economic policy instruments can play a role in achieving water policy goals.

There is growing appreciation globally of the importance of natural capital, including catchment services, to our economy (see Chapter 4) (CIMA, 2013). Recent research suggests that people in Ireland do value water-related ecosystem services and are willing to pay to achieve good water quality in rivers (EPA, 2014a, 2014c).

Many of the environmental problems with water ecosystems (e.g. pollution, overabstraction and physical damage) stem from the fact that water in the environment is an open access resource, and often there are few restrictions on its use (e.g. abstractions and pollutant discharges). Sectors often use water in the environment without paying the full cost of environmental impact that their activities cause.

23 *www.nuigalway.ie/research/seaweed_centre/documents/Seaweedforum_Report2000.pdf*

24 *www.teagasc.ie*

25 *www.ucd.ie/esmanage/*

The WFD makes explicit provision for the use of Economic Policy Instruments (EPIs), in combination with other measures, for the purpose of achieving environmental policy objectives (Lago *et al*., 2015). Economic measures can help society to avoid water-related investments that are economically inefficient and environmentally damaging. They can also help to manage an increasingly scarce resource in ways that are both fair and efficient (Convery, 2013).

What are Economic Policy Instruments?

"EPIs are incentives designed and implemented with the purpose of adapting individual decisions to collectively agreed goals. They include incentive pricing, trading schemes, co-operation (e.g. payment for environmental services) and risk management schemes. EPIs can significantly improve an existing policy framework by incentivising, rather than commanding, behavioural changes that may lead to environmental improvements. They can have a number of additional benefits, such as creating a permanent incentive for technological innovation, stimulating the efficient allocation of water services, promoting water use efficiency, etc."

Lago. et al. (2015).

Conclusions and Future Challenges

The Current Condition of Inland and Marine Waters and the Pressures Acting on Them

In summary, based on preliminary analysis of the most recent datasets, there has been no improvement in river water quality (based on Q values) or transitional and coastal water quality over the past six years (EPA, 2016a). Overall, lake water quality has got slightly worse with a 3% reduction in the number of monitored lakes at satisfactory status. A full water framework directive assessment covering the period 2013 to 2015 will be available towards the end of 2016. However, it is already clear that insufficient progress is being made with improving Ireland's surface water quality.

While overall the length of unpolluted river channel has remained relatively constant there has been a substantial loss in the number of sites where highest quality river sites are found (i.e. Q value of 5). In the most recent monitoring period (2013-2015) only 21 sites were classified as the highest quality rivers (0.7% of sites) compared with 575 between 1987 and 1990 and 82 between 2001 and

2003. This is an area where substantial effort is required to protect the few remaining highest quality rivers and return impacted ones back to their earlier extremely high quality.

Eutrophication, which is caused by excessive nutrient inputs (generally phosphorus in the case of inland waters and nitrogen in the case of marine waters), remains the most significant environmental issue for surface waters. The two most important suspected causes of pollution are agriculture and municipal sources, accounting for 53% and 34% of cases, respectively, in the case of rivers, for example. Nutrient inputs, particularly from the agriculture sector, have fallen, with reductions of 18.7% and 37.7% in nitrogen and phosphorus sources, respectively. There is increasing evidence that the physical condition (hydromorphology) of surface waters may be as important to maintaining healthy ecosystems as the quality of the water sustaining them. Excessive siltation in particular is a cause for concern. Some physical barriers in river catchments, such as impassable weirs, are preventing certain protected fish species from migrating and consequently affecting the health of these populations. Work is ongoing to investigate these further.

Anticipated increases in environmental pressures on waters due to human population growth and agricultural output as a result of the planned expansion in production under Harvest 2020 and its successor, Food Wise 2025, will need to be carefully managed to ensure that not only deterioration is prevented but that water quality improvements take place. More targeted management measures are needed in the agricultural sector to accelerate the improvements required to achieve environmental targets set for waters.

Untreated urban waste water discharges continue to be a concern and impact on both the aquatic ecosystems themselves and their amenity value. Continued investment in infrastructure and a reversal in the recent decline in capital expenditure are essential to provide the waste water treatment necessary to protect receiving waters.

Ocean acidification, as a result of climate change, is a cause of concern worldwide and the effects are now being seen in Irish waters. Coastal erosion as a result of extreme storm events has also become a prominent issue in recent years. While 36% of commercial fish stocks are being fished sustainably, 26% remain overfished. While changes introduced under the CFP have reduced the risks of overfishing, further efforts are needed to protect species that are still under threat.

Why is Progress So Slow and What Steps Are Needed to Accelerate Change?

The target established for Ireland of 13.6% improvement in the ecological status of surface waters from the 2009 baseline to be achieved by 2015, which was included in the first cycle of RBMPs, has not been achieved. In spite of our best efforts, satisfactory progress towards achieving sustainable water resource management is not being achieved.

As well as the WFD, there are several directives in place which relate to the quality and condition of the water environment, including those covering urban waste water, agricultural practices impacting on waters and protected habitats and species, yet we are not seeing significant improvements. It is evident that a multi-party partnership approach involving government, state agencies, industrial sectors, non-governmental organisations and local communities is required to enable significant synergies to be realised. To be effective, the approach will require the pooling of knowledge, resources and efforts and the targeting of tailored management measures based on the best available scientific evidence. Inevitably, this type of approach is challenging, and it will take time to develop and build capacity, but ultimately it should deliver environmental objectives that are ambitious, achievable and acceptable to all sectors.

Weaknesses in governance arrangements were identified as an impediment to implementing the WFD during first river basin management cycle. Changes to the governance arrangements have now been made; as a result there is greater clarity on the roles and responsibilities of public bodies and improved implementation can be expected in the future. In the case of the marine environment, the MSFD is in the process of being implemented and the Marine Spatial Planning Directive is in the process of being transposed into national legislation. Strong and clear governance structures will be essential to achieving the goals of these marine directives.

There is certainly room for improvement in the implementation and enforcement of environmental regulations to increase the level of compliance. Improved environmental regulation leading to better compliance, in combination with other policy tools such as bottom-up community-based catchment initiatives and the use of EPIs, is needed to achieve environmental objectives.

A particular challenge in managing water resources effectively and sustainably into the future is incorporating the value of these resources effectively into economic decision making. Until the real environmental cost of using water resources is internalised into the decision-making processes within all sectors that use the resource, overuse and misuse are highly likely to escalate into the future as demands for catchment services increase. In order to put a value on these resources, sectors must first understand and be aware of the services that catchments provide them with and the value that they obtain from these services. Therefore, the immediate task ahead for environmental authorities is to communicate and raise awareness of the services gained by society from catchments. The ongoing mapping of ecosystem services across the EU, including Ireland, should help to inform this awareness raising.

The recent controversy in Ireland over domestic water charges serves to highlight the need for a mature and rational public debate with regard to how we want to manage our national water resources for future generations, not just from the narrow perspective of domestic drinking water and waste water treatment provision, but taking into account all services that are gained by all sectors. Some of the key questions to be debated include:

- What services do we obtain from catchment and marine ecosystems?
- Who benefits from these services?
- Who should pay the environmental costs taking into account the polluter/user pays principle, affordability and fairness across sectors? and, ultimately,
- How should these environmental costs be paid for?

Underpinning the new river basin water governance arrangements for managing waters and the bottom-up community initiatives is the integrated catchment management approach, which complements the river basin planning process. It approaches sustainable resource management from a catchment perspective, rather than taking a piecemeal approach that artificially separates land management from water management. Details are available on the new "Catchments.ie – Water from Source to Sea" website[26] which provides details on local catchments, how to get involved and work on the WFD.

The promotion of community action at a local level is critical to engaging and securing ownership of the problems at play and generating tailored solutions that work for all sectors. These types of initiatives are important for raising awareness of the value of catchment services to society. To be effective they require the support and technical advice of the environmental authorities.

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26 *www.catchments.ie*

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Chapter 6
Waste

Waste Management

The Current Situation

Improvements in waste management have been achieved, but there remain issues to address.

Diverse societal and economic wastes are generated in Ireland: household and similar waste (commonly called "municipal waste"), industrial process waste (including extractive waste), radioactive waste, animal by-products, explosive and pyrotechnic waste, contaminated land[1] and dredging material.[2]

Ireland's waste management practices, infrastructure and regulation have matured significantly since the Waste Management Act (1996) was enacted. This change has been driven by EU and national legislation, national policy and economic initiatives. Since 2012, there has been a clear government policy focus on waste as a resource and virtual elimination of landfilling. Waste management planning and waste enforcement structures have recently been consolidated and strengthened. The current and future focus is on waste prevention, reuse, maximising recycling and using waste as a fuel in replacement of fossil fuels: all elements of the circular economy strategy to boost competitiveness, foster sustainable economic growth and generate new jobs.

The waste sector is now almost exclusively privatised (although local authorities manage a significant civic amenity and bring bank network, as well as some landfills). The private sector has invested significantly in infrastructure that has increased the sophistication of waste processing and treatment and brought innovation, but privatisation has also brought some challenges. A number of operators have gone into receivership or liquidation, and securing financial provisions for environmental liabilities at waste facilities is of critical importance to ensure that the State is not left with remediation costs.

From an environmental performance perspective, the waste sector is responsible for a high number of odour nuisance complaints, particularly relating to non-hazardous waste transfer and landfill activities, and there were six fires at waste facilities in 2014. Societal littering and fly-tipping is still a problem in urban and rural areas, indicating that a section of society has poor citizenship values.

The most significant change in waste management since the last State of the Environment report in 2012 is that more residual waste is now recovered (i.e. used as a fuel) than disposed to landfill. There are six active landfills for the disposal of municipal waste, compared with 18 in 2012. Segregation and separate collection of food waste from households has been legislated for since 2013 and municipal waste recycling at composting and anaerobic digestion facilities has increased as a result. Ireland is currently heavily reliant on export markets for the treatment of residual and recyclable wastes. Proactive planning for adequate future treatment capacity in the State (and abroad where necessary) is essential to ensure that there are no negative environmental impacts from increased waste generation.

Preliminary data for 2014 (EPA, personal communication) indicate increases in municipal and construction and demolition waste generation since 2012, most likely as a result of economic growth.

1 See Chapter 7.
2 See Chapter 5.

Figure 6.1 Performance Targets under Waste Management Plans, 2015-2021 (Source: WMP Regions)

Waste Policy and Planning

Future objective is a circular economy.

The Department of the Environment, Community and Local Government (DECLG) has published *A Resource Opportunity – Waste Management Policy in Ireland*, which is the current government waste policy (DECLG, 2012a). Radioactive waste, which is subject to separate legislation, has its own policy (DECLG, 2010).

EU legislation, EU action programmes and EU roadmaps continue to be primary drivers of change in relation to waste management practices in Ireland. The waste legislative proposals under the European Commission's December 2015 Circular Economy Package[3] look to set ambitious targets for recycling of packaging and municipal waste, and reduction in municipal waste landfilled.

There are three waste management planning regions (reduced from 10 since 2013): Connacht-Ulster, Eastern-Midlands and Southern. The 2015-2021 Waste Management Plans analyse the current situation and provide information on waste infrastructure. The plans set three performance targets (Figure 6.1) and eight strategic objectives for key policy areas with linked actions and roles and responsibilities.

Waste Regulation

Dealing with odour nuisance, fire risk and securing financial provision for environmental liabilities are key priorities for the Environmental Protection Agency.

The EPA, the National TransFrontier Shipments Office (NTFSO), the National Waste Collection Permit Office (NWCPO) and local authorities are responsible for regulation of the waste industry (i.e. storage, transit and treatment), and approximately 4,500 waste authorisations are in place. The authorisation type (licence, permit or certificate of registration) depends on the class of activity and capacity (EPA, 2015a). The NWCPO maintain national registers of all waste collection and facility authorisations.

Since 2015, three Waste Enforcement Regional Lead Authorities (WERLAs) have been responsible for co-ordinating local authority enforcement within their region, while local authority personnel remain the first responders to investigate breaches of waste legislation.

The waste sector, particularly non-hazardous waste facilities and landfills, continues to be the source of a high number of odour complaints (92% of 539 complaints received in 2014 related to odour). There were six fires at EPA-licensed waste facilities in 2014, and more stringent conditions relating to waste storage and fire risk assessment have been attached to licences to mitigate risk. Eight shipments of waste were returned from abroad in 2014 and, although this represented a very small percentage of overall waste exports, the trend needs to be reversed. *EPA Licensed Sites – Report on Waste Enforcement 2014* (EPA, 2015a) summarises enforcement activities at 169 waste sites licensed by the EPA. In 2014, apart from complaints, the EPA carried out 270 inspections, handled 630 incidents and opened 64 compliance investigations to tackle areas of non-

3 *www.ec.europa.eu/environment/circular-economy/index_en.htm*

compliance. Strategic enforcement priorities for the EPA in the waste sector are:

- dealing with, and minimising the risk of fire
- introducing effective measures to minimise odour nuisance
- securing financial provision for environmental liabilities at waste facilities
- ensuring waste exports comply with the Waste Shipments Regulation
- implementing the reorganisation of local authority enforcement.

Local authorities prepare annual waste enforcement work programmes and, in 2014, they reported carrying out approximately 64,000 inspections and initiating over 450 prosecutions (EPA, 2015a).

Waste Targets and Prevention

Ireland is meeting current waste targets but some future targets are at risk.

A number of EU directives set targets for recovery of waste and its diversion from landfill. Ireland has met all statutory targets, although some future targets are at risk (Table 6.1), particularly for separate collection of portable batteries and recycling/recovery of end-of-life vehicles.

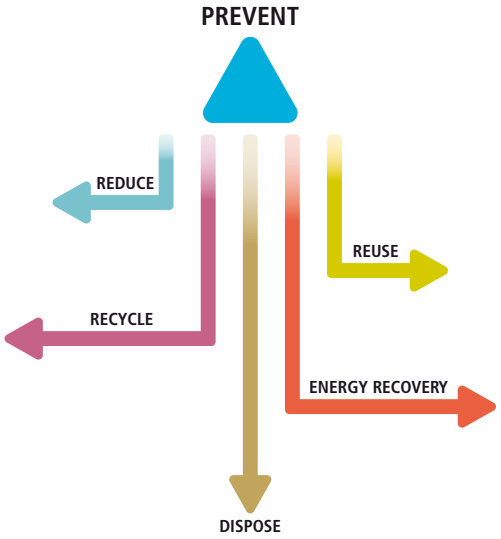
The Commission's Circular Economy Package is proposing ambitious future targets for 2025 and beyond for municipal waste recycling, municipal waste disposal to landfill and packaging waste recycling. These proposals are currently under negotiation.

Waste Prevention

Ireland's National Waste Prevention Programme is well established.

Waste prevention is higher on the waste hierarchy, and is therefore preferred to recovery or disposal (see Figure 6.2).

Figure 6.2 Waste Hierarchy (Source: EPA)



Ireland's National Waste Prevention Programme (NWPP) was established in 2004 and is led by the EPA. Businesses, households and the public sector are given support and guidance to be more resource efficient, not only in waste prevention but also in the reduction of energy and water consumption.[5] Some examples of NWPP initiatives are Stop Food Waste, LAPN (Local Authority Prevention Network

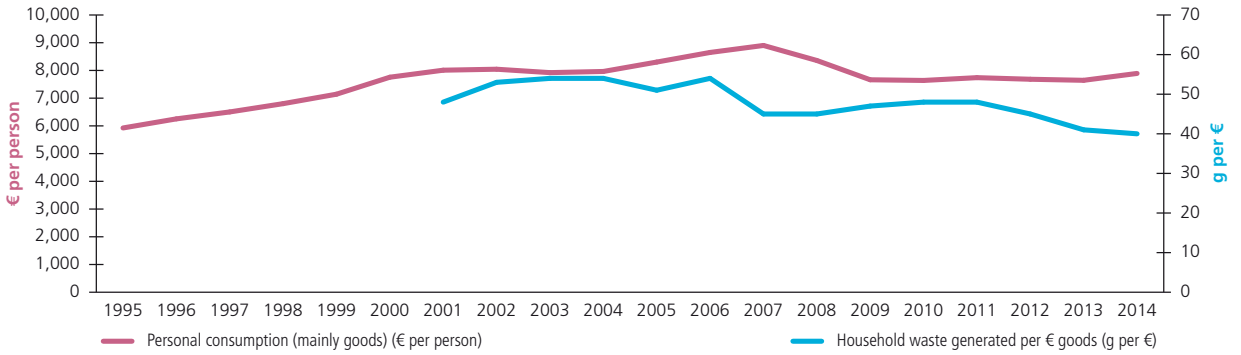
Table 6.1 Progress Towards EU Recovery and Recycling Targets (Source: EPA, various)[4]

Directive	Progress to targets	Traffic light Indicator
Packaging and Packaging Waste Directive (1994/62/EC)	All targets met	●
Landfill Directive (1999/31/EC)	All targets met (preliminary data for 2016 target)	●
End-of-Life Vehicles (ELV) Directive (2000/53/EC)	2015 recycling/reuse targets at risk	●
Waste Electrical & Electronic Equipment (WEEE) Directive (2002/96/EC)	All targets met	●
WEEE Directive recast (2012/19/EU)	2016 targets at risk	●
Batteries and Accumulators Directive (2006/66/EC)	2016 portable battery collection target at risk	●
	Recycling efficiency targets met	●
Waste Framework Directive (2008/98/EC)	2020 targets currently on track	●

4 *www.epa.ie/waste/municipal/*

5 *www.begreen.ie*

Figure 6.3 Waste Intensity of Goods Consumed by Households, 2001-2014 (Source: EPA, CSO)



projects), Green Business, Green Hospitality and Green Healthcare. The latest NWPP plan is *Towards a Resource Efficient Ireland: A National Strategy to 2020* (EPA, 2014a). There is also a strong focus on waste prevention in the current regional Waste Management Plans.

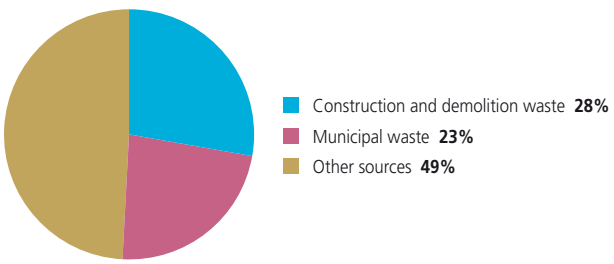
To obtain an indicator for household waste prevention, household waste generated per person was divided by the goods-related component of the Central Statistics Office's personal consumption of goods and services indicator (goods include food, drink, transport, household equipment). This gives estimates for household waste generated per euro spent on goods and is called "waste intensity". There is some evidence of a general decline in waste intensity of goods between 2004 and 2014 (see Figure 6.3), which may be due to waste prevention efforts.

Waste Generation

Industrial waste accounts for 80% of national waste generation.

National waste generation data are compiled every 2 years as required under the Waste Statistics Regulation.[6] Preliminary data indicate that 11.91 Mt of waste was generated in 2014.[7] Of this total, 23% (2.73 Mt) was generated by municipal sources, 28% (3.31 Mt) by construction and demolition sources and 49% (5.87 Mt) by other sources (e.g. industry, agriculture) (see Figure 6.4).

Figure 6.4 Waste Generation in 2014, Percentage by Source (Source: EPA, 2016)



6 Radioactive waste is excluded from the scope of this reporting obligation.

7 Final 2014 data will be available later in 2016.

Extended Producer Responsibility

The national review of extended producer responsibility will lead to an expansion in the schemes in place.

Four waste streams are subject to Extended Producer Responsibility (EPR) under EU legislation: packaging, end-of-life vehicles, batteries and accumulators, and WEEE. In Ireland farm plastics and tyres are also subject to EPR under national legislation. Under EPR, producers[8] have obligations regarding the environmental impact of their products from design to end of life. A review of the EPR models in Ireland by DECLG recommended changes to the ELV and tyre systems (DECLG, 2014). DECLG is currently progressing the review recommendations through stakeholder working groups.

Tyres/Waste Tyres

The management of waste tyres has been subject to national regulation since 2007. The existing scheme is mainly to track tyres/waste tyres, but a review of the scheme estimated that 24–51% of waste tyres were unaccounted for (DECLG, 2014). The DECLG has therefore established a new EPR for the sector, which will place much greater responsibility on producers and importers, and include financing of the scheme. It is anticipated that the revised legislation will be in place by the end of 2016.

8 The definition of producer varies for different EPRs, but essentially covers manufacturers and importers of products.

Waste Management and Infrastructure

The most significant change in residual waste treatment since 2012 has been the shift from disposal to landfill, to energy recovery.

While the collection and treatment of waste is essentially privatised in Ireland,[9] local authorities have a key role in the provision and management of civic amenity and bring bank infrastructure. Local authorities are responsible for the aftercare of a significant number of closed and historic landfill sites.

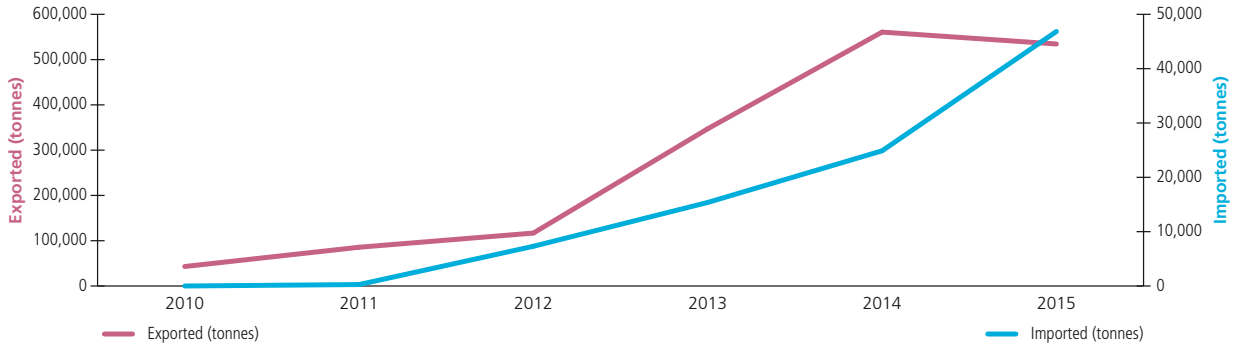
The most significant change in residual waste treatment since 2012 has been the shift from disposal to landfill to energy recovery, with six active landfills in 2016, in comparison with 18 in 2012. One operational municipal waste incinerator has opened since 2012, with a second under construction and due to open in 2017.

Three cement kilns are accepting solid recovered fuel (SRF) for co-incineration as an alternative to fossil fuels. Along with this growth in capacity in the State, there has been a significant increase in the export of residual waste for use as a fuel, peaking in 2014 (Figure 6.5). Note that the import of solid recovered fuel for use as a fuel at cement kilns has also been increasing since 2011 (classed as a thermal waste recovery activity).

Although energy recovery is preferable to disposal on the waste hierarchy, there are challenges in the processing and storage of these wastes, manifested in odour complaints and increased number of fires (EPA, 2015a). There is also the risk that, if energy recovery replaces disposal as the preferred option for treatment of residual waste, opportunities for maximising extraction of recyclables from residual waste will not be fully exploited. The export of waste is a lost resource for the State, and there is a risk that, should the capacity of the export markets decrease at short notice, the infrastructure capacity in the State (landfill disposal and waste to energy recovery) will not be adequate to cope with increased demand.

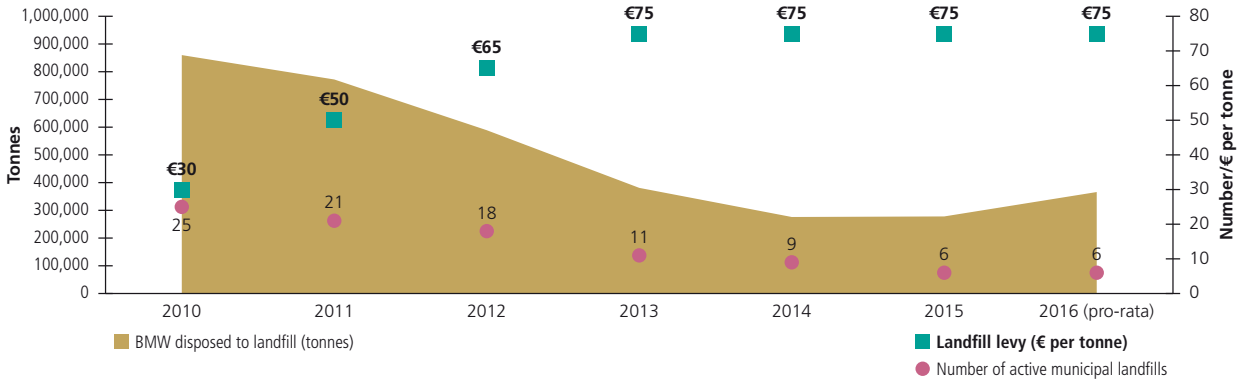
In early 2016, built landfill capacity was identified as critically low; additional capacity was authorised to prevent environmental impacts, such as stockpiling of wastes or illegal activity. Figure 6.6 shows an increase in tonnage of

Figure 6.5 Residual Waste Exported and Imported for Use as a Fuel, 2010-2015 (Source: NTFSO)



9 Kilkenny Borough Council is the only local authority still in the household waste collection market.

Figure 6.6 BMW Disposed to Landfill (tonnes), Landfill Levy (€ per tonne) and Number of Active Landfills 2010-2016[10] (Source: EPA)



biodegradable municipal waste (BMW) disposed to landfill in 2015 and 2016 (in the same time period the export for residual waste for recovery decreased). It would be a retrograde step if the quantity of municipal waste disposed to landfill were to start to increase again, but with additional waste to energy capacity coming on-stream in 2017, it is hoped that the 2015-2016 trend will be short term, the result, perhaps, of a lack of export markets, or cost driven. While preliminary data indicate that the July 2016 Landfill Directive target for BMW disposal to landfill has been met, there is a risk that increased generation of municipal waste, or lack of waste to energy capacity, will increase the BMW disposal tonnage in future.

Many industries treat the waste they generate on-site, under licence issued by the EPA. Types of activity are incineration (e.g. waste solvents) and landfilling (mining/mineral waste landfills).

Segregated metal, glass, plastic, paper and cardboard wastes are in the main exported for recycling owing to a lack of national infrastructure. The regional Waste Management Plans reported an overcapacity for pretreatment activities (storage, sorting, bulking, transfer of waste). Table 6.2 presents information on key waste infrastructure capacity.

Table 6.2 Waste Infrastructure Capacities in Ireland (Source: EPA)

Landfill	Built municipal waste landfill capacity	910,000 tonnes built capacity at end of 2014
	Hazardous waste landfill	Zero
Incineration	Municipal waste to energy incineration	230,000 tonnes per annum active 600,000 tonnes per annum under construction
	Co-incineration of solid recovered fuel at cement kilns	343,000 tonnes per annum
Biological treatment	Composting and anaerobic digestion	Approx. 540,000 tonnes per annum (65,000 tonnes of which is anaerobic digestion)
Commercial hazardous waste treatment		Approx. 380,000 tonnes*
Public amenity facilities**	Civic amenity sites	130 (94 public sector, 36 private sector)
	Bring banks	1,787 (1,772 public sector, 15 private sector)
	Pay-to-use compactors	Approx. 50 (private sector)

*Physical and chemical treatment. Not including incineration and co-incineration plants which are authorised to accept certain hazardous materials for treatment.
**2014 data

10 2016 pro-rata based on Q1 and Q2 2016 data.

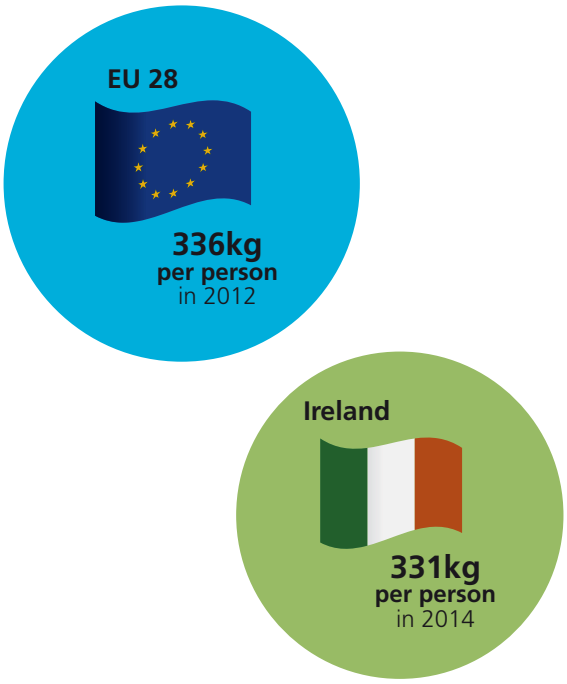
Municipal Waste Management

Municipal waste generation is increasing.

Municipal waste in Ireland is made up of household waste as well as commercial and other waste that, because of its nature or composition, is similar to household waste. Municipal waste generation is a good indicator of the consumption behaviours within society. The amount of municipal waste generated in Ireland in 2014 is estimated at 2.73 Mt (EPA, unpublished preliminary data), an increase of 6% since 2012.

Household waste is a core component of municipal waste. Preliminary data indicate that 1.52 Mt of household waste was generated in 2014 (331kg per person), which is similar compared to the EU-28 average (Figure 6.7). Most household waste is collected at the kerbside. Of households on a kerbside service in 2014, 97% received a two-bin service (residual and dry recyclables bin) and 43% were on a three-bin service (residual, dry recyclables and organics).

Figure 6.7 Household Waste Generated Per Capita in Ireland Compared with the EU Average (Source: Eurostat, EPA)



Food Waste

One of the UN Sustainable Development Goals (Target 12.3) is to "halve per capita global food waste at the retail and consumer level, and reduce food losses along production and supply chains by 2030". EU-funded research estimated that 87.6 Mt of food waste was generated across the EU in 2012 (FUSIONS, 2016). In Ireland, it is estimated that 509,900 tonnes of food waste (251,000 tonnes household plus 258,900 tonnes food services) is generated per annum in Ireland, and that food waste costs each Irish household €700 per year. Ireland's Stop Food Waste campaign has been to the forefront of food waste prevention since 2009 and has been promoting behavioural changes through provision of information, training, local champions and peer example. National food reuse schemes operated by social enterprises such as Bia Food Initiative[11] and by Foodcloud,[12] and supported by food retailers and the catering industry, are EU exemplars.

By July 2016, waste collectors are obliged to offer all households situated in population agglomerations of more than 500 persons a separate food waste collection service. Although the number of households with a separate organic bin service has been increasing (43% of those on a collection service in 2014), householders are still placing food waste into the residual bin, which is a missed opportunity for recycling of food waste (CSO, 2016).

STOP FoodWaste.ie

11 *www.biafi.ie*

12 *www.food.cloud*

Litter and Fly-tipping

Litter and fly-tipping is still a significant issue in Ireland.

The presence of litter and fly-tipped waste in the environment is one of the most visible and undesirable aspects of waste generation. Local authorities are responsible for its management and for enforcement.

The best estimate for 2014 is that 70,000 tonnes of waste from litter and street bins and from street cleansing, fly-tipped and community clean-up was collected for management. This is a considerable amount of waste, which potentially includes recyclable packaging waste and WEEE. The sociological reasons for littering are complex, but in the main stem from cost avoidance and poorly developed citizenship values. The threat of enforcement and the level of economic sanctions are clearly insufficient to deter the public.

The National Litter Pollution Monitoring System's most recent report (DECLG, 2015b) indicates that the proportion of areas deemed to be completely unpolluted was 12.3%, the highest level achieved since monitoring began, while 0.3% of areas were deemed to be grossly polluted. The main cause of litter pollution is passing pedestrians (41%). The main constituent elements of litter pollution are cigarette-related (55%), chewing gum (15%) and packaging (12%).

Some national anti-litter initiatives, which are examples of good citizenship, include:

- National Spring Clean run by An Taisce[13]
- SuperValu Tidy Towns competition[14]
- Irish Business Against Litter (IBAL) National Litter League.[15]

13 *www.nationalspringclean.org*

14 *www.tidytowns.ie*

15 *www.ibal.ie*

See it? Say it!

The EPA's smartphone app *See it? Say It!* helps people to report environmental pollution such as fly-tipping, littering and backyard burning.

This app complements the 24-hour nationwide environmental complaints phone line (1850 365 121). The complaints are ultimately delivered to the FixYourStreet.ie website (*www.fixyourstreet.ie*), which is monitored continuously by all local authorities. Local authorities receive in the region of 50,000 to 60,000 complaints annually in relation to environmental issues, of which approximately 68% are related to litter and fly-tipping. In many cases the litter includes material that can be recycled for free (e.g. WEEE, batteries). The app can be downloaded by visiting *goo.gl/gOJMa* (iPhone App) or *goo.gl/V7eNYe* (Android App).

Construction and Demolition Waste

Quantity of construction and demolition waste generated is a good indicator of economic growth.

The quantity of construction and demolition (C&D) waste managed is indicative of economic activity. The bulk of C&D waste is made up of uncontaminated soil and stones, with the remainder segregated wastes such as rubble, concrete, bricks, glass, plastic, wood, metals and mixed C&D waste. At the peak of the boom, approximately 17.8 Mt of C&D waste was collected for treatment. This dropped to 3 Mt mid-recession. Preliminary data indicate that 3.31 Mt of C&D waste was generated in 2014. With a government policy focus on the provision of social housing, major road infrastructural projects and the new children's hospital, C&D waste generated will increase again in the coming years. We need to ensure that C&D waste is prevented where possible, and otherwise managed properly, and that there is adequate treatment capacity to cope with renewed activity in the sector.

Management of Animal By-products

Animal by-products are regulated because of the risk they pose to human and animal health.

Animal by-products (ABPs) are defined as "entire bodies or parts of animals, products of animal origin or other products obtained from animals that are not intended for human consumption". ABPs can present a risk to human and animal health and their use or disposal is covered by EU legislation.

Approximately 500,000 tonnes of raw ABPs is produced in Ireland each year and is mainly rendered to produce meat-and-bone-meal (MBM) and tallow. Other ABPs that do not spring directly from the meat industry, such as former foodstuffs, are more commonly used as feedstock for composting (DAFM, 2015).

In 2014, renderers accepted 226,000 tonnes of Category 1 material (high risk) and 250,000 tonnes of Category 3 (low risk) material. Processing of Category 1 material produced 61,000 tonnes of MBM and 27,000 tonnes of biofuel. Processing of Category 3 material yielded 70,000 tonnes of meal for pet food and 33,000 tonnes of tallow used for animal feed and industrial uses (Federation of Irish Renderers, 2016).

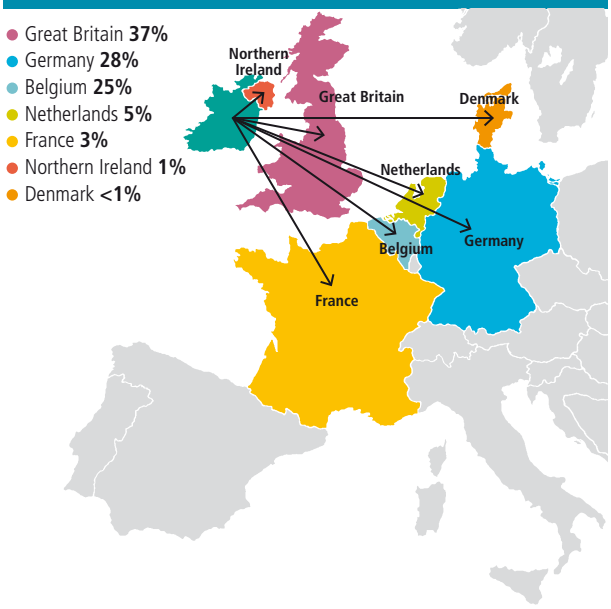
Hazardous Waste Management

Prevention comes first but Ireland is dependent on exporting for treatment.

The current National Hazardous Waste Management Plan (NHWMP) for 2014-2020 (EPA, 2014b) sets out the priorities to improve the management of hazardous waste, including hazardous waste prevention, maximise the collection of hazardous waste, strive for self-sufficiency in hazardous waste management and minimise the environmental, health, social and economic impacts of hazardous waste generation and management.

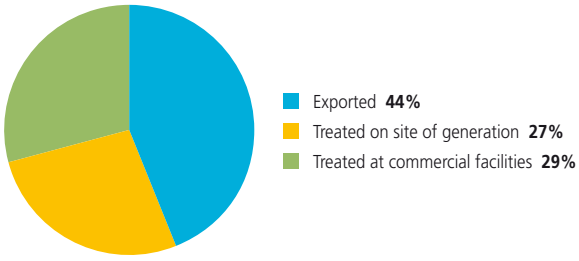
There is no commercial hazardous waste landfill in the State, and there are limited hazardous waste treatment operations (these are mainly used for oil recovery, healthcare waste treatment and solvent reclamation), meaning that Ireland is dependent on export for treatment of many hazardous waste streams. The NHWMP identifies three strategic needs if additional hazardous waste is to be treated in Ireland: (1) expansion of physico-chemical treatment, (2) addressing the deficit in thermal treatment capacity, and (3) securing long-term disposal arrangements for hazardous waste streams not suitable for thermal treatment or recovery. Ireland would be vulnerable in the event of a crisis such as an infectious disease outbreak. Figure 6.8 shows the destination of exported hazardous waste in 2014 (EPA, 2016a). The majority of waste exports were to the UK, Germany and Belgium.

Figure 6.8 Destination of Exported Hazardous Waste, 2014 (Source: EPA, NTFSO)



The amount of hazardous waste generated, and its treatment pathways, have remained relatively unchanged in recent years (Figure 6.9). An example of waste treated on site of generation is waste solvent incinerated at industrial facilities.

Figure 6.9 Treatment of Hazardous Waste, 2014 (Source: EPA)



Farm Hazardous Waste Collection Scheme

The EPA is leading a pilot farm hazardous waste collection programme, which represents the largest ever voluntary bulk removal of highly toxic pollutants out of the Irish environment in a concentrated period of time. Between 2013 and 2015, 598 tonnes of waste was collected at 26 centres (400 tonnes deemed hazardous). Types of waste collected included waste oils, batteries, veterinary medicines and sharps, pesticides and WEEE. Over 1 tonne of the pesticides was classified as persistent organic pollutants (POPs). Many of the POPs collected have been banned for considerable time and included DDT, lindane (gamma-HCH), dieldrin and endosulfan. These waste pesticides not only pose risks to human health and the environment, they threaten the very considerable efforts and investments made in recent years by farmers to enact environmental protection measures should accidental contamination occur. In the long term, the establishment of a national farm hazardous waste collection scheme would support the green and smart ambitions of the farming industry as well as enabling farmers to meet their legislative obligations.

Similar schemes supported by the DECLG which were operated by the local authorities and aimed at householders were delivered in 2015. There is a case to be made for household orientated hazardous waste schemes to be operated on a regional, if not national, scale so as to achieve efficiencies and effectiveness.

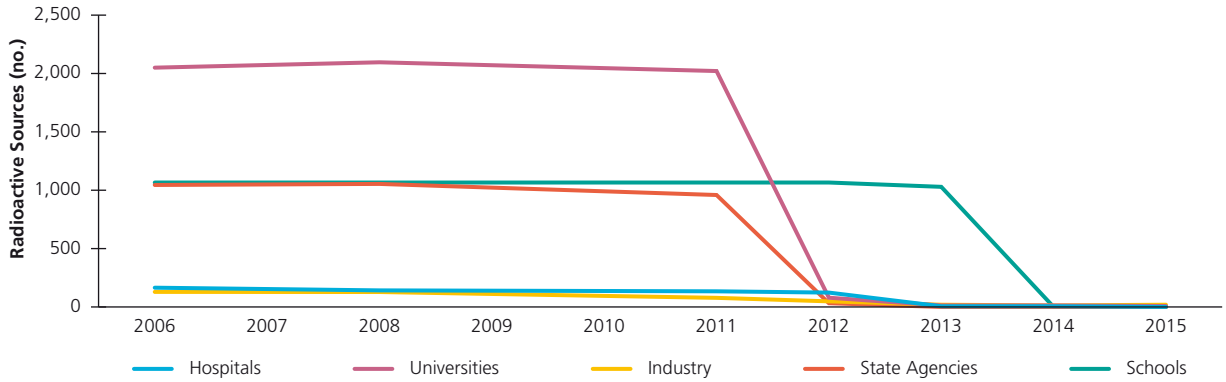
Radioactive Waste Management

A 99% reduction in the national inventory of disused radioactive sources has been achieved.

The National Inventory Reduction Programme is one of the programmes prioritised under radioactive waste policy. Particular focus was given to the inspection of licensees across the medical, industrial, educational and State sectors that had not yet disposed of their legacy radioactive waste. The inspections, in conjunction with other regulatory initiatives, resulted in a 99% reduction in the national inventory of disused sources with half-life ($t½$) greater than 10 years between 2010 and 2013 (see Figure 6.10).

A National Radioactive Waste Storage Facility for disused radioactive sources is to be established. A National Implementation Committee has been constituted to draw up a specification and make recommendations on the siting, management and resourcing of the facility.

Figure 6.10 National Inventory of Disused Sources, 2006-2015 (Source: EPA)



Explosive and Pyrotechnic Waste

Small amounts of explosive and pyrotechnic waste are generated and treated.

Explosive waste (from use in quarries) and pyrotechnic waste (flares and distress rockets) are generated in small quantities. The Navy undertakes destruction of pyrotechnic waste and the small amounts of explosive waste left over from quarry works that cannot legally be returned are subject to controlled destruction on site.

Biological Waste Treatment

National food and biowaste regulations are having a positive impact.

Composting and anaerobic digestion are the main biological treatment processes for biodegradable wastes (food waste, garden and park waste, sludges). With an increasing focus at national and EU level on the segregation and separate collection of food waste, it is critical to have adequate waste treatment infrastructure in the State.

In 2015, approximately 300,000 tonnes of biodegradable waste was accepted at composting and anaerobic digestion plants for treatment with authorised capacity at approximately 540,000 tonnes (see Table 6.2). The Food Waste Regulations, which require the segregation and separate collection of commercial and household food waste, are resulting in increasing amounts of organic waste being available for recycling (Figure 6.11) and are an example of regulation driving better outcomes for the environment. The uptake of anaerobic digestion has been slower in Ireland than other Member States.

When residual municipal waste is mechanically treated, one of the outputs is organic fines. Organic fines need to be biostabilised in order to reduce the biological activity of the material. The quantity of biostabilised residual waste increased from 50,000 tonnes in 2013 to 119,000 tonnes in 2015. The main outlet for this waste is landfill cover. With municipal waste tonnages increasing, and the number of open landfills decreasing, finding useful and safe outlets for biostabilised residual waste will be a growing challenge.

Sewage Sludge

Sewage sludge treatment capacity needs expansion to cater for improving waste water treatment.

Sewage sludge is a by-product of the waste water treatment process and includes biosolids removed from waste water during treatment as well as residual organic matter from the treatment process. Irish Water's waste water treatment plants produced 53,543 tonnes of sewage sludge (dry solids) in 2014. Most of this sewage sludge was treated and used on agricultural land as a fertiliser or soil enhancer (EPA, 2015b). Research has shown that additional capacity is needed for the treatment of sewage sludge (EPA, 2014c). Irish Water published a Draft National Wastewater Sludge Management Plan, which outlines its strategy to ensure a nationwide, standardised approach to managing waste water sludge for the next 25 years (Irish Water, 2016). Some objectives of the plan are establishment of long-term, secure and sustainable treatment routes and outlets, and extraction of energy and other resources where economically feasible. Sewage sludge also arises from domestic septic tanks. The national sludge management plan will need to take the management of domestic sewage sludges into consideration.

Figure 6.11 Municipal Waste Accepted for Composting/Anaerobic Digestion, 2005-2015 (Source: EPA)

Figure 6.12 Sources of Marine Litter (Source: An Taisce)

Marine Litter

Marine litter is a threat to the health of our seas and coasts.

Much legislative focus to date has been on waste in the terrestrial environment, but marine litter is increasingly under the spotlight. The EU Marine Strategy Framework Directive (2008/56/EC) identifies marine litter as one area to tackle in order to achieve good environmental status for all marine waters by 2020. The 2030 UN Sustainable Development Goals include a target to "prevent and significantly reduce marine pollution of all kinds". Marine litter comes from land activities (e.g. littering, landfills, storm water drain discharges) and marine activities (fishing, offshore mining and extraction, illegal dumping at sea) and is a cross-border problem; once it enters the sea, it has no owner (see Figure 6.12). This makes its management dependent on good regional and international collaboration.

Plastic debris is particularly worrying because of its resistance to environmental breakdown. Marine species are affected through ingestion and/or entanglement. Microplastics or beads (items smaller than 5 mm) are of particular concern due to their potential toxicity and size. Microplastics come from products (cosmetic exfoliants, industrial abrasives), fragments from larger plastics, or fibres from washing clothes carried by sewage. While the consequences of plastic build-up in the food chain are not fully known, human health concerns are being raised. Several NGO and State based campaigns are currently focussed on banning micro-beads in product use.[16,17]

Ireland has a number of citizen initiatives that monitor and report on marine litter. The Clean Coasts Volunteering Programme promotes and facilitates clean-up initiatives and marine litter surveys.[18] Over 1,000 volunteers participated in the 2015 All-Ireland Coastwatch Survey.[19]

16 *www.cleancoasts.org/our-initiatives/beat-the-microbead/*

17 *www.marinedebris.noaa.gov/types-and-sources-solutions/states-consider-plastic-microbead-bans*

18 *www.cleancoasts.org*

19 *www.coastwatch.org*

Waste Research

EPA-funded waste research projects have delivered knowledge and solutions and influenced policy.

Between 2007 and 2015, the EPA's Research Programme funded approximately 30 waste research projects with a total commitment of €4.1 million. Research informs policy development and implementation, enforcement and sustainable waste treatment options. A key finding from a research report led to the establishment of the National Waste Prevention Programme (EPA, 2001). Key findings of specific research projects (mechanical biological treatment and pay-by-use charging) were referenced in the National Biodegradable Waste Management Strategy. The DECLG's rx3 Recycling Market Development Programme foundation was attributed to the EPA's research projects. A Waste Prevention Design Tool for architects and designers was developed, as were novel technologies and procedures for environmental enforcement.

Drivers and Pressures

Consumption and waste generation

Consumption is the key driver for waste generation.

Consumption of products and services is the key driver and pressure for waste generation, at household, commercial and industrial level. With regrowth in the economy, there is a risk that waste generation will increase to pre-recession levels, particularly for waste streams such as municipal waste and construction and demolition waste. Ireland's population is estimated to grow by 1 million persons in the next 20 years (CSO, 2013), which will put further demands on waste infrastructure. Resource efficiency and the circular economy (including waste prevention programmes, Eco-design initiatives, and similar) must be kept at the heart of policy and economic initiatives to ensure environmental sustainability. Through periods of economic boom and recession, Ireland has struggled with littering and fly-tipping, which indicates that an element of our society disregards the environmental impact of poor post-consumption behaviours. Although sanctions are available (on-the-spot fines, prosecutions), this does not seem to have been successful as a deterrent to this poor citizenship. While urban communities are well serviced with waste acceptance and collection facilities, the same is not always the case for rural communities, although the issue of littering and fly-tipping is not unique to rural or urban areas.

EU Legislation and Action Plans

EU legislation and action plans driving positive waste management practices.

Without a doubt, EU legislation and policies have been a key factor for improving waste management practices, driving segregation and separate collection of wastes (e.g. municipal waste), prioritising waste streams with significant polluting and recycling potential (e.g. packaging, WEEE, ELVs, batteries), requiring implementation of the waste hierarchy (favouring recovery over disposal), and requiring implementation of waste management and waste prevention plans. The landfill levy has been particularly successful in incentivising diversion from landfill and the plastic bag levy in encouraging consumers to reuse plastic bags.

Responses

National Policy and Implementation

New national policies including pay-by-weight are to be implemented.

The implementation of the measures under *A Resource Opportunity* (DECLG, 2012a) will continue, including the initiatives on regulation of household waste collection. From July 2017, householders will be charged on a pay-by-weight basis for their waste collection service. The aim is to encourage positive environmental behavioural changes, including improved recycling. An EPA research study (EPA, 2011) evaluating pay-by-use domestic waste collection systems found that weight-based charges were the single most effective system, prompting the highest recycling levels, highest rates of diversion from landfill and lowest total kerbside waste figures.

Future Challenges

Future challenges are to move towards self-sufficiency in waste management and deal with emerging issues such as marine litter and regulation of household waste collection.

There was a 10-fold increase in residual waste exported for use as a fuel in the period between 2010 and 2014. While energy recovery is preferable to disposal to landfill, export is not helping Ireland to move towards self-sufficiency. In 2015, the DECLG carried out a public consultation entitled *Exporting a Resource Opportunity? Measures to Maximise Resource Efficiency and Jobs in Ireland* (DECLG, 2015a) in response to the growing trend to export waste for further processing and treatment. It is expected that it will result in a number of policy measures to incentivise treatment of waste in Ireland, which will also result in Ireland benefitting from the associated resource and jobs potential.

Ireland has some waste infrastructure deficits, such as the lack of a hazardous waste landfill, and currently has limited capacity for other infrastructure (waste to energy, landfill, recycling). The tracking of built and planned national waste infrastructure capacity, and monitoring trends in export of waste, is key to waste management planning. If Ireland is largely dependent on its export market and has insufficiently developed national capacity, we are vulnerable to external forces such as economic recession, currency fluctuations and any changes to import policy in the EU.

Ireland is at risk of failing to meet some of its future EU waste targets, in particular the recovery and recycling of end-of-life vehicles and portable battery collection. In order to achieve these targets, there will need to be a concerted effort by all stakeholders to bring in the necessary measures.

There is scope for additional EPR schemes. The farm hazardous waste collection initiative has been a tremendous success. A similar initiative could be rolled out for household hazardous waste streams, which, owing to a lack of awareness and/or outlets, are improperly managed (CSO, 2016).

The consolidation of waste management planning and waste enforcement regions will result in more focused, strategic and consistent waste management planning and enforcement. A key challenge will be ensuring that the lead authorities for these regions are adequately resourced to carry out these important roles. Another challenge the regions face is achievement of the targets set out in their 2015-2021 plans. The plans and target achievement are supported through Local Authority Executive Orders, however waste management is carried out by the private sector with the result that competition and market forces will significantly influence how waste is directed for treatment.

Marine litter prevention and generation are linked to a variety of human activities and policy areas, such as waste and waste water management, product design, shipping, fisheries policies, consumption and behavioural patterns. Successful implementation of waste policy is a prerequisite to avoid plastic litter entering the marine environment.

Another challenge is whether we can become a recycling society. By the end of 2017, there will be national capacity for incineration or co-incineration of up to 860,000 tonnes per annum. The perceived risk is that recycling will suffer at the expense of energy recovery, however there are regulatory controls in place at these facilities to prevent acceptance of recyclable material. Waste operators report high rates of contamination in bins presented for collection, which limits their ability to recycle the material. Significant improvement in national recycling rates could be achieved through improved segregation behaviours at point of generation of waste. With pay-by-weight coming into force in July 2017, it will be a challenge to ensure that associated enforcement plans for any contamination of bins or illegal burning or fly-tipping of waste are targeted, effective and proportional. A major public awareness and educational programme should precede the implementation of the charging measures.

Last but not least, we must ensure that prevention of waste and preparation for reuse remain central to Ireland's waste management policy. There is much scope for building on the successful NWPP and for Ireland to continue to lead on prevention on the EU stage. There is scope to build on existing social enterprises and increase preparation for reuse initiatives for waste streams such as furniture and WEEE.

Ireland has pioneered economic initiatives which have changed consumer behaviour and prevented waste (e.g. the plastic bag levy). Our NWPP is well established and an example of best practice (EEA, 2015; EPA, 2016b). Ireland should seek to be innovative and productive at this time of opportunity while the concept of the circular economy is taking root, being planned and implemented.

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Chapter 7

Land and Soil

Land and Soil

Introduction

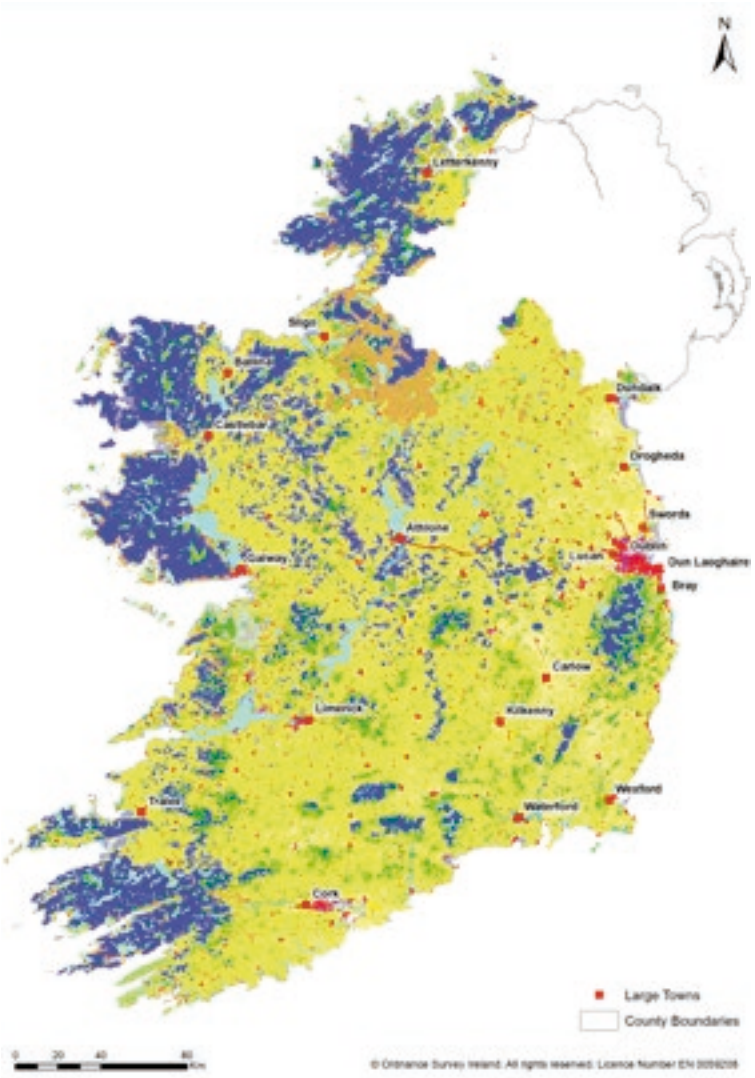
Soil is a biologically active, complex mixture of weathered minerals, organic matter, organisms, air and water. This mixture supports a range of critical functions such as supporting terrestrial ecosystems and biological diversity, agricultural food production, flood alleviation, water filtration and storage, and carbon capture. Soils form over long time periods and should be considered as finite resources to be protected and managed carefully.

The environmental roles and functions provided by different soils are increasingly being recognised. Soil type and overlying surface conditions within water catchments play a key role in determining the risk of water pollution, through preventing nutrient runoff and the treatment of septic tank effluent. There is now a greater awareness of the need to protect soils and manage their use in a sustainable manner and of the wider benefits that can accrue.

Ireland's soils, land use and landscape have been shaped by natural processes and human interventions throughout our history, leaving us with a rich mix of geological features, soil types and land cover. This section examines the key land cover types, sectoral activities, challenges and pressures that shape Ireland's landscape and the state of our environment, as well as highlighting some key research activities providing better mapping of land and soil and understanding of the critical interactions between soil, land use and environmental protection.

According to a recent EEA report, land take for urban, infrastructure and industrial purposes exceeds 1000 km^2 per year in the EU, with half of this surface being defined as "sealed", i.e. the connection between the atmosphere and the soil surface is interrupted. This sealing effect can impact on natural exchanges occurring between soils and the atmosphere which influence the natural function and associated biodiversity of soils (EEA, 2016).

Figure 7.1 CORINE 2012 Land Use and Land Cover Map (Source: EPA GIS stock)



The Current Situation

Land Use and Land Cover

The interactions between land use and land cover shape our environment.

The interactions between human activity, such as farming, forestry and the built environment, are interlinked with processes that shape the environment, landscape and biodiversity of the country. Land cover describes what is visible on the land surface. Land use describes the use(s) the land has been put to from a human perspective. CORINE is a pan-European land use and land cover (LULC) mapping programme and is the main source of national-scale LULC information. The most recent assessment in 2012 shows that agriculture is the primary LULC type within Ireland (67.36% national land cover), followed by wetlands (15.56%) and forestry (9.37%) (Figure 7.1 and Table 7.1).

Land Cover and Land Use Datasets

More detailed mapping will improve the knowledge base and decision-making capability.

No single detailed integrated national baseline LULC dataset currently exists in Ireland. The existing data either lack the appropriate resolution (e.g. CORINE[1]) or are sector-specific subsets of the data produced by various agencies (e.g. forestry data produced by the Forest Service). A national working group is developing a co-ordinated national mapping programme to address this gap. This programme will be essential to monitor, report and assess the environmental impacts of different land cover and land uses. This is illustrated in the water environment, where LULC can, for example, influence susceptibility to flooding and its impact on water quality and water-related ecosystems.

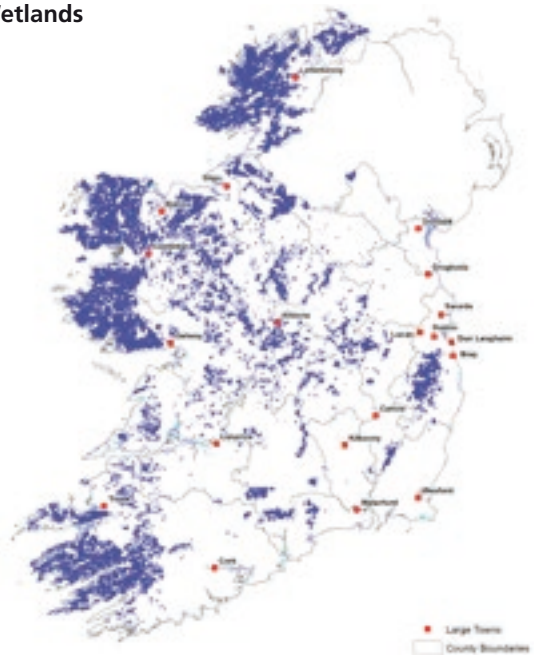
1 Co-ORdinated INformation on the Environment.

Table 7.1 2012 CORINE Land Cover, Land Use and Land Use Change (Source: EPA, 2014a)

CORINE land cover and land use classes	CORINE 2012 summary		
	% of national area	% change since 2006	% change since 1990
Agricultural areas	67.36%	-0.11%	-0.11%
Wetlands	15.56%	-0.04%	-2.95%
Forest	9.37%	0.11%	2.05%
Semi-natural and low vegetation	3.16%	0.00%	0.27%
Artificial surfaces	2.46%	0.04%	1.01%

Figure 7.2 CORINE Landcover Maps (Source: EPA GIS stock)

Wetlands



Semi-Natural & Low Vegetation Areas

Forestry

Artificial Surfaces

Land Cover Data Reporting Variation

CORINE data are presented at a baseline resolution of 25 ha for all land cover classes. Where more detailed sectoral data are available, these are referred to in the sections below. Although it may appear that some CORINE data values are contradictory, this is simply the result of variations in the quality and extent of data available or the mapping resolution used.

Agriculture

Agriculture accounts for the majority of national land use.

Agriculture accounts for 67.36% of the national land cover. The main agricultural class is pasture (54.67% national land cover), followed by land principally occupied by agriculture (primarily pasture), which is interspersed with areas of natural vegetation (6.99%), arable land (4.85%) and areas with complex cultivation patterns (0.84%) (EPA, 2014a). Analysis of LULC change between 2006 and 2012 shows that the primary agricultural changes were as expected, with an internal class change from pasture to arable and vice versa (38.49% of total national change), followed by afforestation of pasture lands (8.32%). The balance of change between agricultural classes has resulted in only a small reduction (-0.11%) since 2006.

Teagasc's Soil Quality Assessment Research Project describes that "the objectives of Food Harvest 2020 place a demand on soils to support the intensification of agriculture to meet global food security objectives. Simultaneously, greening objectives of the Common Agricultural Policy insist that increases in production must be achieved in a sustainable manner".

Peatlands

Peatlands provide a range of environmental benefits.

Peatlands provide a range of functions, including maintaining biodiversity and water quality, carbon storage and sequestration, agriculture, forestry, water regulation, recreation and flood attenuation. According to the Rural Development Programme (DAFM, 2014a), peat soils cover 20.6% of Ireland's land area. Near-intact peatlands may actively sequester, on average, 57,400 tonnes of carbon per year over the whole country. The National Peatlands Strategy (DAHG, 2015a) sets out how to sustainably manage and protect/conserve our national peatland resource. This strategy estimated that Irish peatlands store some 1,566 million tonnes of carbon, representing approximately 64% of the total soil organic carbon stock present in Ireland.

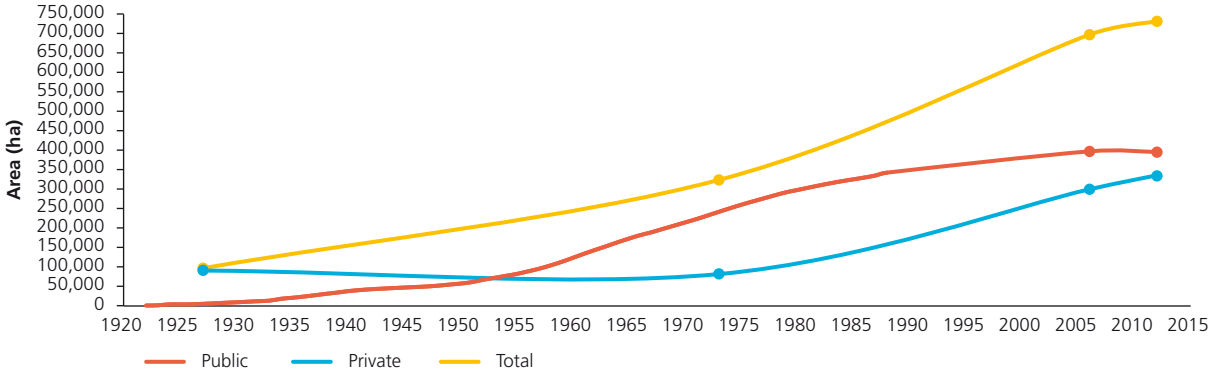
Forestry

Forestry levels in Ireland are low compared with the EU.

Forests provide many environment-related functions, including carbon sequestration and storage, water regulation and support for biodiversity, in addition to their commercial value. Ireland's National Forestry Programme 2014-2020 has identified four key needs for Ireland's forestry sector. These are (1) permanently increasing Ireland's forest cover, (2) increasing and sustaining forest-based biomass production to meet renewable energy targets, (3) supporting forest holders in actively managing their plantations and (4) optimising the environmental and social benefits of new and existing forests. To meet these needs, a series of "woodland and afforestation" schemes have been prepared by the Department of Agriculture, Food and the Marine (DAFM). This afforestation scheme requires a minimum 10% broadleaf component to be included. In addition, a national broadleaf target of 30% has been set for the overall "Afforestation and Creation of Woodland" measure in the National Forestry Programme.

Ireland's 2015 Forestry Annual Statistics Report (DAFM, 2015b) describes forest cover to be at its highest level in over 350 years, with forestation estimated at 10.5% of the total land area. Despite this, Ireland still has one of the lowest afforestation levels in the EU. The national forest estate is an important carbon reservoir, amounting to 381 million tonnes of carbon in 2012, an increase from 348 million tonnes in 2006. The Rural Development Programme 2014-2020 (DAFM, 2014a) also reports that

Figure 7.3 Forest Area Change, 1922-2014 (Source: DAFM, 2014b)



broadleaf planting as a proportion of total afforestation increased from 23% in 2003 to 31% in 2012. The latest edition of Ireland's Forests' Annual Statistics Report (DAFM, 2015b), indicates that broadleaf afforestation currently comprises approximately 23% of all afforestation. Figure 7.3 shows the change in national forest area up to 2014.

Soil Health

Soil health is important nationally for a range of functions.

Healthy soil provides us with clean air, food and water, supports ecosystem services, the growth of plant and animal life and provides the foundations for human habitats and structures. The threats to soils under current land use, management and climate conditions are low by international standards (EPA, 2014d). Soils can act as barriers to subsurface contamination. Where geological bedrock is exposed or soils are thin, the potential exists for pollutants to permeate deeper into the ground and have wider impacts on aspects such as groundwater quality.

The EU Seventh Environment Action Programme (which came into force in 2014) commits Member States to increase efforts to reduce soil erosion, increase soil organic matter and remediate contaminated sites by 2020 (EC, 2013). The Water Framework Directive (2000/60/EC) (WFD) and the Floods Directive (2007/EC/60) create planning mechanisms that can support actions to improve soil quality and combat land degradation, including measures to put green infrastructure in place (EEA, 2016).

There is little specific legislation relating to soil protection in Ireland, apart from that for key habitats/ecosystems associated with peat soils and site-specific regulation linked to industrial and waste facilities. However, the 2011 Environment Impact Assessment Regulations for On-Farm Development include requirements for environmental impact assessments for soil operations. In addition, the European Communities (Environmental Liabilities) Regulations 2008 establish an environmental liability framework based on the "polluter pays" principle to prevent and remedy environmental damage, including damage on, in and under land.

Soil Biodiversity

Biodiversity of soil plays a wider role in our environment.

Approximately one-quarter of all living species live in our soils (e.g. fungi, bacteria and invertebrates). They play a crucial role in regulation of the atmosphere, water quantity and water quality, pest and disease incidences in agriculture, natural ecosystems and human diseases. Soil biodiversity provides for food production, pollution control and development of pharmaceuticals.

Soil organic matter has a key role in maintaining soil functionality, water and air quality and carbon sequestration. Proper land use management is essential to prevent soil-stored carbon being released into the atmosphere, where it would contribute to climate change. Continuous tillage practices may also reduce soil organic matter content; to address this, the DAFM produced guidelines in 2010 to implement sustainable agricultural management practices.

Drivers and Pressures

Changes in Land Use and Land Cover

Some important changes over the past two decades.

Land is subject to many, often competing, sectoral demands. National policies, such as in forestry, agriculture, peatlands and the built environment, influence land use change and resource management. The effects of poor land use management practices can be particularly evident in aquatic ecosystems (e.g. siltation and nutrient runoff and spread of invasive species). Between 1990 and 2012, the amount of forestry increased (due to afforestation programmes) and wetland areas decreased by 2.95% (due to extraction in peatlands, agricultural drainage, etc.). Significant urbanisation also occurred between 1990 and 2006; however, between 2006 and 2012, the rate of urbanisation decreased significantly (reflecting the economic downturn). Urbanisation is expected to increase again with continued economic recovery.

Both single rural housing and suburban growth can both impact on soils and landscape and need to be carefully managed. Ireland has adopted a "core strategy approach" to the development of settlements with the adoption of the Regional Planning Guidelines (2010-2022). The benefits of a core strategy development approach are also recognised at EU level. The European Environment Agency has stated that "compact urban development and resource efficient approaches to the built-environment can provide opportunities to alleviate environmental pressures and enhance human wellbeing and also protect from the impacts of climate change" (EEA, 2015).

The Central Statistics Office (CSO) has estimated that the number of one-off houses in 2011 stood at approximately 433,564. The number of dwellings with septic tanks built between 2006 and 2011 fell from 50,011 in 2006 to 30,895 in 2011; the number with other individual systems rose from 16,689 to 19,074 over the same period. Between 2002 and 2011, the proportion of houses built that are stand-alone decreased from 28.1% in 2002, to 27.1% in 2006 and further, to 26.3%, in 2011 (CSO, 2012).

Strategic Planning and Sector Issues

Population growth

Population increase and settlement growth are the principal causes of land use changes in urban areas. This has implications for soil quality, climate, biodiversity integrity, air quality, flood risk and water quality. Ireland's population is projected to reach 5.1 million in 2031, with the most significant increase predicted for the Greater Dublin Area (CSO, 2013). Forward strategic planning and new infrastructure are needed to ensure that growth is sustainable and does not add to the environmental pressures that are already evident in delivering drinking water, treating urban waste water and tackling air pollution.

Agriculture growth

Achieving the aims of Food Wise 2025 (DAFM, 2015b), without damaging the environment upon which agriculture depends will be a significant challenge. Many significant actions are included in this plan, which relate to sustainable food production and management and protection of soil quality. This key challenge for Ireland's environment is covered in more detail in the section on "Economy and Agriculture", but it is clear that the health of both our soils and our agriculture sector are intrinsically linked and dependent on one another.

Decline in peatlands

Table 7.2 shows that, between 2007 and 2013, there was a decline in the range, area, structure and functions and status of Ireland's peatlands (DAHG, 2014).

According to the National Peatlands Strategy, only 10% of the original raised bog and 28% of the original blanket peatlands resource are suitable for conservation (as natural peatlands). Land drainage, reclamation for agricultural purposes and peat extraction have all impacted peatlands. The damage caused by these activities also has a negative effect on climate mitigation, as it prevents carbon sequestration and reduces the available carbon stock as, when drained, peat oxidises and CO_2 is released. The emergence of climate change as a key social, economic and environmental issue has brought fresh impetus to the need to preserve remaining functional peatlands and to accelerate the restoration of damaged peatlands.

Table 7.2 Changes in Peatlands Between 2007 and 2013 (Source: collated from DAHG, 2014)

	Active raised bog		Degraded raised bog		Active blanket bog	
Conclusion	2007	2013	2007	2013	2007	2013
Range						
Area						
Structures and functions						
Future prospects						
Overall status						

Status code: = Bad = Inadequate = Favourable

Forestry Expansion Programme and associated environmental challenges

According to the National Forestry Policy Review (DAFM, 2014b) annual afforestation has decreased from over 20,000 ha in 1996 to just over 7,000 ha in each of the past 3 years (2012-2014). This Policy Review seeks to increase afforestation by setting an annual afforestation target of 10,000 ha/year by 2015 and a target of 15,000 ha/year for the period 2016-2046. Since 1990, Ireland has had one of the highest rates of increase in forest expansion in the EU. This rapid increase may potentially give rise to additional environmental pressures and requires sensitive environmental management. Afforestation and harvesting may adversely affect natural vegetation, soils, biodiversity and landscape resources. These activities can also impact on water quality through acidification and nutrient mobilisation. However, if carried out in an environmentally sensitive manner and in the right places, expanding our national forestry cover can bring multiple benefits across society, the environment and the economy.

The challenge will be to establish and maintain a sustainable level of broadleaf planting to protect environmental sensitivities (e.g. biodiversity and water quality) while still providing for an economically viable commercial forestry resource.

Soil quality or contamination

Six key degradation processes can impact on soils: soil sealing, erosion, organic matter decline, compaction, salination and landslides. EPA research (EPA, 2014d) shows that the main soil quality pressures in Ireland appear to relate to surface sealing (urbanisation). Human activity is also a significant driver of degradation through poor (or inappropriate) land management practices. However, in Ireland, the overall area of artificial surfaces remains low compared with that in other EU Member States.

Soil contamination can occur as a result of unauthorised waste-related activities, historical activities, leakages and accidental spillages of chemicals. There is currently no specific contaminated land policy in Ireland and therefore no legislation in place to deal with it. However, according to national legislation dealing with Integrated Pollution Prevention and Control (IPPC)/Industrial Emissions Directive (IED) and waste, the EPA is responsible for enforcing the remediation of contamination identified at EPA-licensed facilities and the licensing of remediation activities that fall under the above legislation.

The National Waste Report for 2012 (EPA, 2014c) shows the treatment of contaminated soil off-site in Ireland fell by 40% in 2012 compared with 2011. This correlates with the downturn in the construction industry. Figure 7.4 shows the reported off-site management of contaminated soils from 2009 to 2015 (EPA, 2014c, with additional recent data included).

The Environmental Liabilities Directive (ELD) (2004/35/EC) and related national regulations establish a framework for environmental liability based on the "polluter pays" principle. This includes preventing environmental damage to soils. A recent European Commission report on the implementation status (by Member States) of the ELD has been published (EC, 2016). This report shows that implementation varies across Member States, with some countries (including Ireland) having very few instances of implementing the ELD. One recognised issue is that there is no common understanding of the definition of "significance threshold" for environmental damage.

Figure 7.4 Offsite Management of Contaminated Soils from Ireland 2009-2015 (Source: EPA, 2014c With Additional Recent Data Included)

Responses

Spatial Planning

Good planning decisions are those that are integrated and also provide for a better environment.

Spatial planning strongly influences land use. Good planning decisions can incentivise more efficient resource use in the built environment and avoid the intrusion of inappropriate urban infrastructure into natural areas. According to the European Environment Agency's State of the Environment report (EEA, 2015), integrated spatial planning "can optimise economic development opportunities, ecosystem services, reduce human exposure to environmental pressures and reduce social inequities … the challenge is to design a future urban environment with public appeal while meeting the needs of the population". The importance of clean and well-protected "green" and "blue spaces" such as parks, ponds and wild areas in the urban landscape is now recognised as a key part of urban landscapes that are needed for healthy communities. The real benefits of these areas to health are covered in Chapter 8.

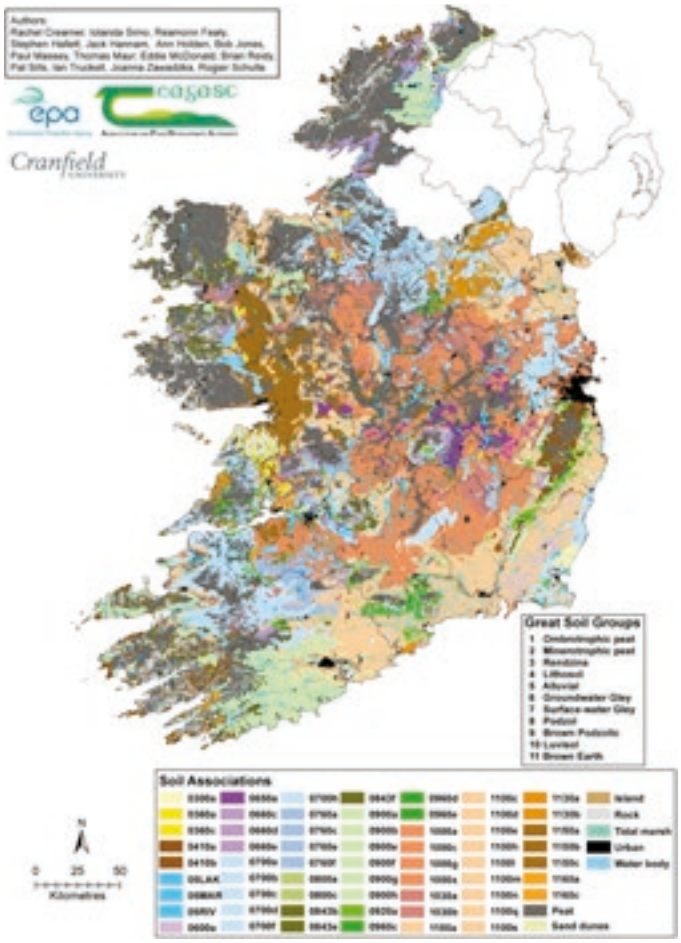
Land Cover Mapping

Mapping at greater resolution is needed to pick out local issues.

Addressing the national level resolution gap in land cover mapping remains a challenge and requires collaboration between many organisations and government departments. An EPA study in 2010 (G. Smith, EPA, December 2010, personal communicationz) found that there is still a need for a national high-resolution (1–5 ha scale) land cover dataset to characterise and assess LULC adequately, as small areas of biodiversity, water bodies and rural/one-off housing are indiscernible at a 25 ha scale. At an EU level, Action 5 of the EU Biodiversity Strategy (EC, 2011) calls on Member States to map and assess the state of ecosystems and their services. A dedicated EU working group has been established to deliver this action.

Irish Soil Information System

Figure 7.5 National Soil Map of Ireland (Source: EPA, 2014b)



Since the last EPA State of the Environment report in 2012 was published, availability of soil data has increased. One area which has seen significant improvement has been the establishment of a national soil map as part of the EPA-funded Irish Soil Information System Project, published in 2014.

The overall objective of this project, undertaken by Teagasc, Cranfield University and University College Dublin, was to assess the national distribution of soil types and prepare a national soil map that would identify and classify soils using a consistent national classification. In addition to the map, a collection of tools to access and interact with the soils data were developed. The various soil types have been assessed taking into account their environmental and agronomic responses. This should assist soils management planning and related policy implementation. This map is now publicly available at: *http://gis.teagasc.ie/soils/*.

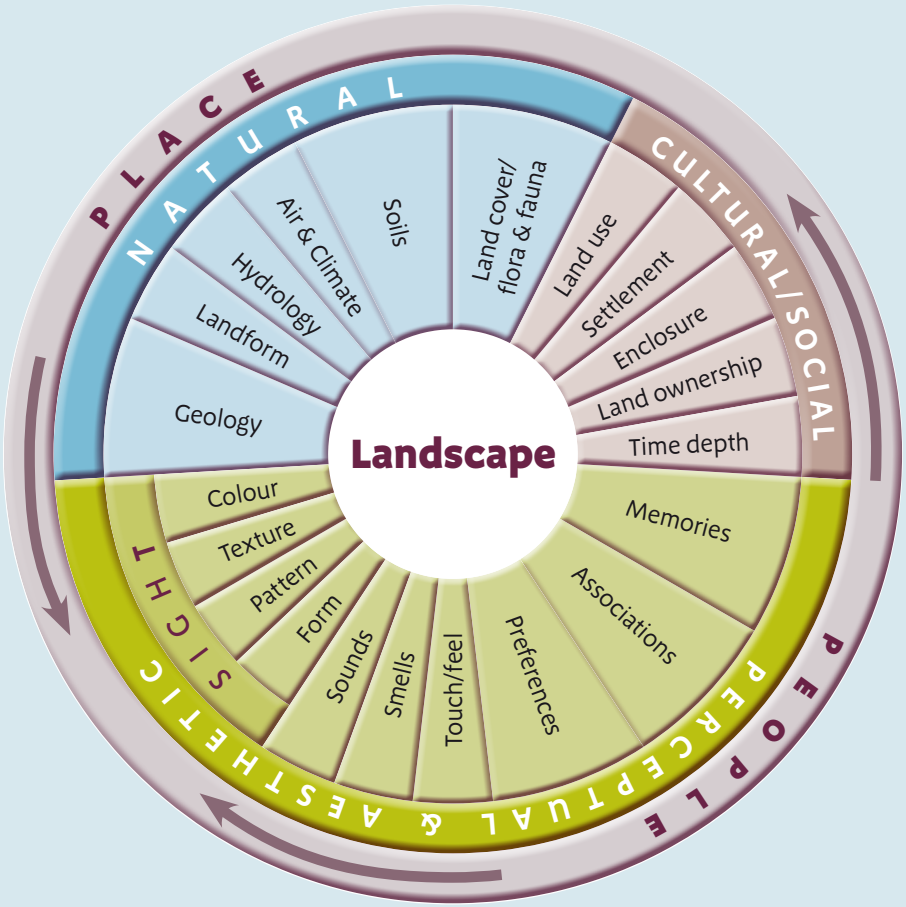
National Landscape Strategy

Protecting and enhancing the landscape while positively managing change.

The European Landscape Convention (ELC) seeks to strike a balance between management planning 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 National Landscape Strategy (NLS) (DAHG, 2015b) also seeks to ensure that Ireland complies with the ELC by establishing principles for protecting and enhancing the landscape while positively managing changes.

The National Land Cover and Habitat Mapping Programme is considering developing detailed land cover maps that will be essential to assess the potential impacts on our landscape resource of land use planning.

Figure 7.6 The Landscape Wheel (Source: Natural England)



The NLS specifies a commitment to ensuring that sector-specific policies and legislation within the remit of relevant bodies are consistent with the objectives of the strategy. These include:

- implementing ELC recommendations into the planning process;
- preparing "State of Landscape Report(s)";
- providing a national and sectoral-level landscape policy framework to protect, manage and plan for the sustainable stewardship of our landscape.

A consistent landscape characterisation framework approach at a national level to inform planning authorities is required. An increased awareness of landscape matters, community participation and the establishment of a consistent methodology to assess, monitor and report on the state of landscape are also recommended. By integrating the NLS into land use planning, sustainable landscape management practices can be progressed.

According to the Heritage Council, the implementation of the NLS should prove to be a turning point in landscape awareness and management. The development of bespoke agri-environmental (locally led) schemes aimed at promoting high-nature-value farming and the development of landscape partnerships, with support under future leader programmes or from national agencies, may also become a growing trend. In keeping with the emphasis placed by the ELC on public participation, the development of Local Authority Public Participation Networks (PPNs) and participative processes, such as community-led village design statements, coupled with the United Nations Economic Commission for Europe (UNECE) Aarhus Convention and its adoption in domestic legislation and policy, are likely to shape future trends.

National Peatlands Strategy

The National Peatlands Strategy is a key strategy that establishes the framework for the future use of our bogs.

The National Peatlands Strategy sets out the actions required and partners responsible for its management and implementation. In 2015, Bord Na Móna (BNM), one of the strategy partners, announced its intention to cease peat harvesting activities by 2030 and focus on supplying renewable energy. It is also notable that between 2009 and 2014, BNM restored 1,136 ha of drained raised bog (BNM, 2015). In 2016, BNM launched its Biodiversity Action Plan 2016-21, which supports the ongoing restoration and management of peatlands.

Identification and Clean-up of Contaminated Land

EPA-licensed sites are required to implement aftercare provisions closure to remove any remaining residual soil contamination.

Appropriate financial provisions may also be required for some licensed sites to ensure that any residual contamination is appropriately managed. The WFD also requires measures to be taken where identified contaminated lands pose a threat to water quality.

Agriculture

Agriculture polices could have a significant bearing on land use in the future.

Food Wise 2025 includes many sustainability-related actions to improve the environmental footprint of the agriculture sector. A wider discussion of this topic and the related environmental challenges is presented later in this report. By fully implementing the environmental-related elements of Ireland's National Rural Development Programme 2014-2020, adverse environmental effects (including on soils, water quality, etc.) can be minimised.

The EU Common Agricultural Policy and schemes such as Agri-Environmental Option Schemes, for example, encourage farming practices that maintain soil fertility and levels of organic matter. Teagasc's SQUARE Project is developing a toolbox for farmers to use to assess soil structural quality, soil functional capacity/quality and impacts of soil structural degradation on its functional capacity. This will be a useful management tool to minimise nitrogen and phosphorus losses.

River Catchment-based Flood Risk Assessment and Management

The flooding along parts of the Shannon catchment experienced in 2015 was widely reported in media news reports that outlined the severe impacts on local communities and business. This flooding has highlighted the need for a wider debate and a national solution to managing flood risks in catchments and managing land use in areas at risk of significant flooding. The national Catchment-based Flood Risk Assessment and Management (CFRAM) programme currently aims to assess the existing flood risk of inland watercourses and coastlines in Ireland and consider flood alleviation options. The programme is also considering the potential for significant increases in flood risk arising from climate change, ongoing development and other pressures that may arise in the future. The CFRAM programme is the vehicle for delivering on the main requirements of the European Floods Directive. This directive applies to inland waters as well as coastal waters.

According to the Office of Public Works (OPW), the national body co-ordinating this work, the objectives of the CFRAM programme are to identify and map the existing and potential future flood hazard and flood risk in the communities at risk, to identify viable structural and non-structural options and measures for the effective and sustainable management of that flood risk and to prepare a series of flood risk management plans that set out the policies, strategies, measures and actions that should be pursued by the relevant bodies (including the OPW, local authorities and other stakeholders) to achieve the most cost-effective and sustainable management of existing and potential future flood risk.

The CFRAM programme covers the whole of the country, divided into seven large areas called River Basin Districts. Each River Basin District is then divided into a number of units of management, and one flood risk management plan will be prepared for each unit. The CFRAM programme is specifically focused on a number of areas where the risk has been determined to be potentially significant, which are referred to as "areas for further assessment", and on the sources of flooding that were determined to be the cause of significant risk within those areas. Detailed draft flood mapping for those areas for further assessment was put out to public consultation in late 2015.

Draft flood risk management plans will be accompanied by strategic environmental reports, which will document the strategic environmental assessment process. The environmental reports will identify, evaluate and describe the likely significant effects on the environment of implementing the measures set out in the draft flood risk management plans. The environmental reports will also document how the plans have been prepared, with a view to avoiding adverse environmental effects and will also, where appropriate, set out recommendations as to how adverse effects can be mitigated, communicated and monitored. A Natura impact statement will also accompany the draft flood risk management plans to set out the findings of the Appropriate Assessment in relation to the impacts of the plans on Natura 2000 sites. Following completion of the consultation process, the draft flood risk management plans will be finalised taking into account comments received, as well as comments on the environmental report and the Natura impact statement.

Work on the CFRAM programme also involves significant overlap and co-ordination with activities related to the WFD, including specific aims to support the objectives of the WFD, consideration of multiple-benefit mitigation measures (such as land use management and natural water retention measures) and joint liaison between the OPW, EPA and the Water Policy Advisory Committee.

The OPW has commenced consultation on the draft flood risk management plans for units of management during 2016.

National Forest Review Policy

Forestry growth under a number of strategies is likely.

The Forestry Act 2014, once enacted, will support the development and management of sustainable forest management practices (Oireachtas, 2014). The National Forest Policy Review identifies climate change mitigation, along with sustainable increases in wood production and contribution to renewable energy source production as key drivers of continued afforestation.

The National Peatland Strategy reports that afforestation of unenclosed lands (mostly comprising peaty soils) peaked in 1995 with over 6000 ha planted. Since then the trend has decreased significantly, with approximately 100 ha of unenclosed lands planted in 2013. Coillte has contributed in restoring approximately 3250 ha of peatland habitat up to 2015, through initiatives including co-funded EU LIFE projects.

In 2010, the Forestry Commission of Scotland advocated forest "zoning" mapping when preparing forestry and woodland strategies. This mapping highlighted the most environmentally favourable areas for afforestation. A similar approach in Ireland may be beneficial to maximise environmental and economic benefits. Work undertaken by both the Forest Service, through its Forest Inventory Production System (FIPS) and the EPA, through its WFD characterisation work, could assist in identifying these areas. The aforementioned national land cover mapping initiative would also provide information that would help with this.

Research

Investment in research will provide information about the interactions between soil protection and wider environmental protection.

The EPA research programme funds research that informs land and soil policy development and implementation, enforcement and sustainable use. The range of projects funded includes desk and medium-scale studies, scholarships and fellowships. A number of key significant soil and land use-related research projects are listed below:

- LANDMARK Project: a pan-European project seeking to unearth pathways to sustainable land management
- H2020 INSPIRATION:[2] integrated spatial planning, land use and soil management research action project (EC, ongoing)
- Irish Soil Information System Project (EPA, 2014b)
- Towards Landcover Accounting and Monitoring Research Project[3]
- Soil Status and Protection Research Project[4]
- Soil Contamination Guidance (EPA, 2013)
- Carbon Restore: assessing the carbon restoration potential of Irish peatlands (EPA, 2012)
- BOGLAND: Sustainable Management of Peatlands in Ireland (EPA, 2011)
- HYDROFOR Project: ecological quality impacts of forest operations on water (EPA, 2014e)
- Potential Threats to Soil Biodiversity in Europe (JRC, 2016)
- The Direct and Indirect Impacts of EU Policies on Land (EEA, 2016).

Conclusion and Future Challenges

Soils, land cover and landscapes are resources that need to be protected, monitored and managed.

Soils, land cover and landscapes are resources that need to be protected, monitored and managed, from high-level national and sectoral land use plans through to local management activities on farms, forest plantations, peatlands, urban and rural settlements. We must also support continued collaborative research to inform decision making that may affect soils, land use and landscapes. Ireland has a rich and productive soil resource that supports significant food production and other social, economic and environmental uses, and it is important that we protect this precious resource for future generations.

In the absence of an EU Soils Directive and associated national soil legislation, the challenge remains to ensure a consistent approach to protecting and managing our limited soil resource, in the context of supporting environmentally sustainable economic and population growth.

Establishing and implementing an integrated national land cover, land use and habitat mapping programme is essential to assist in reporting and assessing the impact of different land cover and land use types on the environment. Providing a single agency with a mandate to develop this programme would help streamline its delivery. It will also be necessary to secure cross-organisational and governmental funding to support its implementation.

It is useful to quote again the European Environment Agency advice that "compact urban development and resource efficient approaches to the built-environment can provide opportunities to alleviating environmental pressures and enhance human wellbeing and also protect from the impacts of climate change" (EEA, 2015). The challenge is to design a future urban environment with public appeal that incorporates climate-proofing aspects, along with green areas and wild spaces for wildlife and people, while also meeting the needs of the population.

2 *www.inspiration-h2020.eu/*

3 *www.landmapping.wordpress.com/talam/*

4 *www.erc.epa.ie/safer/iso19115/displayISO19115.jsp?isoID=3121*

Forward strategic planning for land use and new infrastructure is needed to ensure that growth is sustainable and does not add to the environmental pressures that are already evident, such as the gradual loss of wetlands over the past two decades or capacity issues in delivering drinking water and treating urban waste water.

Land drainage, reclamation for agricultural purposes and peat extraction have all impacted peatlands, leaving only 10% of the original raised bog and 28% of the original blanket bog peatlands resource suitable for conservation (as natural peatlands). The damage caused to bogs is also damaging for climate mitigation. These issues point towards a pressing need to work on the implementation of the National Peatlands Strategy, in order to leave the best examples of the remaining unique and unspoilt boglands as a legacy for future generations.

By integrating the NLS into land use planning, sustainable landscape management practices can be progressed. As with the wider environment, there are a range of issues that affect landscape. Ensuring the sustainable management of landscape remains a key challenge, particularly in the context of evolving social and economic needs as well as climate change issues. The accomplishment of this overarching aim will be possible only through the establishment of consistent characterisation frameworks to assist local authorities and national agencies in engaging in infrastructure development. More initiatives to develop greater awareness of landscape and that facilitate local community participation are also a requisite for success in this area. Assessing the state of the Irish landscape to capture additional information is a key issue for future practice; such measurements may include the rate of Landscape Charter Assessment at a regional level, and the take-up of these assessments in decision making, policies and legislation, scenic designations, local community landscape initiatives, accessibility and awareness.

The flooding that parts of Ireland experienced in 2015 has highlighted the need for a wider debate and an integrated approach to managing flood risks in catchments. The national CFRAM programme that is under way aims to assess the existing flood risk of inland watercourses and coastlines in Ireland. The programme is also considering the potential for significant increases in flood risk due to climate change. The CFRAM programme, co-ordinated by the OPW, will be the principal solution for delivering on the main requirements of the European Floods Directive and should lead to better solutions to tackle flooding while minimising impacts on the wider environment.

Land is subject to many, often competing, sectoral demands. National policies, such as those for forestry, agriculture, peatlands and the built environment, influence land use change and resource management. Both single rural housing and suburban spread can impact on soils and landscape and need to be carefully managed. Achieving the aims of Food Wise 2025 (DAFM, 2015b), without damaging the environment, will be a significant challenge. Many significant actions included in the Food Wise implementation plan relate to sustainable food production and management and protection of soil quality. The implementation of all these sectoral plans and policies should be carefully monitored to ensure a sustainable approach to land use that does not negatively affect the environment, the wider economy and communities.

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Section III

Environment, Health and Wellbeing

Chapter 8

Environment, Health and Wellbeing

Chapter 8

Environment, Health and Wellbeing

Our Environment, Our Health, Our Wellbeing

Introduction

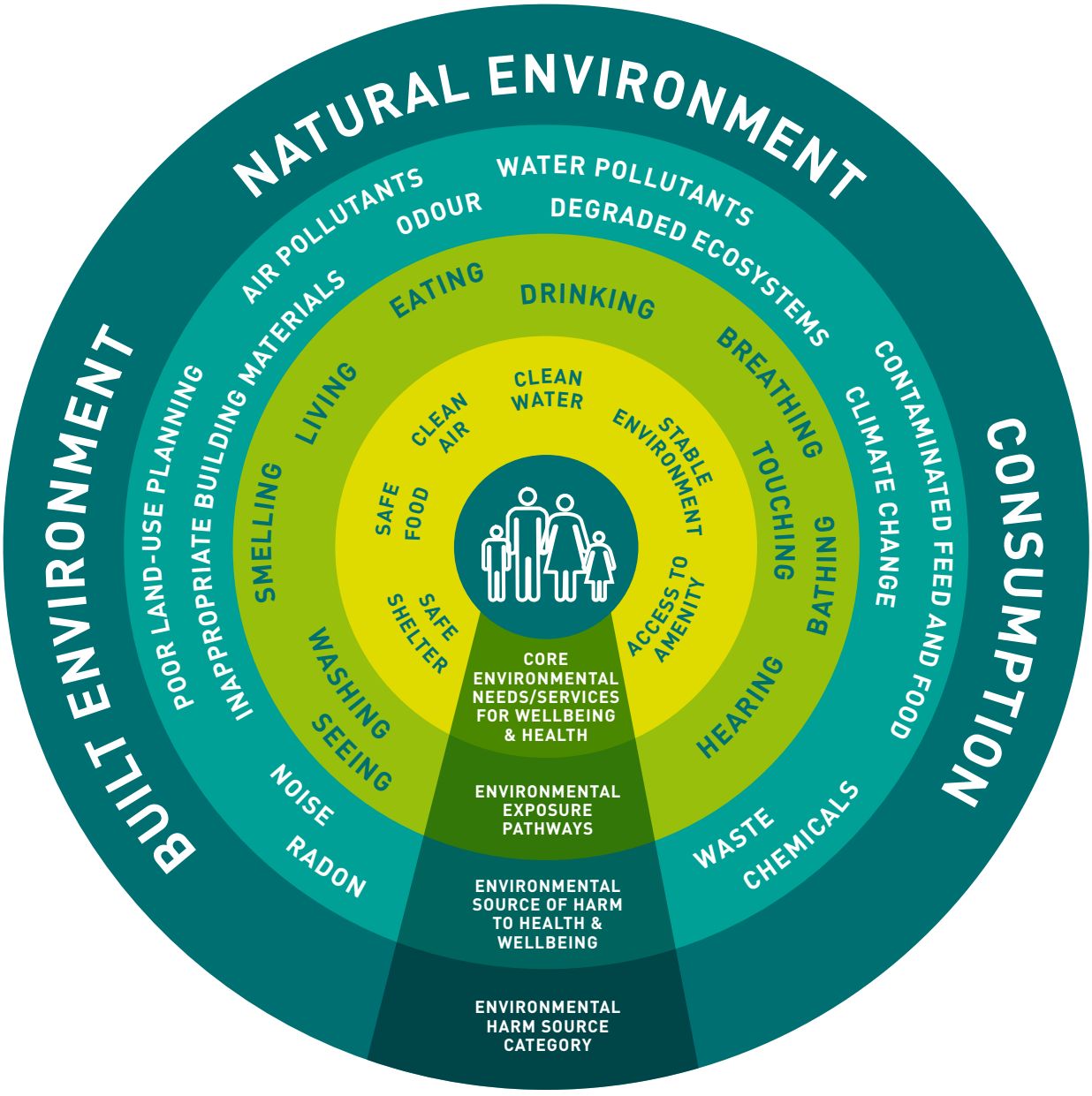
Ireland's environment is a fundamental and high-quality national asset that provides a strong foundation for healthy and contented lifes. Our most basic needs are clean air, safe drinking water and healthy food. The quality of each one of these is directly influenced by the quality of the environment. It follows that preventing damage to the environment arising from human activities also helps to protect our health and wellbeing. Recognition of the intimate interconnections between sustainable environments and healthy lives was highlighted last year by the United Nations and in the recent World Health Organization report 'Preventing Disease Through Healthy Environments' (WHO, 2016) whose Sustainable Development Goals (SDGs)[1] are designed to foster improvements in human health and wellbeing.

In this context, our "environment" is where we live, work and play – our everyday surroundings. While Ireland's environment is generally good by international standards, there are some areas where environmental degradation, and vulnerability to extreme events, can adversely affect health and wellbeing. To formulate an effective response we first need to fully understand and address the issues. Health and wellbeing effects arising from a compromised environment can range from immediate and short-term conditions (such as stomach upsets from contaminated water) to medium-term effects (such as stress from living with noise and odour) and chronic effects that result in illness in which environmental factors have played a key role (for example, poor air quality can result in cardiovascular disease).

Environmental hazards – biological, chemical and radiological – can affect health directly through the contamination of water, air, soil and food. The work of environmental regulation involves preventing people's exposure to these hazards by minimising them or by taking action when standards are exceeded. Figure 8.1 shows the range of environmental "harms" that can affect human health and wellbeing through our built and natural environments and via our consumption practices. These harms can impact on the six core service needs for our wellbeing: clean air, clean water, access to amenity, safe food, stable environment, and safe shelter.

1 *www.un.org/sustainabledevelopment/sustainable-development-goals/*

Figure 8.1 Health Model (Source: EPA)



Many of the environmental threats to our health are associated with our lifestyles and available choices. Our behaviours and consumption patterns clearly cause stress to the environment, leading to consequential poor health outcomes (for example, burning smoky fuels to heat our houses affects local air quality and people's health). A proactive approach to environmental protection, partly through regulation but also by changing how we live, will deliver a safer, healthier place for us to live now and into the future.

"…a healthy environment is a prerequisite for good health."

Dr Margaret Chan,
Director-General, World Health Organization

The European Environment Agency (EEA) estimates that poor air quality contributes to 432,000 premature deaths in Europe each year (EEA, 2015). The most significant pollutant identified by the EEA was particulate matter, which mainly arises in Ireland from traffic emissions and the burning of smoky fuels for home heating. As regards Ireland, the EEA reported that 1,200 premature deaths every year can be attributed to particulate matter exposure. The response required here is clear: policymakers, legislators and regulators need to ensure that the safest fuel and transport options are favoured and promoted to assist people in making healthier decisions. In parallel, individuals need to consider how their behaviours impact on our environment, and therefore contribute to health problems such as respiratory and heart disease in our own communities.

Threats to our environment, health and wellbeing are continually emerging. These include climate change, as, for example, extreme weather events in Ireland are likely to result in increased flooding and risks to drinking water. The EEA refers to other emerging health threats in its most recent State of the Environment report (2015a), including new chemicals and mixtures of chemicals, nanomaterials, endocrine-disrupting hormones and patterns of production and consumption.

In 2013, the Government published the Healthy Ireland framework, which aims to bring about changes to make Ireland a place where everyone has the opportunity to live a healthful life –in terms of both physical and mental health. The inclusion of "wellbeing" in the national discussion on health marks a welcome development, as it moves our ambition beyond "disease prevention" and embraces a fuller vision of people who are living well and have a general sense of satisfaction. Producing a safe, attractive environment and facilitating access for people from all social groups and cultures brings wide-ranging benefits. These benefits are both social, such as improvements in wellbeing and reductions in disease incidence; and economic, such as savings on health service provision and improving workforce health (leading to less absenteeism).

Healthy Ireland – A Framework for Improved Health and Wellbeing

Any environmental degradation has the potential to adversely impact on health. "Healthy Ireland" is a national Government framework for action to improve the health and wellbeing of the people of Ireland. Its main focus is on prevention and keeping people healthier for longer. Healthy Ireland's goals are to:

- increase the proportion of people who are healthy at all stages of life
- reduce health inequalities
- protect the public from threats to health and wellbeing, and
- create an environment where every individual and sector of society can play their part in achieving a healthy nation.

Healthy Ireland is founded on an underlying model of "determinants of health", which articulates a complex range of health-influencing factors that recognise the importance of environmental conditions alongside genetic, social, structural, cultural and economic factors (based on work by Dahlgren and Whitehead (1991), and Barton and Grant (2006)). The Healthy Ireland framework takes a whole-of-society approach to improving health and wellbeing and the quality of people's lives. In recognition of the human responses to different environmental threats and opportunities, the EPA has an active part to play in government actions to achieve the Healthy Ireland goals. Visit *www.healthyireland.ie* to find out more.

Environment and Wellbeing

Our environment has a strong influence on human health and wellbeing.

"We benefit much more from clean air, pure water, good food and exercise and strong communities than we do from hospitals, medicines and clinics."

Professor Martin Cormican, NUI Galway

Often the terms "green spaces" and "blue spaces" are used to describe those parts of our environment that include the natural and semi-natural features. "Green spaces" include farmlands, parks and forests. "Blue spaces" include rivers, canals, lakes and coastlines. As in any system, in order for these spaces to provide a full range of benefits they must be carefully managed so that they are functioning well. For people to want to spend time in green and blue spaces, three factors must be present: they need to be safe, attractive and accessible. Accessibility is key: it can be achieved through developing guided trails and other facilities and by making arrangements to ensure that everybody can meaningfully interact with green and blue spaces, regardless of mobility or other constraints. It is important to note that once accessed, support may be needed to foster beneficial use of the green and blue spaces.

In addition to the beneficial effects of being active in these spaces, scientists have also linked exposure to nature to benefits in coping with mental stress and fatigue. It has been shown that the very act of getting out in nature – whether in a park, on a beach or walking on a road – can bring real benefits to our mental wellbeing. The concept of "green and blue prescriptions" is now being explored as a tool to improve community health and wellbeing. Green and blue prescriptions constitute formal written advice from a health professional to spend time in the natural environment. During 2012, a trial of so-called "green prescriptions" was conducted and found to reduce obesity and to improve physical and mental health in nine trial groups across rural and urban communities around Donegal. Along with the measurable outcomes, such as positive impacts on blood pressure, the participants reported that engagement with nature was also associated with an improvement in mental wellbeing; this was reflected in statements such as "it's very good … to clear the mind" (HSE, 2014).

With over two-thirds of Ireland's population living in cities and suburbs, the inclusion of green and blue space in planning and management of urban development is crucially important in terms of delivering residential areas that provide a good quality of life for our population. Equally, for rural dwellers, safe walking routes and agreed access to parkland, rivers, lakes and upland areas must be provided.

Sustainable Living

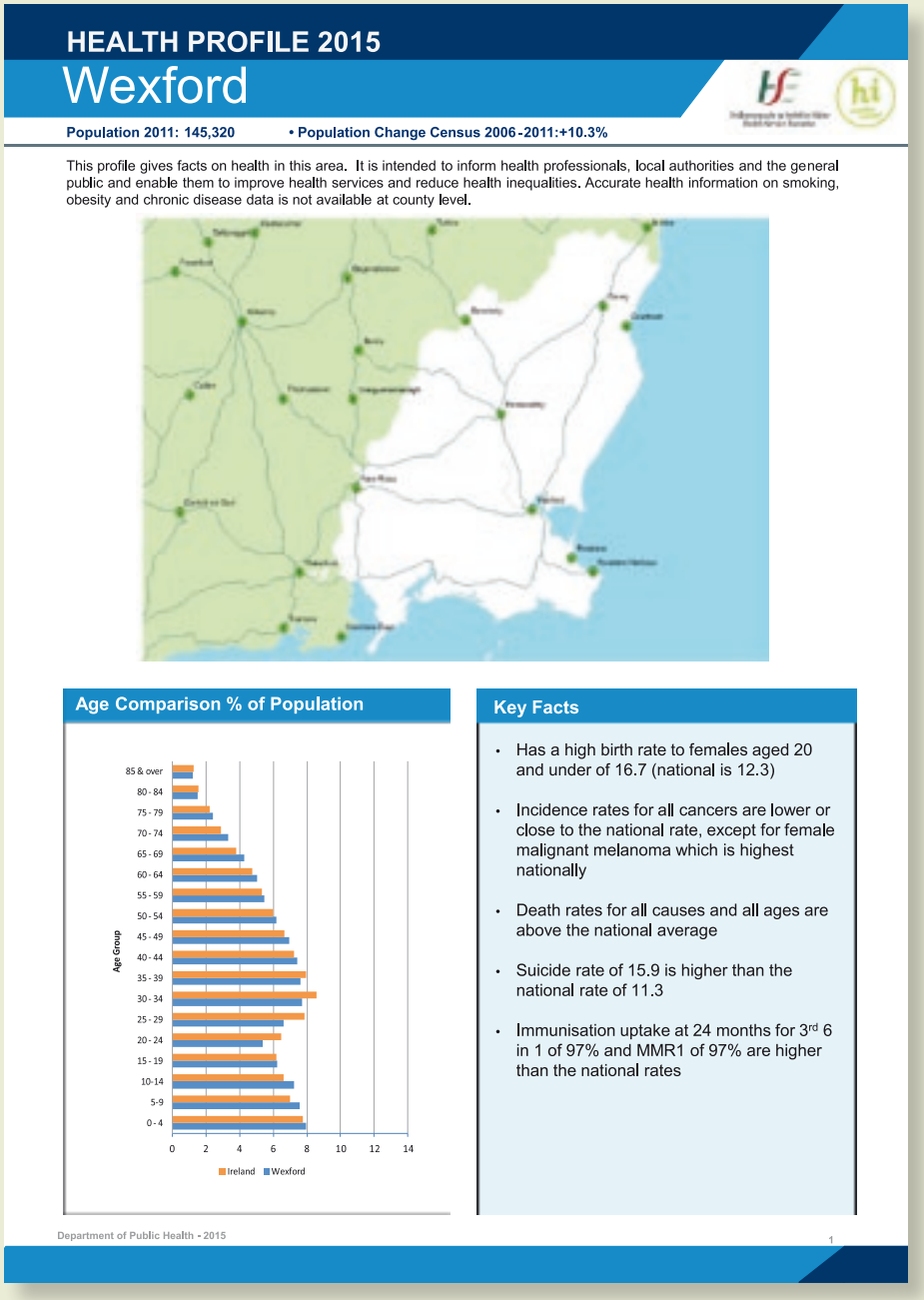
Our sustainable future sets out challenges and how we might address them to ensure that our quality of life and general wellbeing can be improved and sustained in the decades to come.

Most of the 17 Sustainable Development Goals agreed by the United Nations are clearly relevant to improving human health, reflecting a strong relationship between good health and sustainable living. Ireland's own national strategy for sustainability, Our Sustainable Future (Irl Gov, 2012), sets out sustainability challenges and how we might address them in order to ensure that our quality of life and general wellbeing can be improved and sustained in the decades to come. We do not live in isolation: all of us are part of a community, whether we choose to engage or not. It is in our nature to commune with each other, and we have a long history of successful public volunteerism – the bedrock of any community. In general, communities are built around residential, urban, rural, parish, business, educational, spiritual, sporting, artistic or social activities. A vibrant, inclusive and engaged community yields better health and environmental outcomes for all the residents, businesses, schools, etc. within it, i.e. outcomes are more sustainable.

Sustainability in local communities is a key objective of the recently introduced Public Participation Networks (PPNs), which aims to enhance public engagement in decision making and policymaking. PPNs are now established in every county and city across Ireland, based on three "pillars": environment, social inclusion, and community and voluntary.

The pattern of our daily lives at work and at home is largely controlled by the location of our daily activities, and this collectively shapes our urban environment and its relationship with the countryside. Through the strategic spatial organisation of these activities, our lifestyles can be healthier in terms of our personal wellbeing and also in terms of demands on resources and our environmental footprint. The Regional and County Development Plan system is the mechanism by which local authorities set out policies and site-specific land use objectives so as to direct development in a sustainable manner. The social and personal impact of a "loss of enjoyment of amenity", be it physical loss or through nuisance from odour and noise, can often be overlooked when trying to identify the major impacts from a development on a community. Although difficult to quantify, the loss of such amenities will undoubtedly result in deterioration in quality of life for a community. Appropriate regulation through land use planning and activity enforcement can mitigate this potential quality of life impact.

Figure 8.2 Health Profile 2015: Wexford (Source: HSE)



In 2016, new County Health Profiles were launched on the Health Service Executive (HSE) website[2]. The creation of County Health Profiles is one of the key actions from the Healthy Ireland strategy, as understanding health needs at a local level enables local action and creates an environment in which every individual and sector of society can play their part. The county profiles help to identify health priorities and highlight any health inequalities that may exist. They are useful for people who work with health partners on a county basis and are also useful for those who are interested in a short local profile, including healthcare professionals, local authorities and non-governmental organisations (NGOs).

The profiles provide a snapshot of the local demographics, health issues and wider determinants of health of that area, compared with the national picture. The data represent nationally available indicators that are available at a county/local authority level, e.g. population size, deprivation, healthcare utilisation, etc.

2 *www.hse.ie/eng/services/list/5/publichealth/publichealthdepts/pub/profiles.html*

Individual Choices

Areas where we can take action ourselves and make healthier and more sustainable choices.

At an individual level, our choices influence our health and that of our family and neighbours. Choices such as the fuel we use, the water we drink, how we manage our waste, the chemicals we use in our homes and gardens, household ventilation, the noise we create, etc., demonstrate our values and attitudes to our environment, community, health and wellbeing. The collaborative public information resource *www.LiveGreen.ie* gives advice and tips on how we can take action to make healthier and more sustainable choices.

livegreen

SMALL CHANGES, BIG DIFFERENCE

The EPA hosts an online resource called "Live Green – Small Changes, Big Difference" for householders and families, which contains tips, advice and guidance on a range of environmental and health matters across the following household themes:

- health and community projects
- water conservation
- waste prevention
- energy efficiency.

Living green means making small changes at home or in our communities. In turn, living green can make a big difference to our wellbeing, helping people to live a more sustainable lifestyle. Visit *www.livegreen.ie* to find out more.

Regulation and Policy

Environment, health and wellbeing is recognised as a fundamental and complex cross-cutting policy topic.

Concern for avoiding disease threats and fostering improvements in health and wellbeing has traditionally underlain much of the political priority given to environmental issues within the EU and the Member States. It is one of the primary drivers for policy actions that target air quality, water quality, soil quality and chemical use.

Within Ireland, environment and health is an area of growing public interest and involves a large number of organisations from both health (e.g. Department of Health, HSE, the Health Research Board and the Institute of Public Health) and environmental (e.g. various government departments, the EPA, local authorities) perspectives. Under its environmental protection mandate, the EPA delivers direct and indirect benefits to human health through a number of its responsibilities. These include controlling harmful substances, as well as emissions from licensed facilities; maintaining a supervisory function with regard to the provision of safe and secure drinking water; bathing water reporting; research; and monitoring ambient air quality. The EPA's Health Advisory Committee brings representatives from public health authorities together to advise the EPA on carrying out its functions in the context of health protection.

To further strengthen health protection and foster wellbeing, the concept of health assessment has emerged as a component of Environmental Impact Assessment. Through this process, the potential health effects of a development on the local population are considered – in terms of both positive and negative impacts. Such assessments combine evidence from research and monitoring with independent expert opinion to provide a clear understanding of potential direct and indirect health impacts, and to identify adjustments to mitigate future problems.

Clean Air and Health

The air pollution problems affecting cities in Europe are resulting in premature deaths.

Across Europe (including Ireland), the most overtly problematic pollutants causing disease in humans are particulate matter (PM), ground-level ozone (O_3) and nitrogen dioxide (NO_2). However, despite considerable improvements in past decades, Europe's air pollution problem is far from solved and is still responsible for over 432,000 premature deaths each year (EEA, 2015). Worldwide, the World Health Organization (WHO)[3] estimates that some 80% of outdoor air pollution-related premature deaths are due to heart disease and strokes, while 14% of deaths are due to chronic obstructive

3 *www.who.int/topics/air_pollution/en/*

Wellbeing of Future Generations (Wales) Act (2015)

During 2015, the Welsh Government passed a new law that aims to make the country more sustainable from both an environmental and a social point of view, while maintaining a focus on prosperity. The Wellbeing of Future Generations (Wales) Act (2015) is structured around seven "key goals", which aim to build a prosperous country that has a resilient environment and a clear global responsibility; to support a healthy population who have equal opportunities, to foster strong communities and to promote the Welsh language. A Future Generations Commissioner has been appointed and national indicators are being developed to track progress.

A fundamental aspect of this initiative is the clear intention to make Wales a better place to live for all citizens of the country – including an unambiguous focus on environment, health and wellbeing. The "hard-wiring" of sustainable development and wellbeing into governmental decision making is a bold step, and one that could offer a model for Ireland.

pulmonary disease or acute lower respiratory infections; and 6% of deaths are due to lung cancer. The risk of heart disease, which includes heart attacks, has particularly strong and consistent associations with fine particulate pollutants in air (e.g. PM2.5). During 2013, WHO further concluded that outdoor air pollution exposes humans to carcinogens, with the particulate matter component of air pollution closely associated with an increased incidence of cancer, especially lung cancer. As a result of this, WHO declared "It is now clear that the toll imposed by air pollution is much more serious than was previously understood" (WHO, 2015).

As described in detail in Chapter 2, Ireland's air quality relative to our European counterparts is good. However, values for particulate matter and ozone were above the more stringent WHO air quality guidelines at some stations. Polycyclic aromatic hydrocarbons were also above the EEA estimated reference level. The EPA has called for movement towards the adoption of these stricter WHO guidelines, in particular for particulates and ozone, as the legal standards across Europe and in Ireland. Adherence to these new standards will deliver better health outcomes. There are some specific exposures to air pollution in Ireland – especially around cities and towns and mostly associated with traffic emissions in cities and smoke from home heating in towns – that do not benefit from current restrictions on the sale and use of smoky fuels. In order to protect the health status of vulnerable populations and locations, the planned national ban on the sale of all 'smoky coal' in 2018 is a welcome development.

Dioxins

Monitoring shows that dioxins remain at a consistently low level in the Irish environment.

"Dioxins" is a collective term for over 200 chemical compounds, of which 17 are considered to be of toxicological significance. The toxic responses resulting from exposure include skin effects, immunotoxicity and carcinogenicity, as well as reproductive and developmental toxicity. These compounds arise mainly as unintentional by-products of incomplete or poorly controlled combustion (e.g. backyard burning of waste) and from certain chemical processes.

To maintain surveillance of dioxins, the EPA conducts surveys based on levels found in cows' milk. This is considered to be a particularly suitable matrix for assessing dioxin presence in the environment, since cows tend to graze over relatively large areas and these compounds will, if present, concentrate in the fat content of the milk. The most recent survey was undertaken in summer 2014 and follows previous studies carried out since 1995. These studies have shown that concentrations of dioxins remain at a consistently low level in the Irish environment.

As in earlier surveys, testing for dioxin-like polychlorinated biphenyls (PCBs) was also included in this programme, and some "marker" non-dioxin-like PCBs were added in 2012. All dioxin levels recorded in this survey are well below legislative limits and compare favourably with those from previous surveys and from other EU countries (EPA, 2015a). Considering that there is strict regulation of industrial combustion activities, one of the most significant risk factors for elevated dioxin levels in Ireland is illegal burning of waste in fields, gardens and domestic fireplaces (EPA, 2014).

Noise

According to WHO, noise is the second greatest environmental cause of health problems (after air quality).

Excessive noise can seriously harm human health, including mental health, and interfere with people's daily activities at school, at work, at home and during leisure time. It can disturb sleep, cause cardiovascular and psychophysiological effects, reduce performance and provoke annoyance responses and changes in social behaviour. According to WHO, noise is the second greatest environmental cause of health problems after air quality. A study commissioned by the European Commission on the health implications of road, railway and aircraft noise in the European Union (RIVM, 2014) found that exposure to noise in Europe contributes to:

- about 910,000 additional prevalent cases of hypertension
- 43,000 hospital admissions per year
- at least 10,000 premature deaths per year related to coronary heart disease and stroke.

In Ireland, noise issues are typically considered across three categories: neighbourhood noise, environmental noise, and noise from EPA- and local authority-regulated sites. Local noise issues, including those from neighbours and local commercial facilities, represent by far the largest source of noise complaints in this country, and are dealt with by local authorities. The EPA, with these local authorities, is currently developing a standardised national guidance document to be used in the management of noise complaints (expected to publish in 2017).

Environmental noise from major infrastructure including roads, railways and airports is governed by the EU's Environmental Noise Directive (2002/49/EC). The preparation of strategic noise maps is a major task associated with this directive and this is currently under way in Ireland.

Following completion of the noise maps, the relevant Action Planning Authorities will prepare noise action plans. The action plans are designed to act as a means of managing environmental noise through land use planning, traffic management and control of noise sources.

Finally, noise issues can arise at facilities regulated by the EPA and local authorities and, in 2014, 149 noise complaints were received in relation to EPA-licensed sites, compared with 143 in 2013. Nearly 80% of all such complaints related to just five licensed sites. In addition, just two sectors accounted for 90% of complaints: 64% related to the food and drink sector and 26% to the non-hazardous waste transfer stations sector. This information enables targeted enforcement action to be taken against priority sites, where additional resources are then focused.

Quiet Areas

It is important to identify and protect quiet areas.

In addition to controlling excess noise, it is also important to identify and protect those areas which are substantially unaffected by man-made noise. Accessibility to quietness is highly important to the health of both wildlife and humans. This is particularly so in urban environments, leading to the concept of Relatively Quiet Areas. These are areas, such as local parks, green and blue areas, which are characterised by their proximity to areas with high noise levels, and are valued by the public as a perceived area of tranquillity. Using both quantitative and qualitative assessments, eight Relatively Quiet Areas have been designated within Dublin (Dublin City Council, 2013), and areas in other parts of Ireland will be identified in consultation with the public. A recent report from the EEA on quiet areas in Europe provides a first assessment of potential quiet areas in Europe's open country (EEA, 2016a). The key messages from the report are that noise pollution is having a major adverse impact on human health across Europe, and that protecting those areas that are not yet affected by noise will bring significant health and wellbeing benefits.

Odours

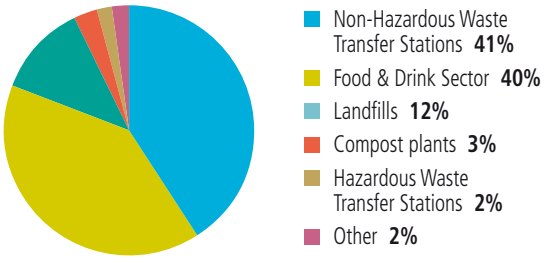
The EPA receives more complaints about odours than any other environmental issue.

Odours are caused by compounds in the air, and can be pleasant, such as the smell of baking bread, or foul, such as the stench from rotting waste. Most of the chemicals that can cause health problems can be detected by people at concentrations below the level in air that is toxic to humans. However, in some cases concentrated odours can cause health problems including headaches and nausea. In addition, ongoing exposure to odour, even at very low levels, can bring on other wellbeing effects such as stress and anxiety.

Although the activities in Ireland that have most potential to cause odour are regulated, there are nonetheless ongoing occurrences, with odours representing a significant source of complaints to the EPA, particularly related to waste transfer stations, landfills, composting facilities and rendering plants. The EPA continues to target facilities that fail to comply with their licences and hold them responsible for their actions in line with its enforcement policy.

Over 1,000 air-related complaints were received by the EPA from the public in 2014 (EPA, 2015b). Odour accounted for 788 of these, with nearly 70% of them related to just 10 sites. Odour control in parts of the waste management and food and drinks sectors needs to improve. More recent data for 2015 shows that these sectors accounted for approximately 98% of all odour complaints made to the

Figure 8.3 Breakdown of Odour Complaints by Sector in 2014 (Source: EPA, 2015b)



EPA about odour during 2015, with 10 sites accounting for 75% of all complaints. While the numbers of complaints are unacceptable, it should be noted that this figure has decreased significantly in recent years.

Bioaerosols

There is sufficient evidence to support a precautionary approach for regulatory purposes.

Bioaerosols are airborne particles consisting of microorganisms and other small biological particles suspended in the air which are generated through both natural and industrial processes. The health risks associated with bioaerosols can be a cause of public concern, especially for people living close to waste composting facilities. Composting is a microbial process and the agitation of compost during turning and screening produces bioaerosols, in particular the allergenic fungus *Aspergillus fumigatus*. Research has found that the general population is not at risk of infection resulting from exposure to bioaerosols; however, immunocompromised individuals are at an increased risk, along with individuals who suffer from asthma or allergies (Prasad, 2004). In a recent study of bioaerosol exposure and health outcomes by Pearson *et al.* (2015), it was concluded that "the evidence base on health effects of bioaerosol emissions from composting facilities is still limited, although there is sufficient evidence to support a precautionary approach for regulatory purposes. While data to date are suggestive of possible respiratory effects, further study is needed to confirm this and to explore other health outcomes."

Composting facilities are subject to regulatory control by the EPA and local authorities, which ensures that their operation does not have an adverse effect on human health and the environment. Health-related exposure limits are needed, especially in approval procedures of industrial facilities such as composting plants or livestock farms emitting bioaerosols.

Clean Water and Health

Drinking water investment is critical to provide safe and secure supplies.

Safe drinking water is essential to public health, and therefore water must not contain microorganisms and substances at concentrations that could endanger health, such as pathogenic parasites or chemical contaminants. Most public tap water in Ireland is drawn from surface water sources, i.e. rivers and lakes (82%), with the remainder originating from groundwater (11%) and springs (7%). The breakdown of drinking water supply types in Ireland is shown in Table 8.1. It shows that there are 973 public water supplies, which is a relatively large number for our population but is reflective of our dispersed settlement patterns (EPA, 2015c).

Drinking water supplies must meet specific legislative requirements, the objective of which is to protect human health by ensuring that water intended for human consumption is wholesome and clean, and to specify quality standards for water at the consumer's tap.

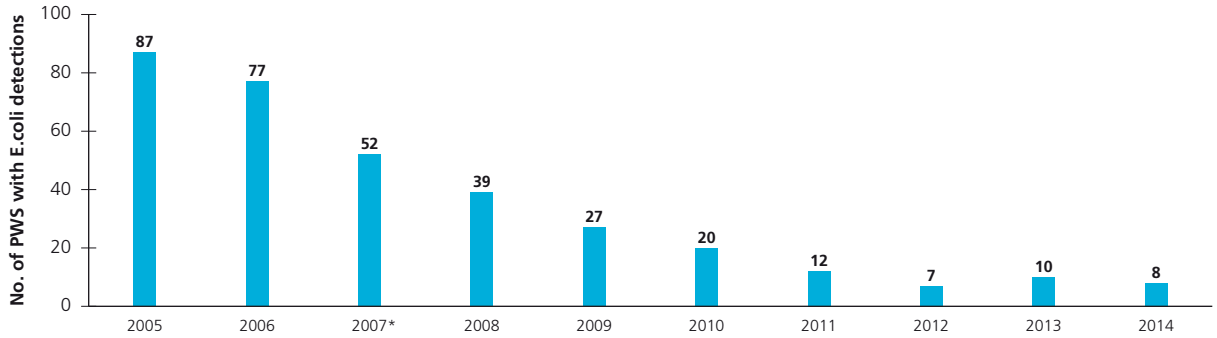
The results of the 2014 drinking water monitoring programme for public water supplies show 99.9% compliance with microbiological standards and 99.4% compliance with chemical standards, based on 175,498 sample results (EPA, 2015c). While this indicates that the majority of public water supplies are safe, further improvements are necessary to improve the security of supplies and avoid long-term Boil Water Notices in the future. In particular, the EPA has identified 119 supplies (as at April 2016) on a Remedial Action List which are in need of upgrade, replacement or improved operational control. The overall compliance figures also mask poor results for a few individual parameters, notably trihalomethanes (THMs) (90.7%, which is very low compared with other European countries) and lead (95.7%). Enforcement actions continue to be taken by the EPA to ensure compliance with drinking water standards.

Table 8.1 Drinking Water Supply Types in Ireland (Source: EPA)

Supply Type	Supplier/Supplying	No. of Supplies	Population (%)	Supervisory Authority
Public Water Supplies	Irish Water	973	81.9	EPA
Public Group Schemes	Local Group	512	1.9	Local Authorities
Private Group Schemes	Local Group	421	4.2	Local Authorities
Small Private Supplies	Commercial/public activity	1,758	0.9	Local Authorities
Exempted Supplies	Individual supplier	170,000*	11.1	Exempted

*estimated number of private wells or boreholes

Figure 8.4 Number of Public Water Supplies in which *E. coli* was Detected in Compliance Monitoring, 2005-2014 (Source: EPA, 2015c)



* EPA became supervisory authority for PWS with enforcement powers

The most important health indicators of drinking water are the microbiological parameters, in particular *Escherichia coli (E. coli)* bacteria. The presence of *E. coli* in drinking water indicates either that the disinfection process at the water treatment plant is not operating adequately or that faecal contamination has entered the water distribution system after treatment. As shown in Figure 8.4, the incidence of *E. coli* in public water supplies in Ireland continues to decrease. However, the microbiological quality of private water supplies remains inferior to public supplies, with a significant number of *E. coli* detections in small private supplies and private group water schemes. Furthermore, it is estimated that up to 30% of the 170,000 unregulated private wells in the country are contaminated with *E. coli*, which presents a health risk for those consuming the water (EPA, 2015c).

There have been cases of faecal-derived *Cryptosporidium* contamination of public water supplies in Ireland leading to illness in the community, e.g. Galway City in 2007 and Westport in 2015. These outbreaks highlight the risks to health associated with the abstraction of drinking water from poorly protected sources, and the need for modern and well-managed water treatment systems. Figure 8.5 shows the number of cases of cryptosporidiosis reported in Ireland between 2004 and 2015 (HPSC, 2015). There were 439 cases of cryptosporidiosis in 2015, 10 of which were definitively associated with drinking water supplies (eight confirmed cases in a general outbreak in Westport and two confirmed cases in a family outbreak linked to a private well).

The winter storms in late 2015/early 2016 resulted in a considerable increase in the number of consumers on Boil Water Notices across the country as a result of a number of supplies becoming contaminated with *Cryptosporidium* because of inadequate barriers at water treatment plants.

As guided by the EPA, Irish Water is adopting the Water Safety Plan approach to managing drinking water supplies. This involves a holistic process to identify, reduce and manage risk, and thereby improve the resilience of water supplies. This should result in a reduced risk to public health of drinking water contamination.

Figure 8.5 Annual Number of Cryptosporidiosis Cases in Ireland, 2004-2015 (Source: HPSC, 2015)

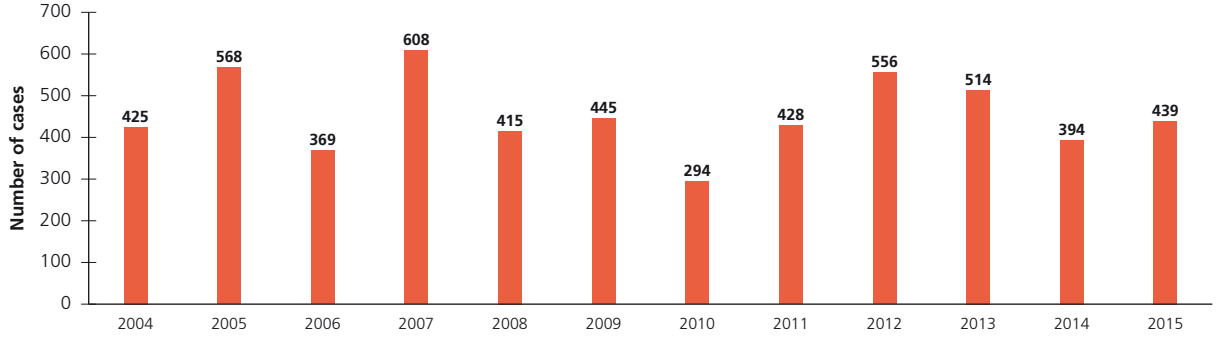


Table 8.2 Chemical Contamination of Drinking Water – Risks and Intervention (Source: EPA, 2015c)

Chemical Contaminant	Source	Risk/Impact	Action/Intervention
Trihalomethanes (THMs)	By-product of the disinfection process, formed by the reaction of chlorine (disinfectant) with natural organic matter in the water	Possible associations with cancer – uncertain in terms of causality	Water supplier should aim to minimise THMs by providing appropriate treatment while not compromising disinfection
Lead	Lead piping in distribution systems and household plumbing	Classified as "probably carcinogenic". Long-term exposure can affect brain development of infants, young children and babies in the womb	Replacement of lead piping and interim mitigation measures under the National Lead Strategy (June 2015) and Irish Water's Lead in Drinking Water Mitigation Plan
Pesticides	Agricultural, commercial and domestic use	Potential harmful health effects depend on the toxicology of the individual pesticide	Protection of drinking water sources from pesticide contamination using catchment-based engagement efforts

Private Wells

Private wells used for drinking water in Ireland remain at risk of contamination.

There are approximately 170,000 private wells in Ireland, of which at least 30% are estimated to be contaminated by *E. coli* (EPA, 2015c; Hynds, 2012). Private wells are not regulated under the European Communities (Drinking Water) Regulations 2014 and are classified as "exempted supplies". This means that there is no requirement to monitor such supplies, nor is there any regulatory supervision of such supplies. In effect, this means that the well owner is solely responsible for the quality of the well water.

Many private wells are at risk of contamination from sources such as septic tanks, landspreading of slurry, animals grazing near the wellhead, chemical storage and fuel storage tanks. Private wells need to be properly sited, constructed and maintained in order to reduce the risk of contamination.

30% of private wells are estimated to be contaminated by E. coli.

Urban Waste Water

The effective management and treatment of our waste waters is critical to the health of our waters, our economy and our population.

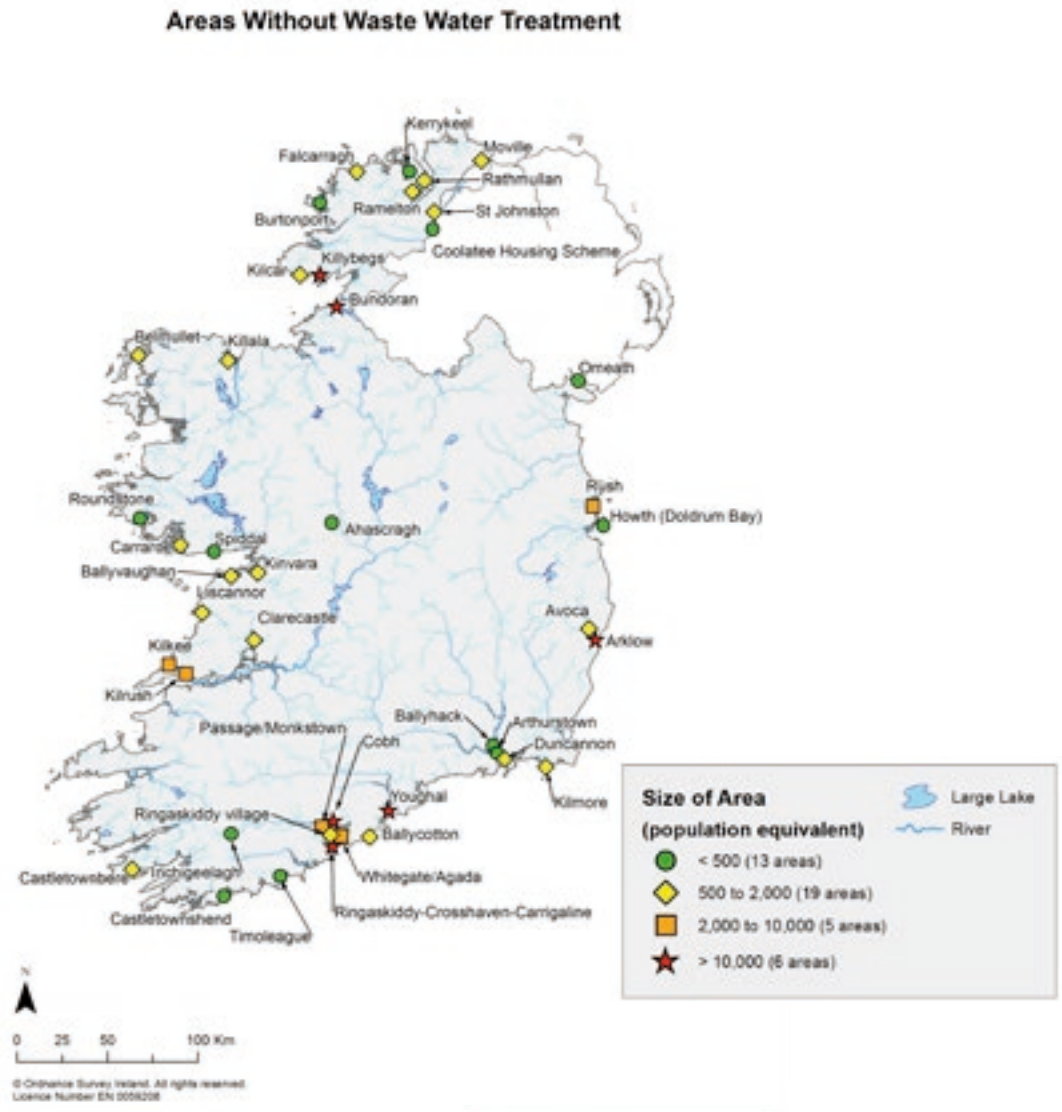
Urban waste water is one of the principal pressures on water quality in Ireland (EPA, 2015d) and also poses a threat to human health. Sewage and other waste waters contain microbiological and chemical substances that can be harmful to health. Waste water collected in urban areas must be treated in order to remove these contaminants, prior to being discharged into receiving water bodies. The treatment and disposal of waste water in an environmentally sound manner is important not only for human health but also for Ireland's social and economic development. Pollution from waste water treatment plants arises where there is inadequate treatment; storm water overflows operating incorrectly; or direct discharges of untreated waste water.

Figure 8.6 Private Wells Infographic (Source: EPA)

Ireland has the highest rate of VTEC (verotoxigenic *E. coli*) in Europe (EFSA, 2016). VTEC is a particular type of the bacterium *E. coli*. VTEC infection causes a wide range of illnesses from mild diarrhoea to haemolytic–uraemic syndrome, a form of kidney failure. In recent years, all reported VTEC outbreaks associated with drinking water have been linked to private water supplies, with the majority of cases affecting children, many of whom have been hospitalised (HPSC, 2013a).

The EPA recommends that well owners should proactively manage the quality of their own water to minimise health risks to everyone in the home. This includes checking that there are no sources of pollution entering the well and getting the water tested at least once a year, ideally following heavy rainfall, when the well is most at risk of contamination. The EPA has developed a *Protect your Well* app (available on *www.epa.ie*) for well owners to assess their own water supply and to identify contamination risks.

Figure 8.7 Areas Without Waste Water Treatment (Source: EPA)



Raw sewage is being discharged into 43 rivers, lakes and coastal areas around Ireland.

Since 2007, the EPA has issued over 1,000 Waste Water Discharge Authorisations for towns and villages across Ireland.

Recent EPA findings show significant infrastructural deficits; for example, the 2014 report highlighted that untreated sewage was discharged from 45 areas (now 43 locations), 12 treatment plants failed to provide secondary (biological) treatment and a further seven treatment plants failed to meet nutrient removal standards (EPA, 2015e).

Monitoring data show that 82% of large urban areas complied with the mandatory effluent quality standards in 2014. However, where waste water is being discharged into nutrient-sensitive areas, only 24% of the load discharged complied with the more stringent effluent quality standards that apply in these areas. Dublin and Cork were the major contributors to this low rate of compliance. Waste water discharges also contributed to poor water quality at 6 of Ireland's 137 identified bathing waters (EPA, 2016).

Significant investment has gone into improving Ireland's waste water infrastructure since 2000. As a result, the proportion of waste water receiving secondary (biological) treatment increased nationally from 29% in 2001 to 94%

in 2014, with the proportion of waste water receiving little or no treatment reduced to under 5% in 2014 (EPA, 2015e). Nonetheless, further investment in infrastructure is necessary in order to eliminate the discharge of raw sewage, comply with the Urban Waste Water Treatment Directive (91/271/EEC) and the Water Framework Directive (2000/60/EC), and meet obligations of EPA waste water discharge authorisations.

Domestic Waste Water Treatment Systems

Household septic tanks can threaten public health and water quality if they are poorly constructed or fail to operate satisfactorily.

There are an estimated 500,000 domestic waste water treatment systems (DWWTS), i.e. septic tanks and treatment systems, in Ireland treating waste water from houses not connected to a public sewer system. The Water Services (Amendment) Act, 2012 was introduced to control discharges from these systems by the registration and inspection of septic tanks to ensure that they meet certain standards. The legislation also required the EPA to put in place a National Inspection Plan in conjunction with the local authorities to reduce the potential threat to human health and the environment.

DWWTS that are properly designed, installed and maintained can provide long-term, effective treatment of domestic waste water. However, DWWTS can threaten public health and water quality if they are poorly constructed or fail to operate satisfactorily; for example, if the waste water cannot discharge through the percolation area, it can form stagnant pools on the ground surface. Through such failures, humans can come in contact with the waste water and be exposed to pathogens, e.g. *E. coli* bacteria and faecal coliforms, and foul odour. 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.

The EPA Inspection Data Report for the period 1 January to 31 December 2015 (EPA, in press), details the results of 1,097 first-time inspections. 33% of all systems inspected also had a private well on site, of which 42% failed the inspection.

The inspection findings show significant failure rates for reasons that are related to the behaviour of the householder rather than faults with the treatment system. In many cases, simple actions are required by the homeowners rather than structural changes to the treatment system. The non-compliance rate decreased from 53% in 2013 to 45% for the 2015 reporting period.

Bathing Water

Good-quality bathing water is a highly desirable natural resource for recreational use as well as being an important economic factor for tourism.

Our modern lifestyle presents continuing challenges to bathing water quality, such as impacts of pollution from urban runoff, waste water discharges and from agricultural sources, especially after heavy rain, which are a continuing threat, particularly in built-up areas. If beaches are closed there are also knock-on effects for people's behaviour (i.e they don't go to the beach) which then play out as health effects (less exercise, increased anxiety).

There are 137 identified bathing areas in Ireland, comprising 128 seawater and nine freshwater locations. Overall, the quality of Ireland's bathing waters remains very high, with 93% meeting the minimum EU standards and achieving at least "sufficient" water quality status (EPA, 2016). In addition, 83% have met the "excellent" or "good" standards. However, six bathing waters failed to meet sufficient quality, which means they were required – for health risk reasons – to have either an "Advice against Bathing" or a "Bathing Prohibition" restriction in place for the 2016 bathing season. Members of the public can find out about bathing water quality on the EPA's Splash website (*www.bathingwater.ie*), on bathing water notice boards at the beaches or from the relevant local authorities.

At European level, Ireland is ranked 18th out of 30 countries and below the EU average in a comparison of bathing water quality for 2015 (EEA, 2016b). Ireland is also one of only four countries, along with the United Kingdom, the Netherlands and Bulgaria, where more than 3% of bathing water sites were of poor quality in 2015. Risks to bathing waters are one of the key criteria in EPA enforcement led recommendations for prioritisation of urban waste water treatment plant compliance and remedial actions (EPA, 2015e).

As well as the 137 designated bathing sites, there are 73 other waters around the country which are being monitored by local authorities because bathing is known to take place there. Of these "other monitored waters"

just two, Stradbally and Ballyvooney – both in Co. Waterford – are likely to be of "poor" quality at times due to impacts from nearby waste water discharges.

Shellfish

Strict shellfish monitoring regimes are in place to ensure that consumption of Irish shellfish poses little risk to public health.

Irish coastal waters provide ideal conditions for shellfish growth. In order to support shellfish life and growth and to contribute to the high quality of directly edible shellfish products, the Quality of Shellfish Waters Regulations (SI No. 268 of 2006, as amended) required the development of Pollution Reduction Programmes for designated shellfish areas.

Norovirus is a leading cause of gastroenteritis in humans and is found in high concentrations in municipal waste water. Bivalve molluscan shellfish such as oysters are filter-feeders and can become contaminated with human pathogens including norovirus when grown in areas impacted by municipal waste water discharges. Waste water treatment is a critical control to reduce the extent of pathogen discharge into aquatic environments. The EPA recently funded research on norovirus in waste water and shellfisheries, to examine the survival of norovirus through waste water treatment, in the aquatic environment and subsequent uptake in oysters (Doré *et al.*, 2013). The research found that a risk-based management approach is required to control risk associated with norovirus-contaminated oysters, and guidelines to this effect should be developed by the Food Safety Authority of Ireland in collaboration with the Sea Fisheries Protection Authority.

Live bivalve molluscs, such as mussels, can be harvested only from shellfish production areas that meet the classification requirements for human consumption. Production areas are classified by the Sea Fisheries Protection Authority according to the quality of the waters. To protect against illness, the Food Safety Authority of Ireland operates a shellfish monitoring regime, in co-operation with the Sea Fisheries Protection Authority and the Marine Institute, with shellfish samples being checked before harvesting is allowed. 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 it into the food chain. In July 2015, the Sea Fisheries Protection Authority seized 5 tonnes of mussels which had been harvested illegally in the East Ferry area of Cork Harbour. This area was closed for the harvesting of mussels at that time owing to the presence of paralytic shellfish poisoning toxins, which can cause serious illness. 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.

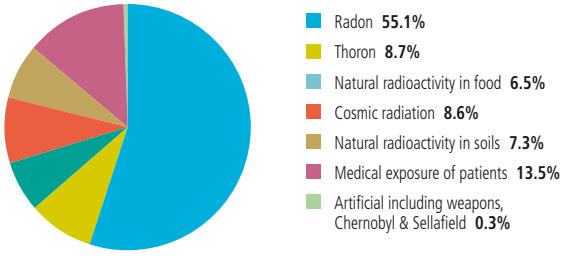
Radioactivity in the Environment

Levels of radioactivity in the ambient Irish environment do not pose a significant risk to public health.

Natural radioactivity in the environment has two principal components: cosmic and geological. Cosmic rays, originating in outer space, strike the Earth's atmosphere; geological radioactivity comes from long-lived radionuclides present from the time of the formation of the Earth. The most significant contribution to human exposure comes from radon.

Artificial radiation is mainly associated with the routine operation of medical diagnostics and treatment as well as from nuclear installations such as 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 to the Irish marine environment is the Sellafield nuclear fuel reprocessing plant in Cumbria; however, the radiation exposure from Sellafield represents only a very small fraction of the overall average annual dose to a person in Ireland, as shown in Figure 8.8 (EPA, 2015f).

Figure 8.8 Sources of Radiation in Ireland (Source: EPA, 2015f)



Levels of radioactivity in the Irish environment have been routinely monitored since 1982. In 2015, EPA reported on comprehensive measurements of radioactivity in air, drinking water, marine environmental samples and a range of foods (EPA, 2015f). The data presented in the report confirmed 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.

In general, levels of artificial radioactivity in the Irish environment remain fairly constant and are broadly consistent with levels reported previously. It must be emphasised that the levels of radioactive contamination

present in the marine environment do not warrant any modification of the daily habits of people in Ireland, either in their consumption of seafood or in any other use of the amenities of the marine environment.

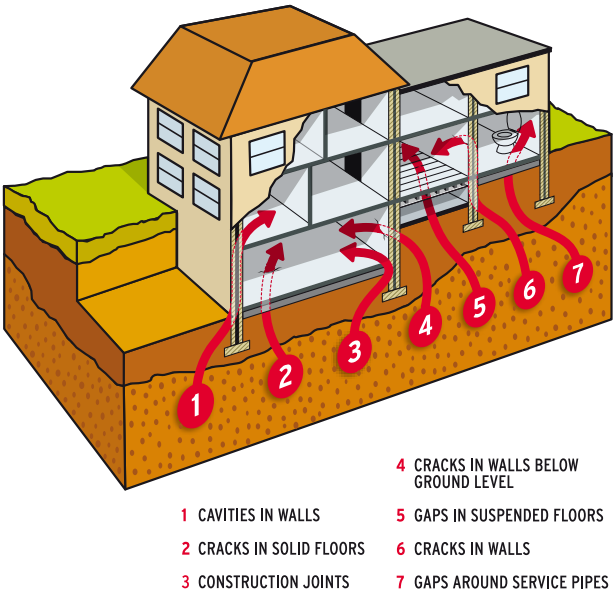
Radon

Indoor radon exposure remains a significant public health concern.

Radon is a naturally occurring radioactive gas formed in the ground by the radioactive decay of uranium, which is present in all rocks and soils. It is the greatest source of exposure to ionising radiation for the general public in Ireland and the leading cause of lung cancer after smoking. It is estimated that exposure to radon accounts for approximately 13% of all lung cancers in Ireland, which equates to some 250 lung cancer cases each year.

High radon concentrations can be found in any part of the country; however, the EPA has identified certain areas which are more prone to radon as High Radon Areas. The EPA regularly runs local awareness campaigns in High Radon Areas in order to raise awareness of the risks from radon and to encourage homeowners to test their homes. To date, only 60,000 homes have been tested, of which almost 8,400 were found to be above the national reference level of 200 Bq/m^3. Figure 8.9 shows the routes of entry for radon into buildings.

Figure 8.9 Radon Entry Points (Source: EPA, www.radon.ie)



Recognising the scale of the radon problem in Ireland, the Government published the 4-year National Radon Control Strategy in February 2014, which contains recommendations on a broad range of measures aimed at reducing the risk from radon to people living in Ireland. These recommendations are set out in six thematic areas as follows:

- radon prevention in new buildings;
- use of property transactions (sales and rental) to drive action on radon;
- raising radon awareness and encouraging individual action on radon;
- advice and guidance for individual householders and employers with high radon results;
- promoting confidence in radon services; and
- addressing radon in workplaces and public buildings.

The results of the 2015 National Radon Survey show that mean indoor radon concentration has fallen to 77 Bq/m^3 (from 89 Bq/m^3 in 2002). Furthermore, a significant reduction in radon levels was found in homes built since 1998, when radon preventative measures were introduced under the Building Regulations, as compared with those homes built before then. This gives a strong indication that the required radon preventative measures in new homes are having a beneficial effect on indoor radon levels. In addition, further work to tackle radon in workplaces will be carried out through the implementation of EU Council Directive 2013/59/Euratom, which lays down basic safety standards for protection against the dangers arising from exposure to ionising radiation.

Non-ionising Radiation

Non-ionising radiation is the term used to describe the part of the electromagnetic spectrum covering two main regions, namely optical radiation (ultraviolet, visible and infrared) and electromagnetic fields (power frequencies, microwaves and radio frequencies).

Electromagnetic fields (EMFs) are associated with electricity flows, and both electric and magnetic fields exist close to power lines, and close to appliances. Since the 1970s, research has been under way to examine if exposure to EMFs has adverse health consequences. In 2015, an EU scientific committee published a Final Opinion on the potential health effects of exposure to EMFs (SCENIHR, 2015). It concluded that there are no evident adverse health effects associated with EMF if exposure remains below the levels recommended by EU legislation (EC, 2015). The findings of this committee were echoed in a study carried out by the Dutch National Institute for Public Health and the Environment, which looked at EMFs in the Irish context and also investigated how different Member States differ in how they deal with European exposure limits (RIVM, 2015).

Advice from the DECLG to those living in close proximity to telecommunications masts or base stations is that there is no scientific basis for, or evidence of, adverse health effects in children or adults as a result of exposure to EMFs below guideline levels. ComReg, the licensing authority for the telecommunications industry, verifies that operators are in compliance with their licence conditions relating to emission limits for non-ionising radiation. Compliance with guidelines is good, and results from the emission measurements have shown values well below limits (DECLG, 2016).

Other Environmental and Health Issues

While this section has so far examined the major environmental and health considerations around air and water, there is also a wide range of issues that can influence our health – some of these are well established and some classed as "emerging".

Climate Change, Health and Wellbeing

Climate change is likely to alter risks to public health and wellbeing in Ireland.

The health and wellbeing of human populations is sensitive to shifts in climate in three ways: (1) directly through changes in the character and frequency of extreme weather events including heat, drought and heavy rain; (2) indirectly through natural systems, for example disease vectors, waterborne diseases and population displacement; and (3) through human systems, for example occupational impacts, under-nutrition and mental stress (Smith *et al.*, 2014).

Globally, there has been increased heat-related mortality and decreased cold-related mortality in some regions as a result of warming. Local changes in temperature and rainfall have altered the distribution of some waterborne illnesses and disease vectors. Throughout the 21st century, climate change is expected to lead to increases in ill health in many regions (IPCC, 2014). In Europe, the impacts of climate change on human health and wellbeing include flooding, extreme temperatures, air pollution, vector-borne disease and waterborne and food-borne diseases. These impacts are projected to change in the future; for example, where precipitation or extreme flooding is projected to increase in Europe, the risk of food-borne and waterborne illness could increase.

Climate change is likely to alter risks to public health and wellbeing in Ireland (Pascal *et al.*, 2013). The key climate change-related exposures of importance to human health are likely to be increases in heatwave-related health impacts, decreases in cold-related health impacts, increases in flood-related health impacts, changes in patterns of food-borne disease, an increase in the burden of waterborne disease and an increase in the frequency of respiratory diseases due to changes in pollen and pollutant distributions (temporal and spatial).

Although all of the population will be exposed to climate change, health effects will depend largely on the vulnerability of individual population groups. For Europe, vulnerability to weather and climate change depends on people's personal characteristics (e.g. age, income, education, health status), their broader social and environmental context, their access to resources (e.g. health services) and their level of exposure to climate change (WHO, 2008). Those population groups considered most vulnerable include the elderly and children, the urban poor, traditional societies and subsistence farmers, and coastal populations.

The risks of climate change for the health sector are intrinsically linked to risks in other sectors (e.g. ecosystems, water supply and sanitation, agriculture, infrastructure, energy and transportation, land use management) that play an important part in determining the risks of disease and injury resulting from climate change (Smith *et al.*, 2014). For example, climate-related impacts on water quality will clearly have knock-on effects for public health. In addition, extreme weather events (such as storms and flooding), causing disruption for communications, power generation and public transport, will have an effect on the delivery of public health services.

In 2015, the second Lancet Commission on Climate Change and Health noted that threat to human health from climate change is so great that it could undermine the last fifty years of gains in development and global health (Wang and Horton, 2015). The commission also focussed on this issue from a different viewpoint and concluded that *tackling climate change* could be the greatest global health opportunity of the 21st century. This is based on evidence compiled by the commission which shows that many efforts to mitigate and adapt to climate change, such as phasing-out coal from the global energy mix, also have strongly positive health effects.

Genetically Modified Organisms

Genetically modified organisms (GMOs) are defined as bacteria, viruses, fungi, plant and animal cells, plants and animals capable of replication or of transferring genetic material whose genetic material has been altered in a way that does not occur naturally by mating or natural recombination.

In the past 40 years, the development and use of genetic engineering technology has brought many useful applications in healthcare, in the form of new pharmaceuticals, vaccines and methods of diagnosing disease. This technology is also making a major impact in the investigation of crime, in waste treatment,

environmental clean-up and in other areas. However, there is significant public concern regarding the possible risks to human health and the environment through the introduction and use of GMOs in our ecosystem.

The EPA is the competent authority in Ireland for the implementation of the Genetically Modified Organisms Regulations on the contained use, the deliberate release into the environment and the transboundary movement of GMOs. As part of its regulatory function, the EPA has established a register of GMO users in Ireland. As of December 2015, there were 587 entries on this register. Over 95% of these are contained users, the majority of which are third-level research laboratories classified as being of negligible risk. The remainder are deliberate release users (small-scale field trials and clinical trials).

In July 2012, the EPA granted consent to Teagasc Oak Park to carry out field trials on a GM potato line with improved resistance to late potato blight fungus for a 4-year period until the end of 2016, with post-trial monitoring continuing until 2020. There is currently no commercial cultivation of GM crops in Ireland.

Any health and environmental issues concerning the use of GM ingredients in food and feed are considered by the Food Safety Authority of Ireland and the Department of Agriculture, Food and the Marine, which are the competent authorities in this area.

Heavy Metals

Heavy metals occur naturally in the environment, and low concentrations of some of these are essential to human health and wellbeing. However, elevated concentrations of many heavy metals are directly toxic to humans, and also to animals and plants, which in turn can accumulate these substances, offering a further threat to humans eating contaminated foodstuffs. Sources of heavy metals include materials such as paints, batteries and piping, and industrial activities including mining and coal-burning electricity generation. Ongoing monitoring of water and air indicates that heavy metal pollution does not pose a significant threat to health in Ireland.

In 2015, the EEA examined emissions of heavy metals and reported an improving situation in Ireland with trends between 1990 and 2013 showing emissions for cadmium down 36.7%, mercury down 37.7% and lead down 88.6%. This downwards trend is mirrored across Europe and is attributed to improvements in abatement technologies, coupled with the effect of EU directives and regulations mandating reductions, and limits on heavy metal emissions. The very large decrease in lead emissions is largely associated with the phase-out of leaded petrol.

Pharmaceuticals in the Environment

Pharmaceutical drugs are contaminants of emerging concern in the aquatic environment.

The amount of pharmaceutical production, consumption and ultimately discharge into the aquatic environment is steadily increasing (EPA, 2015g). Human actions, termed as "involuntary" (pharmaceutical excretion through the body or washing of topical medicines down the drain) and "purposeful" (disposal of unused or out of date medicines), are primarily responsible for the release of pharmaceuticals into the environment (Daughton, 2007).

The unnecessary and excessive use of antimicrobial agents, such as antibiotics, has significantly contributed to the development and spread of antimicrobial resistance (AMR) worldwide across the human population, agriculture and the wider environment. The European Centre for Disease Prevention and Control estimates that AMR results in 25,000 deaths annually in Europe, plus related costs, resulting from healthcare expenses and productivity losses, of over €1.5 billion. The issue is one of such great concern that AMR is listed in the Department of the Taoiseach's National Risk Assessment, which identifies risks that may have an adverse impact on Ireland's wellbeing (Department of the Taoiseach, 2015). In 2016, an EPA-funded research project found high levels of bacteria resistant to all antibiotics in urban sewage from hospitals and from the general city sewage. The researchers also noted that the hospital effluent was different, in that there were high levels of bacteria resistant to a number of newer antibiotics (Morris *et al.*, 2016). The number of antibiotic-resistant bacteria present was greatly reduced by effective waste water treatment, but some antibiotic-resistant bacteria survive and are discharged into rivers and seawater.

Whilst inappropriate prescribing and dispensing of antimicrobials for human therapeutic use is a significant contributor to the AMR problem, use in the agriculture and food production sector is as substantial. In terms of environmental impact from human therapeutic use of antimicrobials, a significant quantity of the antimicrobials given to patients is shed into the toilet in urine or faeces, in a form that is still biologically active. Added to this is the large number of antibiotic-resistant bacteria, which may reside in the gut of humans, passed into the toilet every day. Urban waste water treatment plants and domestic waste water treatment systems are unable to effectively remove all antimicrobials or antibiotic-resistant bacteria, meaning that the resultant "active" effluent is released into the environment, causing subsequent exposure and thereby contributing to the growing problem of AMR.

In the case of the agriculture and food production sector, antimicrobials are not only used therapeutically for treating infection but, in some instances, are also used in healthy animals for growth promotion and prophylactically to avoid the development of infection within a herd or flock. Not only does prolonged use create ideal conditions for the development of AMR but, similar to the healthcare situation, a significant quantity of active antimicrobials is excreted in urine and manure, entering the surface and groundwater and, possibly, potable water sources. Moreover, manure spread across land could contain antimicrobial residues, which, in turn, could be absorbed by food crops, thereby further contributing to exposure to, and persistence of, these contaminants (Graham *et al*., 2016).

Following a major review of evidence, Huijbers *et al.* (2015) concluded that the extent to which the environment contributes to human exposure is simply not known, though the authors state that transmission this way seems "plausible". Encouragingly, progress is beginning to be made in this regard both nationally and internationally. The EPA, along with other EU research organisations, is funding a joint programme of research looking at the emerging threat of AMR to the environment.

Endocrine disruptors are a diverse group of chemicals that affect hormonal function and include some pesticides, PCBs, dioxins, some synthetic pharmaceuticals and industrial chemicals. Research funded by the EPA indicates that, although some endocrine-disrupting compounds were detected in the Irish environment, levels are generally low and not regarded as a significant risk (EPA, 2015h).

Healthy Food

A clean environment is essential to healthy food production.

Much is written about "healthy food", but from an environmental and human health point of view this concept is largely concerned with ensuring that foods are free from contamination associated with chemical or biological pollution. Careful regulation is necessary to ensure that food-growing areas are not adversely impacted by, for example, poorly treated waste water, landspread wastes, contaminated fertilisers, badly managed farm chemicals or air pollutants. International agreements such as the Convention on Long-range Transboundary Air Pollution also have a role to play by reducing the threat of airborne heavy metals coming across our borders and settling on land.

Care is also required around the reintroduction of by-products into the food chain to avoid unintended contamination. Some recent incidents involving Irish producers have shown that monitoring and response systems are working well; however, the goal is clearly to avoid these circumstances arising.

Environment and Health Research

Environment and health is recognised as a fundamental and cross-cutting topic in the national environmental research programme that is managed by the EPA. The aims of the research are (1) to develop national capacity in key areas; (2) to generate data and make assessments of priority issues for Ireland; and (3) to mobilise this knowledge for use in environment and health protection. Overall, the desired outcomes are to identify, characterise and manage threats from the environment to health and wellbeing, and also to recognise opportunities to use the environment to foster improvements in our health and wellbeing.

Since 2007, the EPA has funded over 50 research projects on environment and health issues representing a total commitment of approximately €10 million. Through this research programme, the EPA addresses a broad range of environmental health issues including those that lie beyond its regulatory remit such as indoor air quality. Recently, the EPA established a number of projects with a focus on health and wellbeing which are being co-funded with the Health Service Executive; these include Ecosystem Benefits of Greenspace for Health, and Nature and Environment to Attain and Restore Health.

The key research areas include:

- ecosystem benefits for health
- safe water for drinking, food production and recreation
- clean air and noise
- chemicals and other threats.

Key Achievements

- Researchers have developed new research capability and have provided timely knowledge and assistance to local and health authorities in dealing with significant health scares and outbreaks.
- Researchers have developed baseline information on emerging issues such as antimicrobial resistance, nanoparticles, and endocrine disruptors. This knowledge has been used by operators, regulators and policymakers in support of policy formation and implementation.
- An HSE-led research project concluded that no adverse health impacts were experienced following the operation of an incinerator at an EPA-licensed industrial facility.

Priority Areas

- Understanding environment–health interactions, including risks from emerging chemicals and novel materials (e.g. microplastics, nanomaterials), while highlighting the benefits to human health of a clean and well-managed environment.
- GIS-delivered solutions to understanding integrated impacts of various environmental threats. For example, overlaying maps for air pollution, traffic density, radon exposure, meteorology with pulmonary morbidity.

Conclusion

A high-quality environment provides the foundation for healthy living.

As evidenced in this report, Ireland's environment is generally good, and it can be concluded that, on the whole, Ireland does present a clean, safe environment to live in. The availability of green spaces (parks, woods, countryside) and blue spaces (ponds, riverbanks, lake shores and seashores), along with clean, fresh air and breathtaking landscapes, provides an enviable resource which should be valued and enjoyed.

In common with countries across Europe, key high-level environment and health issues include climate change, antimicrobial resistance and chemical pollution. In addition there are a number of national issues that require action, such as health impacts associated with localised air pollution and drinking water contamination. Many government bodies are actively working to address these issues and, while much has been achieved, there is clearly still work to be done. Some of the key challenges facing Ireland from an environment, health and wellbeing point of view are:

- on-site waste water treatment systems (such as septic tanks) and urban waste water discharges impacting on water quality and amenities
- urban air quality in cities and towns
- nuisance and amenity impact from noise and odour
- radon in homes.

In addition, from an emerging risks perspective, we need to be vigilant in relation to:

- climate change-induced health risks
- antimicrobial resistance
- new chemicals and substances.

While some existing and emerging challenges exist, on the whole Ireland's environment provides an excellent basis for maintaining and improving our health and wellbeing. To capitalise on this, we must foster a new awareness of the

enormous importance of the environment to all aspects of our lives – physical and mental health, social life, economic prosperity and sustainable food and water – by ensuring that people are offered good access to green and blue spaces, and that the Government, businesses and individuals play their part in protecting and sustaining our environment.

What is clear from international work cited herein is that a clean, protected and accessible environment contributes significantly to the status of our health and quality of life, to reducing healthcare costs, and to the successful delivery of national public health policy. Accordingly, Ireland must put in place the necessary measures to ensure that our natural environment is protected and enhanced so that we can derive the associated wellbeing and life expectancy benefits.

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Section IV

Environment and the Economy

Chapter 9

Environment and the Economy: Overview

Importance of the Environment to the Economy

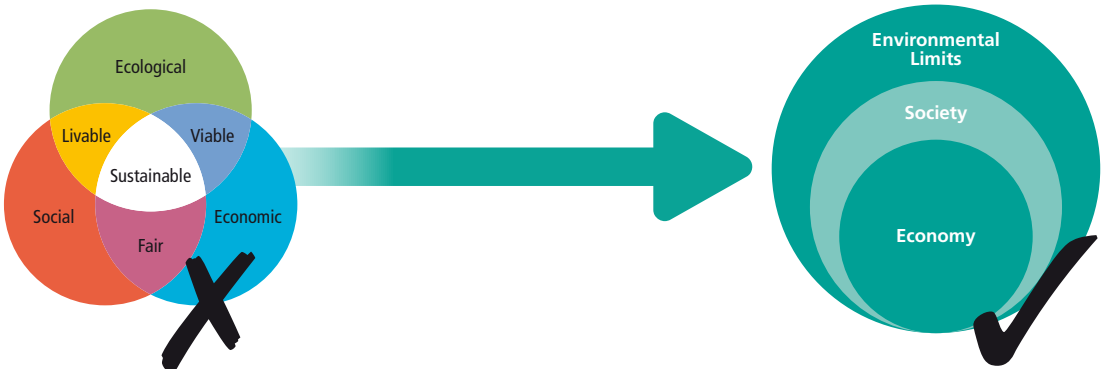
Introduction

Ireland's economic and social wellbeing is intimately associated with the condition of the environment.

The economic resilience of Ireland is intimately linked to environmental quality and to the supporting role of our ecosystems and natural resource services. However, we have designed and evolved our governance structures, our society and our economy in ways that are not always suitably considerate, or protective, of ourselves or of our environment. Moreover, as individuals and as part of our national and global community, we continue to make consumption and production choices that are unsustainable.

The environment will thrive in the absence of an economy or a society, but the opposite does not hold. Economic and social wellbeing are intimately associated with the condition of the environment and its ability to sustain us. In general, what is good for the environment is good for the economy in the long term.

Figure 9.1 Sustainable Development Paradigm



Global Sustainability Models

Both the economy and the society that hosts it can only exist within the confines of the environmental and resource boundaries available.

One of the main frailties of the global sustainability model up to recent years was the incorrect perception that the social, economic and environmental pillars of the sustainable development paradigm were equally weighted, as represented in the classic sustainability Venn diagram (Figure 9.1).

In fact, the relationship is less equal and, at the same time, more complex. Our economy can only expand within society's ability to support it. Both the economy and the society that hosts it can only exist within the confines of the environmental and resource boundaries available. The nested dependencies featured in Figure 9.1 are a better representation of this understanding of the sustainable development paradigm. Infinite economic expansion without regard to environmental constraints is illogical, immoral and, ultimately, impossible.

Economic Cost of Not Protecting our Environment

The proposed economic cost of climate change impacts for the EU – in the absence of adaptation actions – is in the order of tens of billions of euros per year.

Insufficient protection and preservation of our environment has a significant economic cost. The World Economic Forum comments that "… the undesirable environmental consequences of human activity are leading to a less habitable world" (World Economic Forum, 2014). The World Health Organization (WHO) estimated that the overall annual economic cost of health impacts and mortality from air pollution, including estimates for morbidity costs, amounts to €1.45 trillion (WHO Regional Office for Europe, 2015). Another significant economic and social cost resulting from environmental impact derives from climate change.

A recent European Union (EU) study on climate change impacts proposed that the economic cost – in the absence of adaptation actions – for the EU was in order of tens of billions of euros per year (Ciscar *et al.*, 2014). The economic costs-avoided imperative is recognised in the intergovernmental agreement reached following the Climate Change COP21 meeting in Paris in December 2015, one of the recitals to which emphasises the "enduring benefits of ambitious and early action (on climate change), including major reductions in the cost of future mitigation and adaptation efforts".

The World Economic Forum notes that social and environmental sustainability issues increasingly influence economic policy decisions and can have an impact on economic performance (World Economic Forum, 2014). Our future economic and social stability and resilience requires accelerated and sustained action to reimagine and decarbonise our society and move to an enduring state of carbon neutrality.

National "Environomic" Performance

The challenge is to maintain the recent good environmental performance in a recovering economy.

There is some evidence of the need to decouple economic activity and growth from environmental impact. In recent years, Ireland has moved from a position of being one of the most resource-inefficient economies in the EU (our rate of material consumption was growing faster than the population) to greatly improve its efficiency in terms of raw material consumption per capita (Figure 9.2). The reduction in personal consumption and building programmes over this period (associated with the economic downturn) has – we believe – largely contributed to this trend. This reduction in building has induced social challenges (e.g. housing availability), suggesting that the scale of reduction was too severe and poorly managed. Better integration and coherence between environmental, economic and social policy needs could act to mitigate these shock swings.

Figure 9.2 Ireland: Resource Efficiency (Source: CSO)

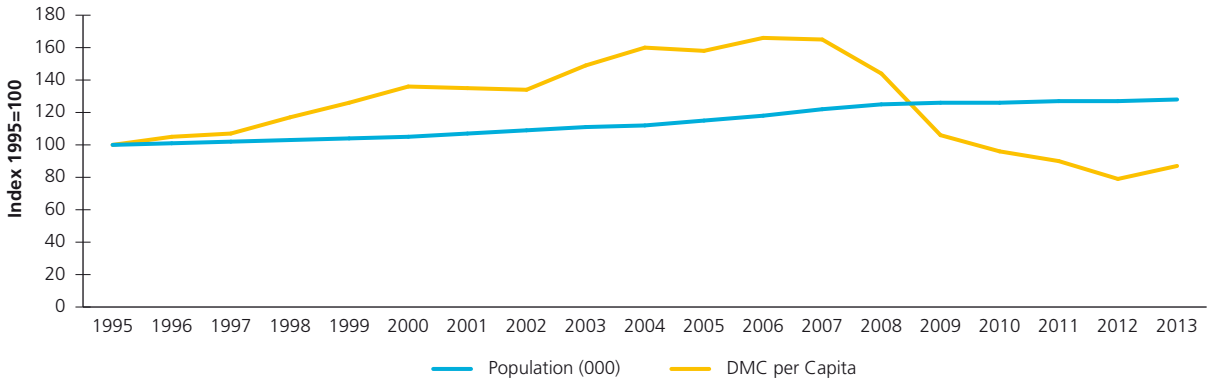


Figure 9.3 Ireland: Resource Productivity (Source: CSO)

In addition, in relation to the productivity of resources consumed as measured by gross domestic product (GDP) (Figure 9.3) Ireland has significantly improved its financial return (in terms of GDP) per tonne of resources consumed. This is a crude measure of the economic efficiency of resources consumed and masks significant sectoral variation. The main challenge over the longer term is to ensure that the productivity curve grows at a rate in excess of the DMC curve (decoupling).

Domestic material consumption (**DMC)** measures the total amount of materials directly used by an economy and is defined as the annual quantity of raw materials extracted from the domestic territory, plus all physical imports minus all physical exports.

(Source: EuroStat).

International and National Policy Context

Living Well, Within the Limits of our Planet

EU action programme that sets out the long-term vision on the environment.

Successive EU Environmental Action Programmes (EAPs) have, since 1973, been the foundation stones of all EU environmental policy development and are used specifically to foster policy action and integration for identified environmental and sustainability issues. EU policies for the green economy, resource efficiency, circular economy, industrial and product regulation etc., can, in some way, trace their lineage to the Action Programmes. In its 7th EAP, *Living Well, Within the Limits of our Planet,* the EU has renewed its commitment to stimulate the transition to a green economy and to strive towards an absolute decoupling of economic growth and environmental degradation. This, it states, will "ease pressure on the environment and bring increased competitiveness and new sources of growth and jobs through cost savings from improved efficiency, the

commercialisation of innovations and better management of resources over their whole life cycle". The Programme adds that all sectors of the economy have to contribute to tackling climate change. Two of the nine priority objectives stated in the 7th EAP relate specifically to economic competitiveness, namely:

- to protect, conserve and enhance the Union's natural capital
- to turn the EU into a resource-efficient, green and competitive low-carbon economy.

(Source: European Commission)

The full and even implementation of environment legislation throughout the EU is seen as a sound investment for the environment and human health, as well as for the economy. Implementation can act to drive sustainable 'greener' economic growth, bringing with it opportunities in innovation and employment. In a recent EU Commission publication, *Green Growth for Jobs and Prosperity in the EU* (EC, 2016), the competitive advantage of green growth is set out, but some key obstacles to this opportunity are also articulated, including regulatory obsolescence and contradictory or unintegrated sectoral policy. The 7th EAP prioritises actions that aim to deliver environmental and economic benefits through legislative implementation, as well as actions to improve environmental policy integration and coherence.

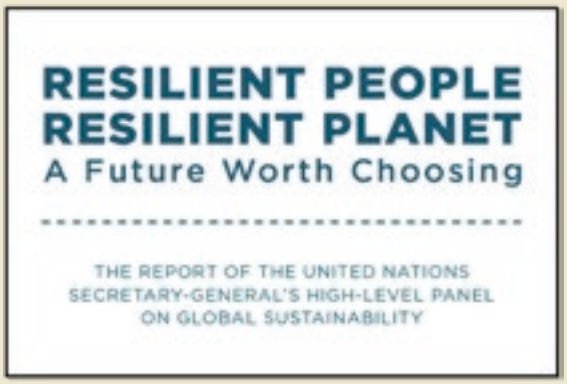
Resilient People, Resilient Planet: The UN Policy to Promote Sustainability

The United Nations (UN) *Resilient People, Resilient Planet* policy document (UN, 2012) states that there are forceful drivers that are challenging the sustainability paradigm, such as current production and consumption patterns and resource scarcity, investment expectations, demographic change, changes in the global economy, growing inequality, changing political dynamics and urbanisation. The UN set out a number of priorities that have strong economic solutions/interventions:

- advancing education for sustainable development
- enabling consumers to make sustainable choices and advance responsible behaviour individually and collectively
- incorporating social and environmental costs in regulating and pricing of goods and services, as well as addressing market failures
- creating an incentive roadmap that increasingly values long-term sustainable development in investment and financial transactions
- increasing finance for sustainable development, including public and private funding and partnerships to mobilise large volumes of new financing
- expanding how we measure progress in sustainable development by creating a sustainable development index or set of indicators.

Resilient People, Resilient Planet

(Source: UN, 2012)



The UN policy document *Resilient People, Resilient Planet: A Future Worth Choosing* (UN, 2012) states compellingly that "Sustainable development is not a destination, but a dynamic process of adaptation, learning and action. … The world is not yet on this path. Progress has been made, but it has been neither fast nor deep enough, and the need for further-reaching action is growing ever more urgent."

United Nations Sustainable Development Goals

17 goals and 169 key global environmental targets that aim to shape our future.

September 2015 saw the globally significant intergovernmental meeting convened by the UN to agree a plan of action for *People, Planet & Prosperity.*[1] Seventeen Sustainable Development Goals with 169 targets were agreed (Figure 9.4). The signatories to the resolution[2] envisage a world in which nations can enjoy inclusive and sustainable economic growth, with decent work for all, and where consumption and production patterns, as well as the use of all natural resources, are sustainable. This, the resolution attests, will deliver sustained and inclusive economic growth, social development and environmental protection. These aspects of the resolution identify two core concepts for sustainability. The first is the need for appropriate (realistic and rational) production and consumption; the second is the balancing of social, economic and environmental needs.

1 *sustainabledevelopment.un.org/*

2 *www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E*

Figure 9.4 Global Goals for Sustainable Development (Source: UN)

Strategies for a Resource-efficient and Low-carbon Europe

The Europe 2020 Strategy[3] reaffirms a collective determination to shift towards a resource-efficient and low-carbon economy and the European Commission has committed to using a range of financing and economic instruments to achieve this objective. These include mobilising EU financial instruments; enhancing the framework for the use of market-based instruments (e.g. emissions trading, revision of energy taxation, state aid framework, encouraging wider use of green public procurement); and promoting a comprehensive programme of resource efficiency leading to changes in consumption and production patterns.

In 2011, the EU Commission published what was then, and still is, considered one of its most significant policy statements for many years. This visionary document, *A Roadmap to a Resource Efficient Europe*,[4] articulates ambitions for European society, economy and environment that seek to address the challenges of environmental damage, resource depletion and climate change.

A 2014 review of progress under[5] the roadmap concluded, inter alia, that the majority of the actions announced in the roadmap have been launched; however, "the full impacts of the actions launched under the roadmap are yet to unfold." The progress report added that the 2020 milestones and the overall objective of decoupling economic growth from resource use and its environmental impacts are not likely to be fully achieved unless efforts are stepped up. As a means to measure progress, a Resource Efficiency Scoreboard has been published by Eurostat since 2013, with the caveat that there is a significant time-lag for many of the statistics around material flows in the economy. The midterm review stated that "action on the side of national, regional and local governments is important, since in many cases the most effective policy instruments to promote efficient resource use and implement sustainability in practice are in their hands – for instance in the areas of waste and water management, urban planning, or public procurement."

Harmful Environmental Subsidies

Elimination of environmentally harmful subsidies and taxation systems will come into stronger focus internationally and in national economic and finance policy in the coming years.

Internationally, through the Organisation for Economic Co-operation and Development (OECD), the UN, the EU and the Group of Twenty (G20), the subject of environmentally harmful subsidies has been put on the agenda for discussion and resolution (Oosterhuis and ten Brink, 2014). Subsidies do lead to lock-in of unsustainable technologies and infrastructure, as well as poor decision making. The EU 7th EAP and *A Roadmap to a Resource Efficient Europe* call for urgent attention to be applied to the phasing-out of environmentally harmful subsidies at the national level. The roadmap estimates that the scale of subsidies with potential negative impacts on the

3 *www.ec.europa.eu/europe2020/index_en.htm*

4 *www.ec.europa.eu/environment/resource_efficiency/about/roadmap/index_en.htm*

5 *www.ec.europa.eu/environment/circular-economy/pdf/Progress-report-roadmap.pdf*

environment, notably in the areas of fossil fuels, transport and water, are worth €1 trillion per year. Environmentally harmful subsidies lead to higher levels of waste, polluting emissions (including climate change gases), inefficient resource extraction and negative impacts on biodiversity. They can lock in inefficient practices and hinder businesses from investing in green (more sustainable) technologies. The EU roadmap notes that environmental externalities are not always reflected in the price of goods and services and advocates that new policies should aim to correct prices of resources and natural capital that are considered not appropriately valued on the market, such as water, clean air, ecosystems, biodiversity and marine resources. The EU Commission sees environmental taxation as an essential market mechanism to address any pricing market failures.

Environmentally harmful subsidies through for example, investment write-off or other relief, can lead to long term lock-in in relation to unsustainable technologies. Moreover, vested interests – generally those with most to lose or gain – will invest in lobbying to protect their particular sectoral or group interests which may not be aligned to the public interest.

Elimination of environmentally harmful subsidies and taxation systems will come into stronger focus internationally and in national economic and finance policy in the coming years. The State on its own, or as a consequence of European action, will need to undertake a review of environmentally harmful subsidies that may be operating within its finance/taxation system and set about eliminating them; examples include subsided peat extraction, low CO_2 vehicle tax (causing rise in diesel use and particulate air emissions) and green diesel VAT relief. There has been little work on this area of policy conflict to date and it is not clear whether regulatory impact assessments for new legislative policy adequately address such externalities.

It should be noted that Ireland has achieved considerable behavioural change success in relation to employing taxation based measures to address certain environmental harms, e.g. the plastic bag tax, the landfill levy, and the carbon tax.

A Roadmap to a Resource Efficient Europe (2011) presents a policy ambition milestone that states:

"By 2020, market and policy incentives that reward business investments in efficiency are in place. These incentives have stimulated new innovations in resource efficient production methods that are widely used. All companies, and their investors, can measure and benchmark their lifecycle resource efficiency. Economic growth and wellbeing is decoupled from resource inputs and come primarily from increases in the value of products and associated services."

(Source: EEA)

Raw Material Use in the Economy

Securing a sustainable supply of raw materials for the EU, and nationally, is a key priority.

In late 2013, the European Commission established the EU Raw Materials Initiative with a view to securing a sustainable supply of raw materials for the EU as a key priority. Raw materials, such as metals and minerals or forest-based materials, are essential to the EU's economy, growth and competitiveness. The EU reports that more than 30 million jobs and many key economic sectors, such as automotive, aerospace and renewable energy, are dependent on a sustainable supply of raw materials. The associated strategy has three stated aims, which are to ensure the following:

- fair and sustainable supply of raw materials from global markets
- sustainable supply of raw materials within the EU
- resource efficiency and supply of secondary raw materials through recycling.

The EU subsequently published an assessment of raw materials deemed critical to the EU economy (EC, 2011). The EPA, through its national environmental research programme, is funding projects that aim to advance knowledge and innovation in the critical raw materials area.

Ireland – Our Sustainable Future

International policy ambitions inform Ireland's sustainability strategy.

International policy ambitions have informed, and will continue to inform, a raft of recent EU market interventions, and many of them resonate with national ambitions articulated in Ireland's sustainability strategy *Our Sustainable Future* (DECLG, 2012).

The aims of this government policy are to provide for the integration of sustainable development into key areas of policy, to put in place effective implementation mechanisms, and to deliver concrete measures to progress sustainable development. A progress report on actions under the national sustainability plan was published in 2014,[6] and, in 2015, the Central Statistics Office published an updated set of national sustainable development indicators that address national performance and also consider performance with respect to other EU Member States.[7] The progress report concluded that Ireland continues to move in the right direction generally across the spectrum of Sustainable Development Goals, while recognising the role of the economic downturn in reduced emissions and consumption. The report also concluded that it will be important to maintain our focus on sustainability through the period of economic recovery and growth. In its 2014 Climate Change Policy Position document, the Irish Government articulated a vision to 2050 that integrates the climate and sustainability imperatives in stating that it aims "as a fundamental national objective, to achieve transition to a competitive, low-carbon, climate-resilient and environmentally sustainable economy by 2050" (Government of Ireland, 2014).

6 *www.housing.gov.ie/sites/default/files/publications/files/our_sustainable_future_progress_2014.pdf*

7 *www.cso.ie/en/media/csoie/releasespublications/documents/environment/2015/sdi_2015.pdf*

Our Sustainable Future (DECLG, 2012) states that "decoupling environmental degradation and resource consumption from economic and social development is an enduring challenge in Ireland as elsewhere and requires a paradigm shift in our approach to future development. The 'business-as-usual' approach will not suffice; we require a major reorientation of public and private investment, ... We need a more developed 'green economy' focus, achieving a more mutually supportive interface between environmental protection and economic development, ..."

Key Current and Emerging Policy Trends

Circular Economy

A model for sustainable production and consumption.

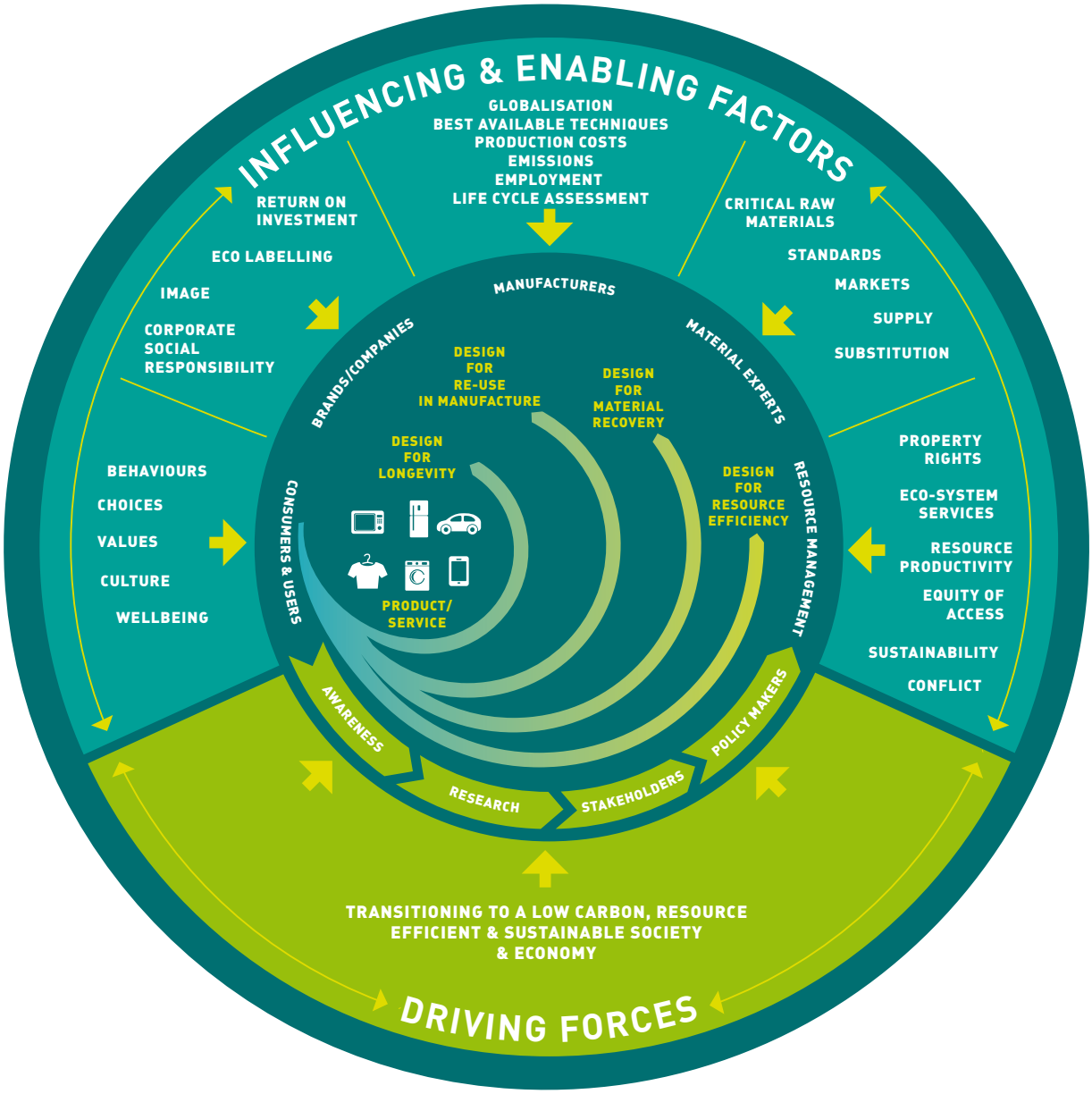
The coming years will need to see much greater effort – at an institutional and commercial level – to secure the supply, from sustainable sources, of the primary and secondary raw materials necessary to sustain our economies and our wellbeing. The recognition of the limitation of critical raw materials, allied to the ambition of resource efficiency and life cycle assessment for goods and services, has evolved and coalesced into the concept of the circular economy (EEA, 2016).

Circular Economy

While most discussion of the subject deals with the "material flow" dimension of the circular economy model, it must be understood that true economic circularity is far more complex and involves matters such as property rights, equity of access, valuing of ecosystem services, resource productivity, fair and safe social and employment structures, wellbeing and resilience, clean technology, etc. It is, in fact, sustainable development, but in recognition of the dominance of the economic drivers, is repackaged in more tangible economic models and production/consumption cycles and enabling conditions (Figure 9.5).

This model of sustainability (Figure 9.5) or, more accurately, a model of sustainable production and consumption, looks at the materials flowing through the economy (biological and technical) and imagines the sustainable draw-down and maximum utility of these resources/materials. It sees the material or product value chain moving from a take–make–use–dispose linear model to a closed loop that seeks to minimise – if not eliminate – wastefulness at every stage from resourcing, to design, manufacture, distribution, use and post-consumption stages. The EU Raw Materials

Figure 9.5 Circular Economy – Material Flow Aspects (Source: EPA, EEA, 2016)



Initiative discussed previously is also strongly integrated with the EU circular economy policy area.

The enabling conditions needed to move to a circular economy require wide-ranging integrated market interventions such as eco-design, eco-labelling, life cycle assessment, secondary materials standards, recycling, durability, consumption awareness and education, clean production, repair and reuse, green public procurement, elimination of harmful chemicals, renewable energy, carbon neutrality, etc. Most of these policies and concepts will require major intervention over the coming years if they are to become the reality and norm. Also of key importance are appropriate price signals and research into more efficient products and services. There are, of course, huge challenges, not least of which is that Ireland is an island nation and our economy depends on imported raw materials sourced on the global market. Significant opportunities also flow through, for example, green goods and services design and delivery. From a social and values perspective, the circular economy can assist in driving an appreciation of sufficiency as regards consumption behaviours. Advancing circular economy ambitions – even on the limited material flow dimension – is hugely challenging in terms of world trade agreements, complexity of issues and influencing factors and cost; it is undoubtedly a classically "wicked problem".[8] Ireland will be able to tackle many of these issues only as part of the EU, by negotiating internal and international trading

8 *Financial Times* lexicon *lexicon.ft.com/Term?term=wicked-problem*

standards and agreements. However, at the core of the circular economy paradigm is consumption, and the State can, working through its citizens and value systems, educate and promote a reimagining and realisation of what sustainable consumption should be. What it should not be is the vulgar conspicious and inefficient consumption we have seen in the past.

Emerging Environmental Governance trends

There has been a rapid expansion of business-led, and government-fostered, sustainability programming.

The last few years has seen a significant growth of business and municipality led environmental governance initiatives, that involve the voluntary making of environmental commitments and reporting of progress. Initiatives include such schemes as ISO Standards, green accounting and green investments, carbon disclosure, etc., which here we will cluster as corporate social responsibility (CSR) programmes. Many of these programmes were originally intended to be carried out at a multinational level, but more recently appear throughout the value chain, and many civil society groups, municipalities and large cities are also getting involved. It is not a new idea, but it might be one whose time has come as a result of a convergence of social, marketplace and governance expectations. Corporate social responsibility is a concept whereby enterprises integrate their social and environmental responsibilities into their mainstream business operations, and business decisions are made with reference to wider sustainability issues. This is a rapidly expanding area of business-led, and government-fostered, sustainability programming, and needs, over the coming years, to expand from the sphere of multinationals to the wider business and public service community.

The UN Global Compact[9] is a call to companies to align strategies and operations with universal principles on environmental protection, along with wider human rights, labour issues, etc., and take actions that advance societal goals. It involves over 8,000 companies operating in over 160 countries worldwide. Twenty-two businesses are registered under Ireland, and have submitted pledges. These companies operate in a variety of fields including services, distribution, engineering, academic and manufacturing. It is a voluntary initiative based on company commitments to implement universal sustainability principles and to take steps to support UN goals. Further supporting resources are available on the World Business Council for Sustainable Development website.[10]

In 2013, the EU adopted a proposal for a Directive on Non-Financial Reporting,[11] which aims to have large companies report CSR-type metrics on an annual basis. The UN-fostered and multinational-supported Global Reporting Initiative (GRI)[12] helps companies to be transparent about their sustainability goals, performance and impacts. Its Sustainability Reporting Guidelines (known as G4)[13] are the most widely used comprehensive sustainability reporting standards in the world; there are currently over 23,000 reports recorded in the GRI database, and this number is still growing. Transparent sustainability reporting is a key element of CSR.

The recent Climate Change Council of the Parties meeting in Paris involved a large group of companies, cities, regions, civil society organisations and investors which have made non-regulatory-demanded climate change-related pledges collectively known as the UN-moderated Climate Action Agenda NAZCA pledges.[14] These coalitions of actors are intended to accelerate activity to deliver the necessary systemic changes. This follows the commencement of the non-state sector pledge platform at the Council of the Parties meeting in Lima in 2014, and, to date, the programme includes over 11,000 pledges. Only a limited number of Irish organisations have registered pledges so far.

Ireland's National Plan for Corporate Social Responsibility 2014-2016

Promoting environmental practices that enhance a company's profile and competitiveness.

Ireland's National Plan for Corporate Social Responsibility 2014-2016 is a very significant government policy intervention (DJEI, 2014). The policy observes that CSR practices that are embedded as a genuine part of a company's values and operations can help enhance the company's profile and competitiveness; CSR is good for business and good for the community. The national policy presents a model of five CSR pillars, with each pillar including a number of elements of activity/action (Figure 9.6), and establishes five key objectives for the National Plan. There are good examples and more information of business-led CSR activities in Ireland on the Business in the Community website.[15]

CSR goes beyond mere compliance with legislation to promoting mutually supported shared value-resilient businesses and resilient communities.

9 *www.unglobalcompact.org*

10 *www.wbcsd.org*

11 *www.eur-lex.europa.eu/homepage.html*

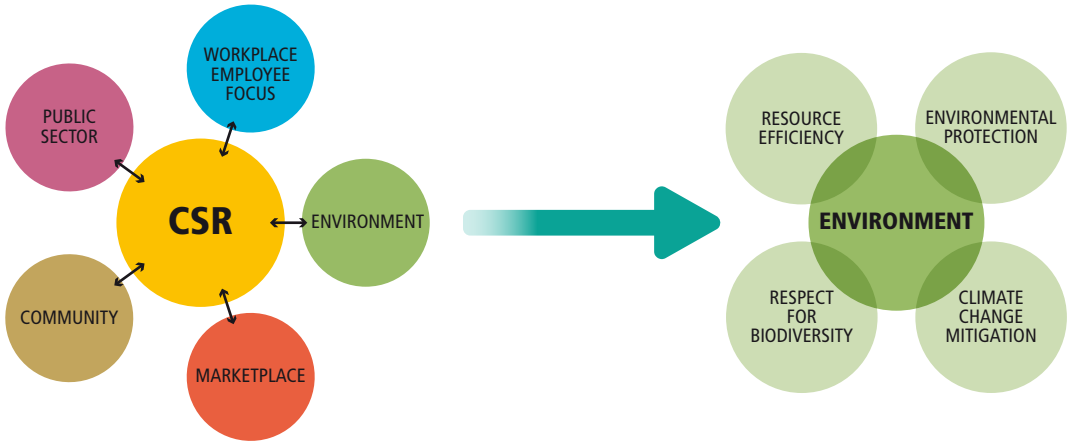
12 *www.globalreporting.org*

13 *www.globalreporting.org/Pages/default.aspx*

14 *climateaction.unfccc.int*

15 *www.bitc.ie*

Figure 9.6 Five Pillars of CSR, and Four Key Elements of the Environment Pillar (Source: DJEI, 2014)



Assessing the Life Cycle of Goods and Services

Making information available to allow consumers to make informed choices.

In the coming decade, businesses will increasingly be required through regulatory approaches to undertake life cycle assessment for their goods and services and to adopt eco-label standards. The latter are essential to support informed consumption choices. Goods and services that currently incorporate environmentally harmful substances/practices will be required by future EU-driven product policy to be eliminated or replaced. In Ireland, the significant role expected for agricultural and food production and tourism in national economic recovery and future growth will require ambitious and monitored sectoral development plans to ensure that this growth can be achieved through carbon neutrality and sustainable production/service processes. The national food sector development plan, Food Wise 2025, includes a monitoring and implementation plan that seeks to track and measure implementation of initiatives and actions, in particular those dealing with the environmentally sustainable expansion of the sector.[16]

Sector Plans and Policy Context

Economic Sector Plans for Sustainability

Regular public reporting on the environmental performance of economic sector plans will be important for increased accountability and transparency during implementation.

National plans and programmes also contribute to progressing decoupling. Bord Bia, through its very successful Origin Green Programme, has identified the competitive advantage of marketing sustainable low-carbon produce to a national and international audience (Figure 9.7).

Figure 9.7 Origin Green (Source: Bord Bia)

Bord Bia has developed a suite of programmes for its client primary producers and processors to progress certified resource-efficient sustainable food production practices. Major producers, retailers and service providers are also progressing greener credentials as part of their commercial strategy (e.g. Green Hospitality, the Musgrave Group's Environmental & Social Accountability Policy, Marks & Spencer's Plan A, Glanbia's Performance System, Intel's CSR Climate Change & Environmental Policies, Unilever's 5 Levers of Change). The need for sustainability is strongly reflected in a number of national sectoral policies and economic development strategies (e.g. Food Harvest 2020, Food Wise 2025, Our Ocean Wealth, Education Strategy for Sustainable Development, National Energy Efficiency and Renewable Energy Action Plans, Ireland's Transition to a Low Carbon Energy Future and the National Plan on Corporate Social Responsibility).

16 *www.agriculture.gov.ie//foodwise2025*

Figure 9.8 Musgrave Group Sustainability Commitment

MUSGRAVE GROUP

What does sustainability mean to us?

"Our long term approach to relationships and business means that we place great emphasis on the core responsibilities that any good business should have: to look after its people and customers, to minimise its environmental impact and to produce sustainable wealth for the benefit of all stakeholders in the long term – not just for short term financial gain."

Musgrave focuses on embedding sustainability in its operations and brands, concentrating on 9 of 17 UN Sustainable Development Goals that are relevant to the retail sector.

These fall into four broad categories:

- minimising environmental and climate change impacts;
- driving sustainable sourcing and consumption;
- leading in health and wellbeing;
- taking an active leadership role in the community.

Aligning our sustainability strategy with the UN's Sustainable Development Goals

6 11 13

Minimising environmental & climate change impacts

- Carbon managment
- Packaging & waste
- Food waste
- Water conservation

2 12 14 15

Driving sustainable sourcing and consumption

- Ethical sourcing
- Human rights
- Sustainable consumption
- Animal welfare & biodiversity

3

Leading in health & wellbeing

- Nutrition & healthy eating
- Education & awareness
- Active living

8 11

Taking an active leadership role in the community

- Being a good neighbour
- Vibrant communities
- Employment & opportunities

Many economic sectors have strategies in place for growth or change. Implementation of these strategies can come with potential environmental risks and challenges. It is now recognised that it is necessary to ensure that growth strategies are sustainable in the long term. Strategies should include a commitment to report publicly and regularly on their environmental performance against relevant environmental indicators. This will make the strategies more robust and provide for increased environmental accountability and transparency during implementation. A strategy review mechanism should kick in if the performance monitoring demonstrates an unfavourable situation for Ireland's sustainability and its legal obligations to meet environmental targets. The implementation plan established for tracking the performance of Food Wise 2025 is an example of good practice in this area.

Strategies to Deliver More Efficient Businesses

Waste prevention projects have demonstrated what is achievable.

Since its inception in 2004, Ireland's National Waste Prevention Programme has successfully delivered solutions for individuals and organisations that recognise the economic and reputational costs of wasteful consumption (both excess purchasing and final disposal charges). The programme, which is overseen by the EPA, has evolved beyond an initial focus on preventing generation of solid wastes to a broader view of preventing wastage across materials, energy and water; this is primarily because of the integrated nature of relationships between them. The latest strategy 'Towards a Resource Efficient Ireland' (EPA, 2014a) with its vision of living better, using less,

reflects this broad approach and highlights the key role for the programme in delivering on national priorities on competitiveness and green growth. Over the years, through successive annual reports,[17] the EPA has demonstrated that businesses, the public sector and households can achieve significant financial benefits, and, in case of businesses, competitive advantage, by implementing resource-efficient practices, with participant enterprises achieving average savings of more than €12 million per annum.[18] An EPA research report published in 2013 identified that a modest national target of 2% efficiency in material consumption has the potential to yield a saving to the national economy of approximately €1 billion (EPA, 2013).

Green Procurement

Green procurement can deliver more sustainable and more competitive goods and services.

The Irish Government, through its policy on green procurement, and the subsequent national guidance published by the EPA, set out to push the delivery of more sustainable goods and services through public tendering contracts (DPER, 2012; EPA, 2014b). The purchasing power of the State (10–12% of Ireland's GDP; approximately €25 billion) and of large businesses (through their supply chain) can be used very effectively to deliver more sustainable and more competitive goods and services.

Economic Value of the Environment

We need a better appreciation of the economic value of a protected environment and its wider services to society.

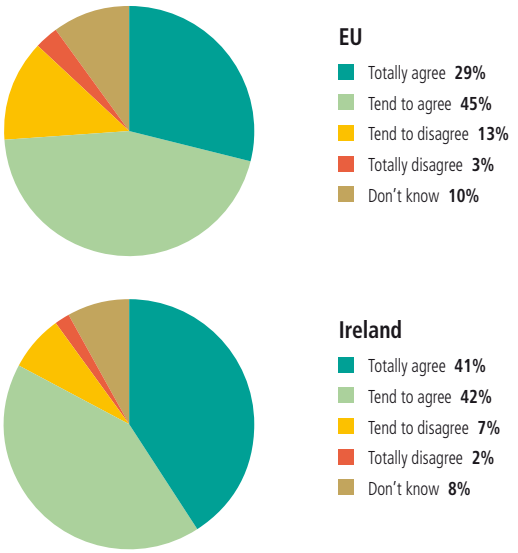
Not only is there evidence of decarbonisation, resource efficiency and green growth, but there is also evidence that the economic contribution of a valued and protected environment (and its services) is becoming widely appreciated at business and policy level (e.g. Origin Green, eco-labelling, green tourism). This realisation is strong at the general public level, also, as indicated by the results of a 2014 EU survey of environmental attitudes, which found that Irish people's appreciation of the economic value of the environment significantly exceeds the EU average (Figure 9.9).

From a national growth perspective the coming years will need to see a broader range of metrics and indicators developed for national economic performance that take into account matters such as wellbeing, environmental health, ecosystem services and natural capital.

Figure 9.9 Environment and Economic Growth Survey 2014 (Source: Eurostat)

To what extent do you agree or disagree with the following statement?

The protection of the environment can boost economic growth in the EU



Ecosystem Services – The Value of Being Clean and Green

The rapid growth in economic valuation activity in the field of ecosystem services also attests to this realisation (e.g. DECLG, 2008; Bullock and Hawe, 2014; EPA, 2014c); this includes the establishment of a national working forum. This commitment to valuing our natural capital is also reflected in the government policy *Delivering our Green Potential*, in which it is stated that we must "ensure that the value of ecosystem services and biodiversity to the economy is captured and monitored so as to ensure sustainable drawdown and protection of (our) natural assets. The protection of the environment and the development of the green economy are integrally connected" (DJEI, 2012). Tourism was worth in excess of €6.5 billion to the Irish economy in 2014, and Ireland hosted over seven million international visitors.[19] Environmental attributes were two of the top five reasons cited for successful tourism visits (i.e. scenery and nature), and this is expected to grow with the success of the marketing of the Wild Atlantic Way.[20] Irish food and drink exports are worth €10.6 billion to the Irish economy[21] and the Origin Green dimension of marketing for these

17 *www.epa.ie/waste/nwpp/reports/#.VuFjKBivlok*

18 *www.begreen.ie*

19 *www.failteireland.ie/Research-Insights/Tourism-Facts-and-Figures.aspx*

20 Wild Atlantic Way Operational Programme 2015 *www.failteireland.ie/Wild-Atlantic-Way/The-Wild-Atlantic-Way-Operational-Programme/Environmental-Surveying-and-Monitoring-Programme.aspx*

21 *www.bordbia.ie/industry/buyers/industryinfo/agri/pages/default.aspx*

exports is intimately linked to environmental quality and sustainability. National economic growth and success is inextricably linked to environmental sustainability and we have to strive for carbon neutrality to remain sustainably competitive.

Conclusions and Outlook

Sustainable competitiveness should be at the heart of thinking about sustainability. This is because competitive economies tend to be more innovative, more resilient and better able to respond to external shocks and, therefore, maintain high levels of prosperity into the future. A 2015 report by a group of experts convened by the EU Commission provides advice in the form of a roadmap for systemic eco-innovation to achieve a low-carbon circular economy; the report concluded that the economic challenges currently facing Europe are not cyclical, but of a structural nature (EC, 2015). The report added that European production and consumption practices and expectations are not equipped to face a global climate of slow demand growth and resource volatility, commenting that "without change the EU will become inevitably less competitive, less attractive, and less economically viable".

Growing population, the competition for diminishing resources, the appropriate recognition of ecosystem services and natural capital, as well as the adaptive challenges arising from our changing climate and our national climate change commitments will, over the next 30 years, require ambitious social and economic interventions and responses. The emerging consensus is now focusing around the need to put economies on a more sustainable footing, resulting in a resource-efficient, carbon-neutral, circular economy. This will require an all-of-society response: essentially we have to rethink, and redesign what we mean by social and economic 'prosperity' in order to deliver the resilience essential for us to prevail. We must all learn to live, produce and consume within the physical and biological limits of the planet. To achieve this will require integrated and enduring governance, including brave social and economic measures. Ireland's economy needs to strive for sustainable competitiveness, which the World Economic Forum defines as the set of institutions, policies and factors that make a nation productive over the longer term while ensuring social and environmental sustainability. We cannot necessarily wait for regulatory intervention to change; non-state actors are already leading and coalescing around goals and ideals to progress climate change and sustainability agendas.

The EU Commission's 2016 winter forecast bulletin notes that the European economy is now entering its fourth year of recovery, and growth continues at a moderate rate, driven mainly by private consumption. In Ireland this growth is predicted to be between 3% and 4% in 2016 and 2017. Without market-wide eco-labelling and life cycle analysis for consumer products and services, it is not possible to determine the sustainability of this growth. We know from previous national statistics that excessive consumption can lead to significant wastefulness and other environmental burdens. The EU's Eurobarometer survey of environmental attitudes notes that 94% of Irish people rate protection of the environment as fairly or very important, and 96% agree that they can play a role in protecting the environment.[22] The governance challenge is to realise these declared intentions in displayed behaviours. The State must consider market interventions and other policy instruments that correct market failures, and also both direct and where possible "nudge" (through elective and, in time, normalised value-based decisions) consumption and production behaviours towards a more sustainable outcome.

Our conventional measures of prosperity (e.g. gross national product, GDP, value added) are of limited use in that they do not factor in elements such as environmental quality, social wellbeing, ecosystem services and drawdown of natural capital into any measure of economic and social progress and sustainability.

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22 *www.ec.europa.eu/public_opinion/archives/ebs/ebs_416_fact_ie_en.pdf*

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Chapter 10

Environment and Transport

Environment and Transport

Introduction

Our transport system is highly fossil fuel dependent, which results in significant emissions of greenhouse gases (GHGs) and air pollutants that are contained in exhaust fumes. Overall, 19.5% (11.3 Mt CO_2eq) of Ireland's GHG emissions are from the transport sector, and this proportion is expected to increase substantially by 2020. The national climate policy goal (DECLG, 2014) is to reduce overall emissions of carbon dioxide (CO_2) by at least 80% of 1990 levels by 2050. Ireland also has various targets in the transport sector that it has to achieve, including an obligation to deliver 10% of transport energy from renewable sources by 2020. These stringent goals will require a major transformation in how our transport network is operated and managed.

A recent report by the European Environment Agency (EEA, 2015) has highlighted that a modal shift away from road transport and a switch to alternative fuels are among the key future challenges to be overcome if Europe is to achieve its decarbonisation targets. In Ireland, there is an urgent need for better urban and spatial planning, as well as a major investment programme to encourage much more fuel-efficient transport, a switch to cleaner and alternative fuels, a rapid increase in the electrification of our car stock and a very significant shift from private car to public transport. Without these measures, Ireland will fall well short of meeting its various targets in the transport sector, and of ultimately reducing its emissions of CO_2 by at least 80% by 2050.

Current Trends

Transport Emissions

Transport is a significant contributor to Ireland's greenhouse gas emissions.

Transport was responsible for 19.5% of Ireland's total GHG emissions in 2014 (EPA, 2016a). Transport emissions grew considerably between 1990 and 2007. By 2007, emissions were up to 180% higher than in 1990. However, the economic downturn meant that emissions from transport decreased by 25% from 2007 to 2012. Changes to emissions-based motor and vehicle registration taxes also had an influence on this reduction, as did EU emissions limits. For people with options for commuting, other than by car, the introduction of carbon taxes also had some effect though in the short-term at least fuel consumption remains relatively static.

Since 2012, with a resumption of economic growth, transport emissions have started to rise again (Figure 10.1). GHG emissions, including CO_2, are projected to increase by at least a further 10% by 2020 (EPA, 2016b). This increase could be even higher, as it is based on an assumption that there will be 50,000 electric vehicles on the road and that the 10% renewable fuel use target has been met. There are currently only around 1,700 electric vehicles on the road, highlighting the scale of the challenges to be addressed in the transport sector.

Air Pollution and Transport

Air pollutants released from transport are a key public health issue.

The impact of air pollution arising from transport emissions on the environment and health is covered in Chapter 2 of this report. The transport sector accounted for 12% of all air pollutant emissions in 2015 and is one of the largest contributors to particulate matter pollution in cities (Figure 10.2). The diesel car fleet is a key source of this particulate pollution. The predominant message is that there are significant human health impacts from particulate matter (PM) and nitrogen oxides (NO_x) emissions, which include cardiovascular disease, lung disease and heart attacks (EPA, 2015), and this points to a clear need to reduce transport-related pollution emissions. The recent controversy over the misrepresentation of NO_x concentrations in car emissions serves to underline the importance of industry integrity and transparency, as well as the need for independent validation of standards necessary to ensure protection of public health.

Figure 10.1 Transport Greenhouse Gas Emissions, 1990-2014 (Source: EPA)

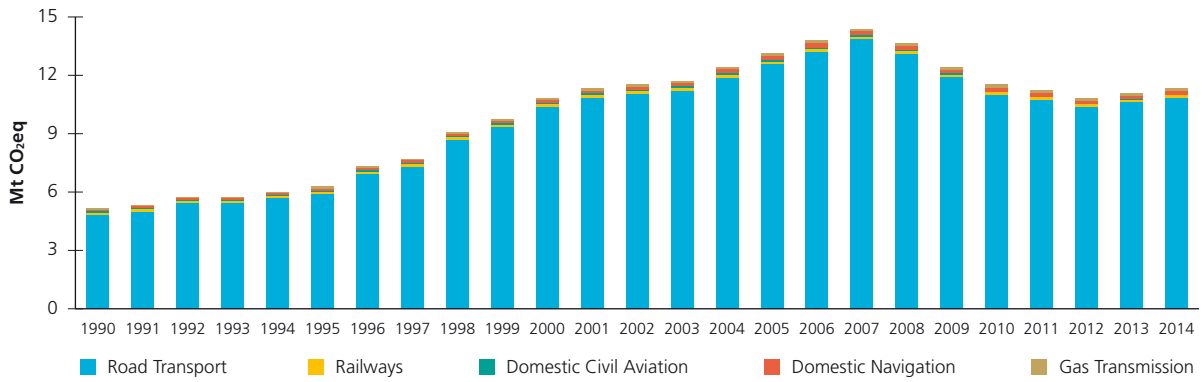
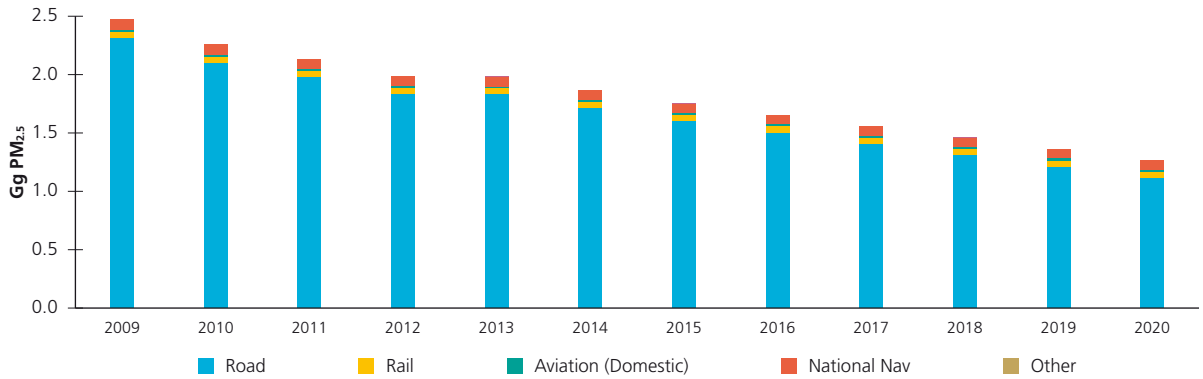


Figure 10.2 Particulate Matter ($PM_{2.5}$) Inventories and Projections by Transport Type, 2009-2020 (Source: EPA)

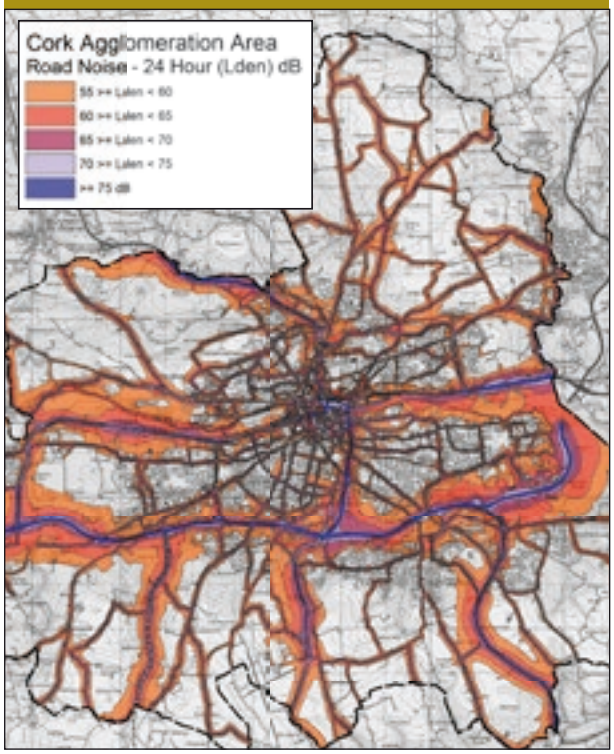


Gg is gigagrams, which is equivalent to kt (kilotonnes).

Other Environmental Pressures

Noise pollution is an important health concern affecting quality of life and wellbeing, and road transport is one of the main sources of environmental noise pollution in Europe, as outlined in Chapter 8 of this report. An example of transport noise mapping in cities in shown in Figure 10.3. Land use planning to safeguard the protection of quiet areas not yet affected by noise can bring significant environmental health benefits. Other environmental aspects include the significant impacts from large transport infrastructural developments on both the human and natural environment, such as on air quality, climate, land and soil.

Figure 10.3 Environmental Noise Map of Cork City (Source: Cork City Council)



Passenger Road Transport

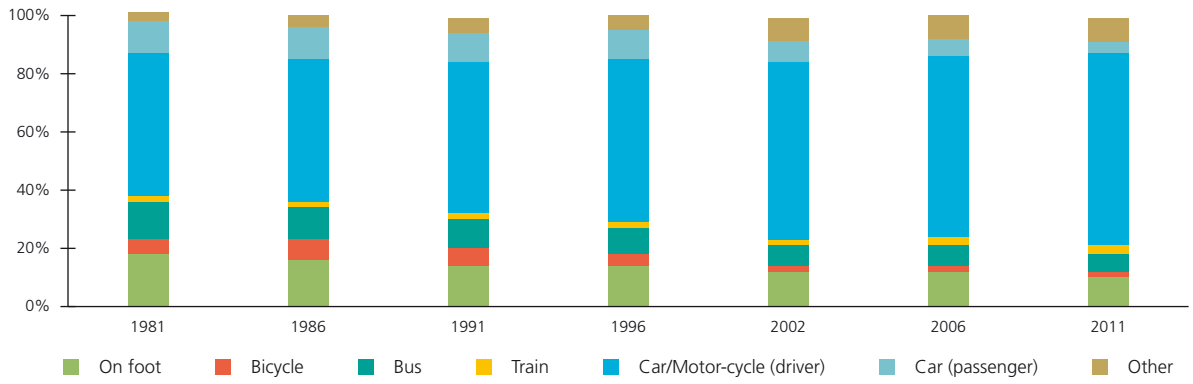
The car is still the dominant choice.

The private car remains the dominant mode of transport in Ireland, accounting, on average, for 74% of all journeys (Figure 10.4) and 79% of all journeys outside Dublin (CSO, 2015). The dependency on car transport outside Dublin can be partially explained by the low-density, dispersed nature of the rural population, making it very difficult to effectively operate a public transport service in rural Ireland. This high dependency has a very significant environmental impact in terms of both GHG and air pollutant emissions.

The total number of licensed vehicles on Irish roads exceeded 2.5 million for the first time in 2014 (DTTAS, 2015a), which included over 1.9 million private cars. While private car ownership levels in Ireland are still below the EU average, the challenge for policymakers is to try to develop a sustainable transport model that can meet the Department of Transport, Tourism and Sport's (DTTAS) sustainable transport vision of:

- maximising efficiency and alleviating congestion;
- minimising the impacts of air pollutants and GHG emissions; and
- reducing overall travel demand and commuting distances by private car.

Figure 10.4 Travel to Work by Mode (Source: CSO)



Road Freight

Road freight is projected to increase again as the economy grows.

There was significant growth in the number of heavy goods vehicles (HGVs) from 1990 onwards. The estimated energy demand of Irish road freight between 1990 and 2007 increased by 239% (SEAI, 2014a). However, the estimated final energy demand of HGVs was down 49% in the period 2007 to 2013, and HGVs have become much more fuel efficient due to more stringent EU standards. Nevertheless, the energy demand from HGVs has now started to increase again which clearly indicates that economic activity is a significant factor when it comes to road freight based emissions.

Rail and Bus

The challenge is to increase passenger numbers to reduce car dependency.

Rail freight traffic declined by 83% over the period 1990 – 2014, from 589 million tonne-kilometre (tkm) in 1990 to 100 million tkm in 2014, although since 2012 it has been increasing. While the demand for rail freight has declined over the period, combined rail and road freight has increased significantly which indicates a very significant modal shift to road freight. The CO_2 emissions profile for rail freight could be up to 90% less than that for road freight with the new longer trains under trial, while any CO_2 emissions from electric trains would be minimal (Irish Rail, 2016).

The total number of heavy rail passengers dropped from 44.7 million in 2008 to 36.7 million in 2013 in line with economic and transport demand decline. Recent years have seen a renewed growth in rail passengers. Meanwhile, the Luas has experienced consistent passenger growth since 2009, with provisional figures indicating that 34.6 million passengers used this service in 2015, which is 9.2 million higher than in 2009. Bus vehicle kilometres increased by 39% from 1998 to 2008, before falling back by 10% from 2008 to 2012. The total kilometres operated remained constant between 2013 and 2014 at 163.6 million vehicle km, with a small decline in both Dublin Bus and Bus Éireann public service obligation (PSO) services balanced by a small increase in other services (DTTAS, 2015b).

Cycling

Cycling in cities has recorded steady growth.

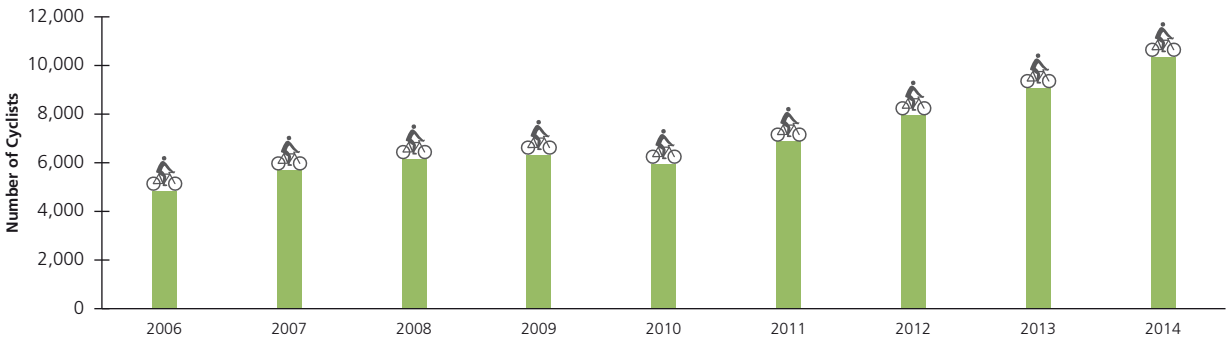
The number of journeys on the Dublin Bikes scheme, which began operations in Dublin in 2009, increased from 1.2 million in 2010 to 4.1 million in 2015. There are now similar schemes in operation in Cork, Limerick and Galway. The number of journeys in 2015 was 289,426 in Cork, 40,118 in Limerick and 19,934 in Galway. Cycling to work in Dublin has seen steady growth since 2006 based on counters placed along the canals (Figure 10.5).

Aviation

Air transport passenger numbers are increasing.

Following a substantial drop in numbers from 2009 to 2011, the number of passengers handled by Irish airports has rebounded again to reach 26.5 million in 2014, with the upward trend likely to continue for some time to come. The energy demand of aviation is estimated based on the sales of jet kerosene. Between 1990 and 2007, estimated aviation energy demand grew by 179%, from

Figure 10.5 Cyclists Crossing the Canal Cordon in the Morning (a.m.) Peak (Source: DTA)



375 kilo-tonnes of oil equivalent (ktoe) to 1045 ktoe (1 toe is the amount of energy released by burning 1 tonne of crude oil). This was followed by a decline of 44% up to 2012, while 2013 saw an increase of 3.4% to 607 ktoe, and this upward trend is continuing.

Marine and Navigation

Tonnages handled by Irish ports, while increasing in 2014, were still 12% below 2007 levels. The number of vessels handled was 24% lower in 2014, suggesting a move towards fewer larger vessels. This transport sector involving Ireland's cargo ships and tankers is simply known as "navigation". Navigation energy demand is estimated based on sales of marine diesel. For the period 1990 to 2013, the estimated energy demand increased from a low base in the early 1990s of approximately 7 ktoe to a peak of 81 ktoe in 2008, declining to 57 ktoe in 2013. The trend for energy demand in this mode is currently poorly understood.

What's Being Done

Energy Efficiency

Initiatives to increase energy efficiency in the transport sector are in progress.

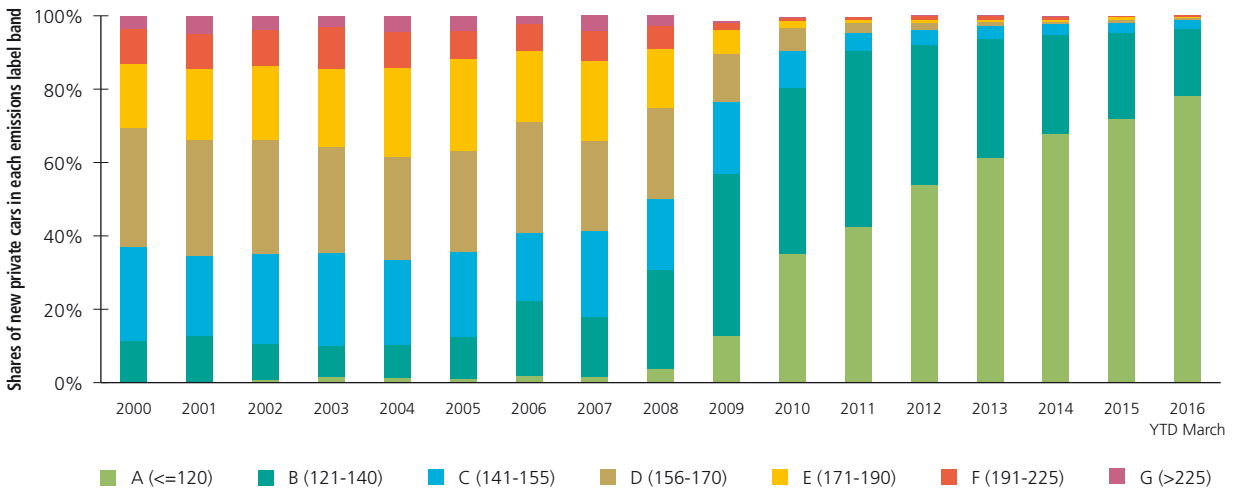
Ireland's third National Energy Efficiency Action Plan (NEEAP) was launched by the Department of Communications, Energy and Natural Resources (DCENR) in 2014. The NEEAP sets out a suite of policies and measures to deliver savings resulting from energy efficiency. The transport sector accounts for 14% of the total energy efficiency savings identified. The majority of the energy savings (66%) are expected to come from the EU regulations on improved fuel economy of new private cars, but this assumes that the energy efficiency figures supplied by the various vehicle manufacturers can be validated.

According to research by the International Council on Clean Transportation (ICCT), real-world emissions of CO_2 are up to 40% higher than emissions measured in the testing lab, with the largest discrepancy observed in hybrid cars (EEA, 2016).

The charging system for Vehicle Registration Tax (VRT) and motor tax for private vehicles continues to promote the purchase of energy-efficient vehicles. In 2013, 61% of new purchases were in Band A (1–120 g/km) and 32% were in Band B (121–140 g/km), while cars with CO_2 emissions of 140 g/km or higher accounted for just 7% of new car purchases (Figure 10.6). Whilst a successful policy from the perspective of CO_2, this tax transfer did lead to higher environmental NO_x and particulate emissions as consumers migrated to low-CO_2 diesel cars. A significant portion of the Irish passenger car (PC) fleet still uses older exhaust emission reduction technologies, such as Euro II (1997-2001) and III (2002-2005) , but this is changing as newer technologies such as Euro IV and V become more dominant (EPA-UNFCCC, 2016). The potential impacts, particularly the effects of NO_x emissions resulting from continued dieselisation (increase in relative numbers of diesel vehicles) on ambient pollutant levels and therefore human health, are becoming more clearly understood and must also be factored into policy development in this area. The environmental efficiency of such a taxation measure is therefore questionable.

Initiatives are under way to modernise the public transport fleet by introducing reduced emission vehicles. There is a commitment to establish a Green Bus Fund to cover the differential between the cost of a conventional diesel bus and the cost of an alternative fuelled equivalent. This, and other transport measures, are included in the White Paper on Energy Policy *Ireland's Transition to a Low Carbon Energy Future 2015-2030,* which was published in 2015 (DCENR, 2015).

Figure 10.6 Share of New Cars by Emission Band (Source: SEAI 2014a Energy in Transport)



Alternative Fuels

Promoting the use of alternative fuels including electricity is a key policy objective.

The use of alternative fuels, including electricity, forms a significant part of government policy to reduce transport emissions. Under the EU's Renewable Energy Directive (2009/28/EC), Ireland is obliged to deliver 10% of transport energy by renewable sources by 2020 – this is called the RES-T (renewable energy in transport) target. The Biofuels Obligation Scheme, which places an obligation on suppliers of transport fuels to ensure that 6% (by volume) of petrol and diesel is produced from renewable sources, e.g. ethanol and biodiesel, is set to increase this obligation to 8% from 2017 (NORA, 2016). In practice, the consumption of biofuel is predominantly achieved by the blending of liquid biofuels with petrol and diesel. Biodiesel is the dominant biofuel (72%), with the rest being bioethanol.

To promote renewable electricity in transport, a grant support scheme for electric vehicles (EVs) enables purchasers of such vehicles to receive up to €5,000 off the cost price, and EVs are also treated favourably under the motor tax system, qualifying for VRT relief of up to €5,000. In addition, a tax incentive for companies paying corporation tax allows companies to write off 100% of the purchase value of qualifying energy-efficient equipment against their profit in the year of purchase. In 2014, the Electricity Supply Board (ESB) successfully completed the installation of electric vehicle fast chargers across the country, with a fast charger located every 60 km along Ireland's main roads (ESB, 2016).

Electric Vehicles: Case Study of the Aran Islands Electric Vehicle project

Twenty-four households on the Aran Islands have participated in a pilot project to demonstrate the smart grid technologies needed to transfer and store wind energy in EVs. Each household was fitted with an innovative smart charger unit that could be accessed remotely to allow matching of available wind power with vehicle-charging requirements. It was found that EVs have reduced reliance on imported energy for transport by 68%, and analysis shows that this could be cut further by replacing heating systems with heat pumps powered by wind or wave energy (SEAI, 2015).

Planning for Sustainable Transport

Land use planning should be consistent with spatial planning objectives.

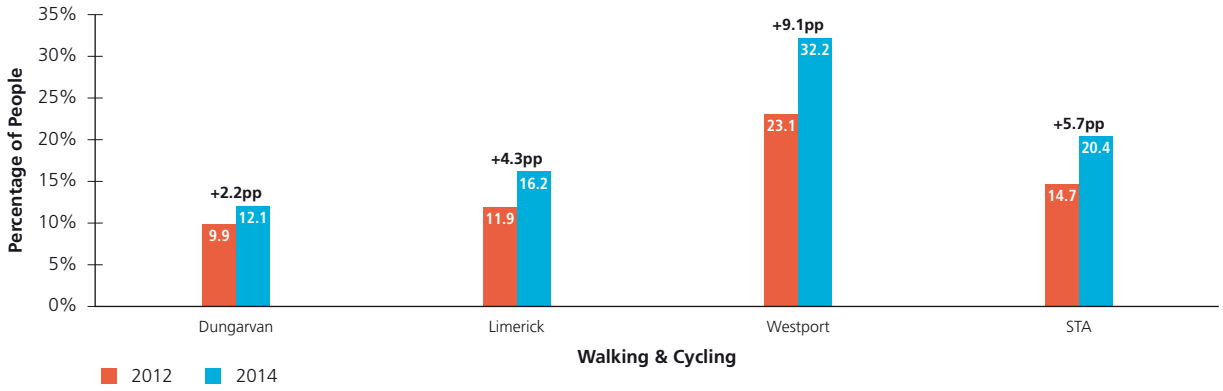
The National Transport Authority (NTA) is responsible for ensuring that integration of land use and transport planning in the Greater Dublin Area is consistent with spatial planning objectives. The Transport Strategy for the Greater Dublin Area 2016-2035 has now been approved by the DTTAS and sets out the principles for land use and transport integration (NTA, 2016).

The DTTAS funds the NTA to administer a range of behavioural change programmes. These include the Smarter Travel Workplaces, Smarter Travel Campuses and Green Schools Travel programmes, which are designed to raise awareness around more sustainable travel options and to encourage a shift away from the car to more sustainable modes of transport. The Dublin Bikes scheme has been a great success, and the scheme has been rolled out to the regional cities of Cork, Galway and Limerick, while taxation incentives, such as the Bike to Work scheme, have also been very successful.

Smarter Travel Areas: Case Study of Smarter Travel Areas – Limerick, Dungarvan, Westport

Under the Smarter Travel Areas (STA) programme, three areas (Limerick City, Dungarvan and Westport) have officially become Ireland's Smarter Travel Demonstration Areas 2012-2016. They represent a city area, a medium-sized town and a small town. The three areas will see a combined investment of €23 million in order to encourage a behavioural switch to more sustainable forms of transport such as cycling, walking and public transport. This investment in Smarter Travel Areas is intended to reduce congestion and pollution, improve road safety, create local employment opportunities, and improve people's health and fitness, as well as enhancing local townscapes and streetscapes. A 2016 interim report evaluated the modal shift seen so far in these areas when compared with Dublin, with increased uptake in both walking and cycling, particularly in Westport (Figure 10.7).

Figure 10.7 Modal Shift for Walking and Cycling (Source: AECOM, 2016)



Outlook

Transport and Planning

Planning and public transport policy needs to be integrated.

Sustainable transport policies aimed at reducing travel can only be delivered if there are complementary spatial policies locating future developments closer to employment centres and the services that support them, including education, retail and leisure opportunities. In terms of making public transport more attractive and accessible, some good progress has been made in recent years through tax saver schemes, integrated ticketing, use of smart technologies, journey planners and real-time passenger information, but much more needs to be done. The forthcoming National Planning Framework (NPF) is a 20 year strategy for the spatial development of Ireland that will promote a better quality of life for all, with sustainable economic growth and an environment of the highest quality as key underlying principles (DECLG, 2015).

The DTTAS is currently developing a National Intelligent Transport Systems (bio) Strategy, which is due for completion in 2017. Among the key advantages of intelligent transport systems (ITS) is their ability to maximise the potential of infrastructural and consumable resources including fuel. The strategy aims to develop a two-channel approach based on (1) research and development in ITS and (2) the co-ordinated delivery of ITS in Ireland in the medium term. This two-pronged approach will lead to commercial opportunities and, through shared services, a more co-ordinated delivery of ITS (ITS-Ireland, 2014).

Greening Transport Survey

Incentivise commuters to use public transport.

According to the preliminary findings of a recent survey (Greening Transport, 2016a) of commuters in the Greater Dublin Area, time considerations are the main factor influencing transport mode when travelling to and from work or education. The costs and health benefits associated with public transport, cycling, walking are also important considerations for commuters.

Interestingly, the average monthly costs of car ownership, including carbon emissions-based motor tax, did not prove to be an important factor influencing respondents' decision to own or use a car. Increasing the efficiency of bus services could be achieved by improving bus priority on certain roads, reducing bus stops situated at bottlenecks by directing attention to orbital routes or routes which have greater bus segregation from other traffic, and reducing the number of stops at close proximity to each other. Stop times could be reduced by increasing electronic ticketing. Fast, clean, convenient and affordable public transport needs to be part of any sustainable transport strategy that successfully reduces private car use in urban areas. The Greening Transport project, currently in its first phase, aims to look at the emissions reduction potential of behaviour change in the transport sector (Greening Transport, 2016b).

The 2030 Rail Network Strategy

Progressing the strategy for Ireland's rail network will reduce the use of fossil fuels.

The focus of the 2030 Rail Network Strategy is on the future development requirements of the Iarnród Éireann InterCity Network and the regional services. The Energy White paper supports the introduction of a suite of initiatives to improve the energy efficiency of the rail network, for example further rail electrification will be a priority in future capital plans, as it substantially reduces the use of fossil fuels. The recently published Capital Plan 2016-2021 also provides for further such public investment in the Greater Dublin Area (DPER, 2015).

Rail Freight

The potential for rail freight was also considered in this rail network strategy, but it is limited in Ireland as the small scale of the Irish market is insufficient to justify large scale capital expenditure. Some ways to increase rail freight include carbon or tax credits for shippers to incentivise rail rather than road use, the reduction of the track access charges to make rail more competitive with road freight, and the promotion of rail freight to shippers and to freight forwarders.

Road Freight

Alternatives to oil as transport fuel are available.

The introduction of the Euro class standards for exhaust emission reduction technologies have had a significant impact on reducing atmospheric emissions such as NO_x and particulates, meanwhile the Alternative Fuels Infrastructure Directive (2014/94/EU) outlines the various fuel options that could provide alternatives to oil in road and maritime transport. In relation to liquefied natural gas (LNG), there are currently no facilities in Ireland, so consideration will need to be given to the level of infrastructure such as developing fuelling stations and incentives needed to support this fuel.

Currently, natural gas offers certain benefits in terms of emissions reductions and air quality, and the technology is mature. Natural gas vehicles (NGVs) have several benefits over conventional diesel vehicles, including a 10-20% reduction in CO_2 emissions and 70%, 80% and 99% reductions in nitrogen oxide, sulphur dioxide and particulate emissions, respectively. They can also deliver fuel savings, reduce noise emissions, and operate on natural gas or biogas. Natural gas vehicles fuelled by compressed natural gas (CNG) are particularly suited for heavy road freight. The Alternative Fuels Infrastructure Directive requires the provision of a sufficient number of publicly accessible CNG refuelling points to be built by 2025. The target number of refuelling points will be included in a National Policy Framework on Alternative Fuels Infrastructure for Transport, due for publication in late 2016.

Another benefit of supporting CNG-fuelled vehicles is the creation of a market for biomethane as a transport fuel. Biogas can be upgraded to biomethane with a methane content of 96%, and biomethane can be used in gas vehicles as a fuel without modification of the engine. According to the recent SEAI report *Ireland's Energy Targets – Progress, Ambition and Impacts* (SEAI, 2016), the use of biofuels added to traditional transport fuels needs to treble in the next 5 years if renewable targets are to be met. The development of the current gas infrastructure to better enable the production of biomethane from a range of sources, including from farm waste, is addressed in the Bioenergy Strategy (DCENR, 2014).

Reducing Vehicle Emissions

More energy-efficient vehicles are needed.

According to SEAI (2016), new electric vehicle registrations need to grow from less than 1% of new car sales to 20% within the next 5 years, i.e. annual sales of EVs need to reach 50,000 by 2020 in order to contribute to meeting binding EU energy targets. This level of growth is highly questionable. It requires a very significant shift in incentives, education and public attitude as there are over 200,000 commercial vans in Ireland (under 3 tonnes), a shift to electric vans (e-vans) could have a significant impact. At present, electric cars account for only 1.3% of new car sales in the EU, but this figure rises to 12% in the Netherlands and to 8% in Denmark (EEA, 2016).

In Ireland, increasing sales of car models emitting less than 100 g CO_2/km would result in a significant reduction in transport carbon emissions (more stringent requirements for average CO_2 emissions for new cars, 95 g CO_2/km, will take effect from 2021 under new EU legislation). There are now more than 300 models of petrol and diesel cars emitting less than 100 g CO_2/km and they attract no price premium. These figures do not include hybrid or electric cars, which could result in further reductions. Measures to support such a transition need to be considered in the National Mitigation Plan (NMP) currently under development. A transport sectoral plan needs to outline how Ireland is going to reduce its CO_2 and air pollutant emissions while trying to minimise the costs. Bringing the sectoral plans together into the NMP will require the proposed measures to be complementary across all sectors.

Demand Reduction Measures

Incentives encourage more sustainable car use.

Financial incentives such as subsidies or preferential tax treatments (e.g. free parking in the city centre, free tolls, and lower fuel or registration taxes) play a major role in the consumer's choice of the type of car bought. Past studies have shown that fuel taxes, where they are high, have restrained growth in fuel demand over the long term (Sterner, 2007) by leading to the purchase of more fuel-efficient vehicles. The implementation of various "demand management" measures, as set out in the *Transport Strategy for the Greater Dublin Area 2016-2035*, should help to accommodate future travel growth in a managed and balanced way, while some behavioural change programmes are also highlighted in this report (NTA, 2016).

In addressing the need to reduce emissions from transport, a range of approaches to demand management and mode shift will need to be considered, such as measures to target those drivers who use their car for non-essential journeys, and to reward those people who switch to public transport or actively car pool using the national car-sharing website. The intention of any such measures should be to reward good behaviour as well as to ensure that sustainable transport modes will become the cultural norm. We also need to look at technological advances and approaches successfully delivered elsewhere, e.g. innovative taxation systems, and to implement those aspects that would best suit the Irish situation.

Cycling and Walking Initiatives

A new plan looks to expand the existing cycle network.

The NTA has published a Greater Dublin Area Cycle Network Plan, which sets out a 10-year strategy for the counties of Dublin, Kildare, Meath and Wicklow. The cycle network outlined in the plan will treble the existing network in urban areas from 500 km to 1485 km in length, and will provide over 1300 km of new connections between towns in the rural areas of the Greater Dublin Area (NTA, 2014).

The proposed National Galway to Dublin cycleway will be Ireland's first dedicated inter-city route for cyclists and walkers, who will be able to travel between Galway and Dublin without using roads, while the Wild Atlantic Way which includes driving, cycling and walking routes has already been a huge success for both locals and visitors alike (GDC, 2015). In addition, the Active Travel Towns programmes were established to secure increased walking and cycling mode share in large population and employment centres.

Conclusions and Future Challenges

Key High-level Messages

We need to support a modal shift away from the private car to an efficient sustainable transport system through better alignment of land use and transport planning and by making public transport faster, cleaner, more convenient and more affordable.

We need to ensure that all major transport forms (HGVs, car, bus, train) become much more fuel efficient, as well as incentivising a very significant increase in alternative fuels and electric vehicle use.

We need to develop a prudent mix of planning, infrastructural investment and fiscal measures to bring about a reduction in transport demand.

For larger urban areas, we need to change our current silo approach and work on many different levels to have a much more integrated network, where all streets are walkable, bikeable and pleasant to live and work in.

In Ireland, it is anticipated that reductions in GHG emissions from transport will come mainly from fuel efficiency gains and, to a lesser extent, from the use of alternative fuels. There is a very significant challenge to develop suitable alternative fuels that meet the currently available vehicle technology in the short term.

In relation to road freight transport, the conversion from diesel to cleaner NGVs is a policy option that should be progressed with the installation of sufficient infrastructure and refuelling points. Other measures may include incentives for lower emitting vehicles through the tax system, grants for purchase of cleaner vehicles, scrappage schemes for older vehicles as well as policy options to maximise zero-emissions vehicle sales in 2035. These measures will need to be driven as part of the National Mitigation Plan and when implemented will play a key role in reducing CO_2 emissions. An integrated strategy, tackling GHG and air pollutant emissions together, needs to be pursued to ensure that the public health co-benefits are realised.

A genuine change in the image of public transport and cycling in the Greater Dublin Area (as well as other large urban areas in Ireland) is required if the behavioural

change needed to move away from individual car usage is to be achieved. This change can be realised through a combination of public awareness campaigns and significantly more funding being assigned to projects like walkability audits, plans to expand and declutter footpaths, priority routes and schemes for traffic management of public transport, especially at junctions, greater segregation of cyclists from mainstream traffic and safe cycling infrastructure (e.g. bicycle parking, early starts at traffic lights and safe road surfaces) (Greening Transport, 2016b).

This awareness campaign should occur in line with "green city" measures that act as a barrier to car use in large urban areas, for example greater pedestrianisation of streets, congestion charging, creation of more park and ride facilities; and movement of car parks away from city centre areas, as set out in the in the *Greater Dublin Transport Strategy 2016-2035*. These measures should be put in place to encourage sustainable transport use in order to ease traffic congestion and ultimately result in a reduction in emissions. However, viable alternatives to the private car need to be available for these measures to be effective.

The main initiatives and legislative requirements are outlined in the Energy White paper, the Biofuels Obligation scheme, the National Mitigation Plan, the Draft Transport Strategy, and the Dublin Area Cycle Network. The relevant authorities will be responsible for ensuring the effective implementation of these policies. Going forward, it will be necessary for periodic reports to be prepared and published to outline how the environmental and sustainability actions incorporated into these projects are progressing, and to assess whether they are contributing to significant and verifiable reductions in our emissions of CO_2 and air pollutants.

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Chapter 11

Environment and Energy

Environment and Energy

Introduction

Major transitions are needed in Ireland's energy systems.

Ireland's energy systems will face a major transformation in the coming decades. The key driver for this is international action to address and limit climate change. This transformation is supported by a range of policies at national and European levels,[1] including the White Paper on Energy (DCCAE, 2015), the National Policy Statement on climate change (DHPCLG, 2014)[2] and targets agreed under the EU's 2020 Climate and Energy Package and 2030 Climate and Energy Framework. These effectively envisage decarbonisation of national and European energy systems by 2050. They provide the longer-term vision of transformation and the shorter-term steps needed to achieve the vision. Large-scale public and private investments in energy infrastructures, efficiency and management systems will be needed.

An essential element of this required transition is the decarbonisation of Ireland's electricity generation system. This can be achieved with currently available technologies. However, significant and specific challenges exist for the buildings and transport sectors. Energy efficiency and innovation are essential in these areas, which are highly fossil fuel-based. Innovations include information provision and education, as well as new technologies. The transition to a fossil energy-free Ireland can provide short-, medium- and long-term benefits, including enhanced energy security and reduced costs, as well as significant co-benefits for human health, the environment and socio-economic development. However, considerable barriers to this transition exist and addressing these will be essential.

1 *www.unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf*

2 *www.housing.gov.ie/environment/climate-change/policy/national-climate-policy*

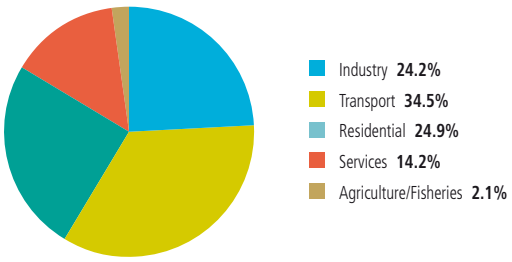
Current Position and Trends in Energy Use

As the economy improves the renewable sector needs to keep pace and the decoupling of economic growth from increasing energy use needs to be accelerated.

Ireland's total energy use in 2014 was 556 terajoules (TJ) (1.5 × 108 kWh). According to the Sustainable Energy Authority of Ireland (SEAI), the average household uses just under 50 kWh daily, of which 13 kWh is electrical energy.[3] European Environment Agency (EEA) data suggest that, at a European level, Ireland's household energy usage is the second highest, only below that of Finland.[4] Ireland had the fourth highest rate of energy import dependency (85.3%) among the European Union (EU) Member States in 2014, mainly in fossil energy. This dependency is both expensive (€5.7 billion in 2014) and environmentally unsustainable. However, overall energy use in Ireland has declined since its peak in 2008. While this was primarily linked to the economic recession, there is evidence of increasing energy efficiency. There was also an increased use of renewable energy in this period. As Ireland returns to prosperity, decoupling of economic growth from increasing energy use needs to be accelerated.

As shown in Figure 11.1, Ireland's principal energy requirements arise from transport, accounting for 35% of the total, and residential heating and electricity, accounting for 25%. Decarbonisation of energy use in the transport sector is a key challenge, which is addressed in Chapter 10.

Figure 11.1 Ireland's Energy Requirements by Sector (Source: SEAI, 2015)



Current Dependence on Fossil Fuels

Fossil fuel energy, especially oil, still makes up about 90% of Ireland's energy use profile, illustrating the extent of the decarbonisation challenge.

Figure 11.2 shows the sources for energy used in Ireland in 2014 (SEAI, 2015a). Fossil energy makes up about 90% of Ireland's energy use profile, of which oil (at 47%) remains the dominant fossil energy used, primarily for heating and transport. Overall trends in the use of various fossil energy sources vary, but there is a general decrease in fossil energy use and the use of renewable energy is growing, albeit from a very low base (currently approximately 8%).

Figure 11.2 Fuels Used for Energy in 2014 Based on SEAI Data (Source: SEAI)

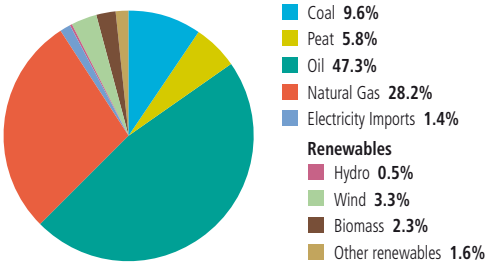


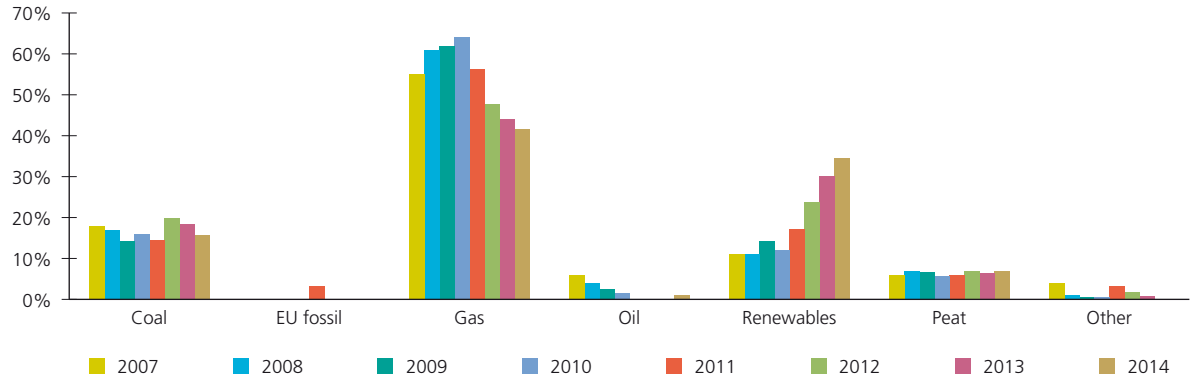
Figure 11.3 shows the changing nature of the fuels used for electrical power generation over recent years (CER, 2015). While there has been a significant increase in renewable energy generation, largely from wind, the data also show that gas remains the largest source of energy used. The increase in renewable energy use largely displaced gas rather than coal or peat, use of which has remained relatively stable. There are a number of compelling reasons why displacement of peat and coal would be preferable to displacing natural gas, including reducing greenhouse gas (GHG) emissions and improving air quality.

In Ireland, the electrical power generation sector accounted for 35% of energy used in 2014. Just over half of this energy is lost in the generation process and in distribution losses in the grid (SEAI, 2015a). The use of highly carbon-intensive fuels such as coal and peat has remained remarkably stable in this sector since 2007. Decarbonisation of this sector requires that coal and peat use is phased out rapidly, while a much greater use of renewables is required going forward. It is also essential that energy losses in transmission are factored into decision making on future energy systems.

3 *www.seai.ie/Publications/Statistics_Publications/Energy_in_Ireland/Energy-in-Ireland-1990-2014.pdf*

4 *www.eea.europa.eu/data-and-maps/indicators/energy-efficiency-and-energy-consumption-5/assessment*

Figure 11.3 Fuel Types Used for Electrical Power Generation in Ireland, 2007-2014 (Source: CER, 2015)



Renewable Energy

Energy derived from sustainable sources such as wind, sunlight, oceans, geothermal, biomass and biofuels is referred to as renewable energy. Ireland has considerable renewable energy resources, only a fraction of which are utilised to address our energy requirements. See *www.seai.ie/Renewables/* for information. The deployment of associated technologies, including wind turbines, solar panels (photovoltaic and thermal), has increased significantly in recent years.

Wind, ocean, solar, hydro and geothermal energy do not produce GHG emissions or emissions of air pollutants such as particulates, sulphur dioxide and nitrogen dioxide. Use of these renewable resources can have considerable co-benefits for human health and ecosystems. Meeting energy requirements from renewable resources can provide significant economic and employment benefits at local to national scales.

Bioenergy arises from combustion of various materials, including wood, animal wastes, and liquid biofuels such as biodiesels and alcohols. Historically, wood was the largest renewable energy source in Ireland; however, it was largely derived from unsustainable harvesting practices which led to Ireland's forest being steadily reduced so that just 1.5% of the total land area was under forest in the early 20th century (DAFM, 2008).

Sustainable bioenergy has the potential to replace some fossil fuels but a range of support measures will be required to incentivise this switch. *Ireland's Transition to a Low Carbon Energy Future 2015-2030* (DCCAE, 2015) includes measures to introduce a Renewable Heat Incentive from 2016 to reward each unit of renewable heat produced and used. Unsustainable bioenergy production can result in significant emissions of GHGs, while the biomass combustion process, particularly at a domestic level, and if not adequately regulated, can produce considerable emissions of air pollutants.

Use of solar energy in Ireland has been limited thus far to direct water heating. However, the improvement in efficiency of photovoltaic (PV) technologies and the remarkable decline in their costs mean that there has been an increase in the use of these technologies to provide electrical energy, with systems being installed in public, commercial and private buildings. If the trends in technological development and cost continue then PVs may become a major source of energy for Ireland.

The Residential Sector: the Second Largest Energy User (After Transport)

There are big opportunities for improvements in energy efficiency and cost savings for older homes.

The residential sector accounted for approximately 25% of energy used in 2014 (Figure 11.1). The profile of residential energy use is shown in Table 11.1. There has been a considerable shift from coal and peat to oil and particularly gas since 1990. Although electricity use has also grown, oil still dominates residential heating.

Residential energy use in Ireland peaked in 2010. Since 1990 there has been a move away from coal and peat to oil, gas and electricity. However, fossil based energy sources still predominate.

Table 11.1 Residential Energy Use in Ireland (Source: SEAI)

Residential energy use (GWh)	1990	2010	2014
Coal	7,277	2,957	2,546
Peat	8,430	2,948	2,325
Oil	4,528	14,690	9,967
Gas	1,364	8,253	6,229
Electricity	4,142	8,546	7,704
Renewables	520	631	754
Fossil fuels (total)*	21,598	28,848	21,068
Total	**26,260**	**38,024**	**29,526**

*Fossil fuel (total) is the sum of coal, peat, oil and gas use, while the final Total column also includes electricity and renewables use.

Significant improvements to the energy efficiency of housing have been evident since 2000 as a result of improved building regulations (e.g. the Building Energy Rating scheme – see topic box "Building Energy Rating" and Figure 11.4).

Building Energy Rating – Opportunities for Energy Efficiency and Cost Savings for Householders

The Building Energy Rating (BER) is a home energy rating from A to G. It is based on energy performance and CO_2 emissions. A-rated homes are the most efficient and will have the lowest energy use and costs.

Figure 11.4 shows the distribution of BER-certified homes in 2014. It can be noted that 50% of houses tested were rated D or lower. This represents both a considerable ongoing cost for these households and significant opportunity to improve energy efficiency.

Figure 11.4 Distribution of BER-certified Homes in 2014 (Source: SEAI BER data)

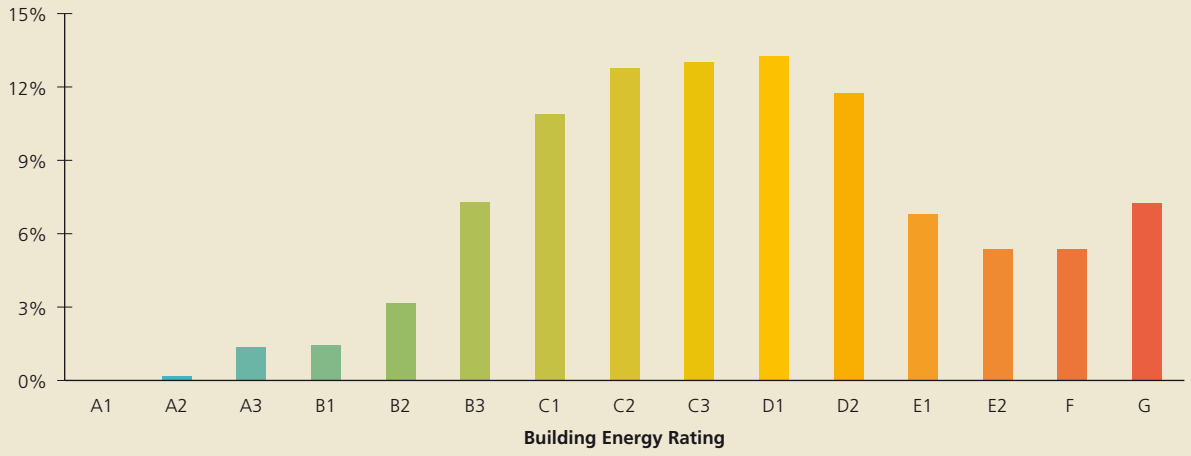
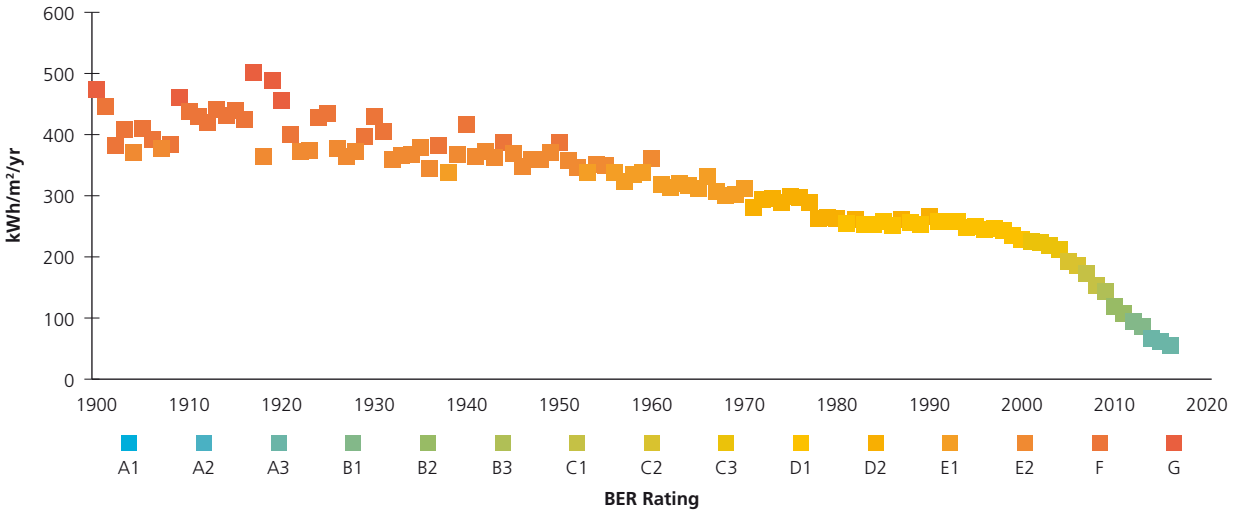


Figure 11.5 Average Building Energy Rating of Dwellings Constructed Since 1900 (Source: SEAI)



A Significant Increase in Retrofitting of Homes and Businesses is Essential

Approximately 75,000 homes and businesses will need to be upgraded for improved energy efficiency every year between now and 2020 if Ireland is to achieve the EU's 2020 energy efficiency target.

Retrofitting of the housing stock to reach BER grade A is an essential action to reduce GHG emissions. Upgrading a C-rated house to an A rating can reduce energy use from an average of 220 kWh/m² to 67 kWh/m² (TEP, 2015). This represents a major increase in comfort and long-term savings in energy costs. The "nearly zero-energy building" is a building standard that has a very high energy performance with the energy requirement being met to a significant extent by renewable sources. Recent (SEAI, 2016) data show that approximately 75,000 homes and businesses will need to be upgraded for improved energy efficiency every year between now and 2020 if Ireland is to achieve the EU's 2020 energy efficiency target. This is a very significant and immediate challenge.

Tipperary Energy Agency Warmer Homes Insulation Scheme

Since 2004, the Tipperary Energy Agency (TEA) has worked on a series of projects to support the retrofit of thousands of houses to bring these houses to grade D1 (from grades E-G) and to grade B3 standards, (from grades C1-C3) respectively. However, TEA determined that existing housing could be retrofitted to a better standard that virtually eliminates fossil fuel use.

In 2015, the TEA, under the SEAI Better Energy Finance Pilot programme, completed renovations of 10 private houses and achieved an average reduction of 153kWh/m²/yr, reducing energy consumption from 220 kWh/m²/yr on average (C3 standard) to 67 kWh/m²/yr on average (A standard). This near zero-energy building standard of retrofit (SuperHome Retrofit) included the provision of designed ventilation, air-tightness and an air source heat pump heating system. Retrofitting of a further 25–30 homes is due to be completed in 2016, leading to an estimated 60–70% reduction in household carbon dioxide (CO_2) emissions from these homes. This retrofit also resulted in a significant decrease in particulate emissions from open fires or stoves. See *www.superhomes.ie* for more information.

The Tipperary Energy Agency example shows how both learning and the effective use of incentives and innovative financing schemes can rapidly advance this retrofit process. Deep retrofits involving very extensive insulation and major energy efficiency measures, coupled with greater use of renewables on the electricity grid and the phasing-out of peat and coal over the next decade, can significantly lower CO_2 emissions from the domestic sector. Such approaches need to become central to the national discourse on actions to improve the quality of the national housing stock and the quality of life and health of communities.

What is Being Done (Energy Policy)

In 2014, renewable energy accounted for approximately 8% of all energy used, mainly from bioenergy and wind power; our target for 2020 is 16%.

The Renewable Energy Directive (2009/28/EC), which is incorporated into the EU 2020 Climate and Energy Package, requires Ireland to meet 16% of its energy needs from renewable sources by 2020. There are also specific national targets established under the National Renewable Energy Action Plan targets for electricity, transport and heating, for example that renewable energy should supply 12% of heating, 40% of electricity and 10% of transport energy requirements by 2020.

In 2014, renewable energy made up approximately 8% of energy used, mainly from bioenergy and wind power (SEAI, 2015a), which is some way short of our 16% target. Currently, 23% of electricity generation is from renewable sources (half of 2020 target): this has reduced annual energy imports by €255 million and avoided 2.6 Mt of CO_2 emissions. Renewable energy also supplied 6.6% of heating requirements and 5.2% of transport energy requirements.

A Bioenergy Strategy is, among other initiatives, expected to introduce an Exchequer-funded renewable heat incentive scheme in 2016, which will be aimed at larger commercial and industrial installations. In addition, enabling policies will address supply chain challenges through the establishment of a biomass feedstock planning scheme to optimise the supply chain in a sustainable manner.

There is a clear need for technological developments that would allow for energy storage systems to assist in the management of energy systems in Ireland. Significant innovations are anticipated in the United States of America (USA) and elsewhere, with local storage linked to local generation emerging as a model at household and community level. Such developments can have co-benefits for resilience and flexibility, as severe weather can cause significant network problems. Distributed and local storage, in combination with modern grid and energy management technologies, can be part of a robust and resilient energy system.

Energy efficiency enables achievement of the same or improved performance using less energy. Energy use in Ireland in all sectors is very inefficient, giving rise to increased energy costs, cold and uncomfortable housing, as well as emissions of carbon dioxide and other air pollutants. Increasing energy efficiency, through the insulation of buildings and use of efficient lighting and appliances, has multiple benefits inducing reduced energy costs and improved air quality.

The EU Energy Services Directive (2006/32/EC) provides the framework for energy efficiency policy. The National Energy Efficiency Action Plan sets out how Ireland will meet its energy efficiency goals. Ireland has a national target to deliver a 20% reduction in energy costs as a result of improved energy efficiency by 2020. Government bodies will lead in this process and have a higher efficiency target of 33%. According to the SEAI's *Annual Report 2015 on Public Sector Energy Efficiency Performance* (SEAI, 2015b), efficiency gains have been achieved through better energy management, building and facility upgrades, retrofit, and changes in transportation. By 2014, just over 50% of the required savings had been achieved.

Home Energy Storage Enters a New Era

Recent developments in residential solar power in the USA include a "Powerwall battery" for the home energy storage market, while another company has unveiled a "lightweight battery system" for homes and small businesses that offers a longer lifespan and does not require expensive cooling and ventilation systems. The growing popularity of residential solar panels is increasing interest in batteries that could store electricity from those installations. In the future, such storage systems could benefit homeowners by giving them more control over how and when they obtain the power they need, while helping utilities by shifting demand to off-peak hours and smoothing out the load on the system.

www.technologyreview.com/news/541336/home-energy-storage-enters-a-new-era/

The *Offshore Renewable Energy Development Plan* (OREDP) was published in 2014[5] and identifies the sustainable economic opportunity for Ireland in the period to 2030. The OREDP sets out key principles, policy actions and enablers that provide a framework for the development of the sector. The OREDP identifies opportunities for the

5 *www.dcenr.gov.ie/energy/en-ie/Renewable-Energy/Pages/OREDP-Landing-Page.aspx*

sustainable development of Ireland's offshore renewable energy resources. Its implementation will facilitate increased indigenous production of renewable electricity, thereby contributing to reducing GHG emissions, improving energy security and creating employment.

Ireland's position in the Atlantic Ocean gives it an almost unparalleled offshore energy resource, with suitable conditions for the development of the full range of currently available offshore renewable energy technologies.[6] Offshore wind is considered to be technologically mature, but regulatory and support systems will be needed to incentivise developments. However, given the levels of investment required, these are likely to be delivered by international consortia rather than local communities.[7]

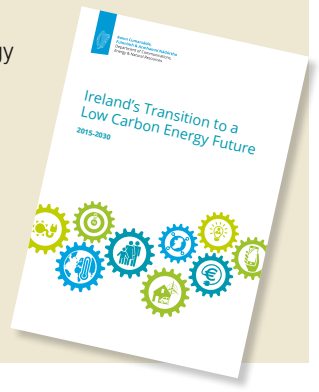
The Energy White Paper – Ireland's Transition to a Low Carbon Energy Future

This White Paper sets the blueprint for a major transformation of Ireland's energy system, including elimination of fossil fuel use.

Ireland's Transition to a Low Carbon Energy Future 2015-2030

The Government's White Paper on Energy envisages a low-carbon future that will require us to take the necessary steps to:

- radically change our energy usage profile as citizens, industry and Government;
- become more energy efficient;
- generate our electricity from renewable sources of which we have a plentiful indigenous supply;
- move to lower emissions fuels (e.g. moving from peat and coal to gas);
- increase our use of electricity and bioenergy to heat our homes and fuel our transport;
- support the wide-scale deployment of renewable heat in the business, public and residential sectors.



The Energy White Paper *Ireland's Transition to a Low Carbon Energy Future 2015-2030*[8] sets out a framework for a major transformation of Ireland's energy system, including the elimination of fossil fuel use. The aim is to enable Ireland to realise the maximum potential of its renewable energy resources in a cost-effective and sustainable manner. The White Paper sets out our energy future and outlines three core objectives of sustainability, security of supply and competitiveness. It strives to strike a balance between these three pillars, whilst ensuring a low carbon future. The White Paper highlights the need for greater community and citizen engagement in this process, the opportunities for electricity in wider decarbonisation, and the need to improve grid links with Europe.

Sustainable Energy Communities

Community projects involving energy efficiency and renewable energy have a very important role in the energy transition.

Sustainable energy communities are those in which a community works together to develop a sustainable energy system to fit their own energy requirements. This exemplifies the transition process. It is generally a two-step process in which energy-wasteful activities and processes are identified and reduced or eliminated as part of an energy efficiency process. The second step is to replace fossil energy with renewable energy. This is largely carried out in a decentralised manner. A sustainable energy community can include a wide range of energy users, e.g. homes, businesses, sports clubs, community centres and churches, and a number of them are supported by the Sustainable Energy Authority of Ireland (SEAI), which aims to build capacity and share learning.[9]

6 *www.oceanenergyireland.com/*

7 *www.seai.ie/Renewables/* and *www.seai.ie/Publications/Statistics_Publications/Energy_in_Ireland/Energy_in_Ireland_Key_Statistics/Energy-in-Ireland-Key-Statistics-2014.pdf for more information.*

8 *www.dccae.gov.ie/energy/en-ie/Energy-Initiatives/pages/white-paper-on-energy-policy-in-ireland-.aspx*

9 *www.seai.ie/SEC/*

Case Study of the Aran Islands' Sustainable Energy Community

Over 350 homes and community buildings on the Aran Islands, two-thirds of the total, have undergone complete energy upgrades, involving improvements in insulation and installation of efficient heating systems, with support from the SEAI. This is resulting in more comfortable homes and lower energy bills, with total annual energy savings accruing to the islanders of €250,000. A trial of electric vehicles has also demonstrated how transport fuel needs can be dramatically reduced. Analysis shows that energy imports could be reduced even further by replacing heating systems with heat pumps powered by wind or wave energy in the future.

www.seai.ie/News_Events/Press_Releases/2015/Aran-Islands-Take-Action-to-Eliminate-Fossil-Fuel-Dependence-.html

Future Energy Distribution Systems

There needs to be a clear vision of the future: multifunctional and Smart energy management systems for Ireland.

Ireland's energy distribution systems need to be upgraded to ensure that they are fit for purpose for this century. Future energy distribution systems will need to be responsive to diverse user needs, flexible to new and emerging technologies, and resilient and robust in the face of increasing climate change impacts. The transition from centralised and fossil-based energy to more distributed and renewable-based energy systems poses challenges for existing grids and energy infrastructures which will need to be addressed.

It is also important that future grids are developed in a manner that enables positive community engagement. Further interconnectivity with the UK and Europe is also needed. The cross-border Renewable Integration Development Project is currently working to identify the optimum configuration of the electricity transmission grid in the north and north-west of the island to cater for renewable energy sources. Similar development and investment will be needed on an all-island basis to achieve the required decarbonisation of energy systems.

The transition process will be challenging for existing infrastructures and systems, significant elements of which are likely to need to be replaced. This process needs to be carried out in a manner that addresses the technical issues associated with the transition to a grid system that is fit for renewables, including microgeneration. Societal, institutional and socio-economic barriers also need to be addressed. Overall continued investment in the network and smart energy management systems is essential to meet customer and citizen needs. Clear information to inform consumer decisions over short, medium and longer timescales is needed. Future incentives and technical innovations in grid management systems are required to allow microgeneration to expand and to enable electrification of heat and transport. Central to this is a clear vision of the future multifunctional grid for Ireland.

Current plans for Ireland's future energy system include "Grid25". This is a high-level strategy outlining how EirGrid intends to undertake the development of the electricity transmission grid in the future, to support a long-term sustainable and reliable electricity supply. The

purpose of the upgrade is to allow the infrastructure to meet Ireland's future energy requirements, and aims to reinforce the transmission system. It also proposes an alternative for Grid West, which would include significantly less new overhead cable.

A "smart grid" is an electrical network in which power generators, electonic devices and distribution networks are interconnected via communication and smart processing technologies. Such a system could enable more distributed power generators such as combined heat and power (CHP), wind turbines, and micro-renewables (domestic wind turbines and photovoltaic systems), which could reduce electrical distribution losses and improve overall energy efficiency. A smart grid could also respond rapidly to emergencies (such as a power station failure) by reducing non-essential electrical loads in sequence to prevent the entire network from collapsing.

Carbon Lock-in, Outlook and Future Challenges

Transition to a carbon-free energy society and economy creates opportunities at a range of scales and will involve public and private investment.

With a 90% dependency on fossil energy Ireland is highly locked into carbon-intensive systems in electricity generation, transport and heating. This reflects infrastructure lock-in, as well as societal and cultural lock-ins. Investment, innovation, information, education and behavioural change are needed to overcome this damaging cycle and enable our society to embrace renewable alternatives. Renewable systems need to be backed up by information and education, as well as proper support structures so that individuals, communities and organisations can work together to take ownership of this complex challenge.

Transition to a carbon-free energy society and economy creates a new opportunity for many actors at a range of scales and will involve public and private investment in energy infrastructures, energy efficiency and innovative management systems. Approaches to and technologies used in transport and heating will also have to change, with electrification becoming a key option for both of these sectors. However, syngas (produced by the gasification of a carbon containing fuel) and other alternatives such as hydrogen power are also likely to have significant future roles. Investments need to be coupled to progressive policies and information provision in particular to enable engagement and ownership by citizens and other energy users.

Case Study of Aurivo Dairy Biomass Project

Aurivo Dairy Ingredients achieved a 70% reduction in oil consumption and a 50% reduction in carbon emissions when it installed a €5.25 million state-of-the-art biomass facility at its Dairy Ingredients plant in Ballaghadereen, Co. Roscommon. Aurivo was using 5.5 million litres of heavy fuel oil per year. This has now been replaced with 27,500 tonnes of wood biomass at 55% moisture content, and this fuel switch alone represents an annual saving of 17,160 tonnes of carbon.

www.seai.ie/Your_Business/Large_Energy_Users/LIEN/LIEN_Events/Events-2014/Biomass-Solution-for-Aurivo-Dairy-Ingredients-.pdf

Fossil Fuel Subsidies

There are calls at a global level to phase out subsidies for fossil fuels.

The Global Commission on the Economy and Climate's report, *The New Climate Economy: Better Growth, Better Climate*, calls for a phase-out of subsidies for fossil fuels as part of its 10-point Global Action Plan.[10] These subsidies are diverse and include those provided for exploration, production, distribution and purchase of fossil fuels including coal, peat, oil and gas. The International Energy Agency (IEA) latest estimates indicate that fossil fuel subsidies for consumers, in 2014, were US$493 billion. Those subsidies were over four times the value of subsidies to renewable energy.[11]

In Ireland, fossil fuel subsidies are estimated to be €386 million annually. This is made up of the share of the public service obligation (PSO) levy allocated to subsidising peat and securing gas supply, totalling €169.2 million in 2014, combined with elements of the fuel allowance payments to low-income households of about €217 million annually.

Energy Statements

Making information available to consumers promotes energy saving.

Key information on energy use is not readily available to households and businesses. It is recommended that multi-annual and detailed information on energy use is provided to users. The provision of such energy statements should become the norm for all centralised suppliers and enable users to assess where they are on the energy use spectrum

10 *newclimateeconomy.net/content/new-climate-economy-january-update*

11 *www.worldenergyoutlook.org/resources/energysubsidies/*

benchmarked against peers and best practice, e.g. with improved efficiencies. Such statements could include details on financing options to increase efficiency.

In this regard, the smart meter allows very accurate recording of an electricity consumer's true consumption, and it allows this data to be read remotely. This potentially allows consumers greater freedom in their choice of tariff and, in the future, may also enable consumers to know their exact carbon footprint from their electricity consumption.

Conclusions and Future Challenges

Key High Level Messages

Currently fossil fuels provide approximately 90% of Ireland's energy this is causing significant adverse effects on human health, ecosystems and our climate system.

The planned phase out of fossil fuel use and deployment of renewable energy resources will be central to a major transformation of Ireland's energy systems in the coming decades.

This will require large-scale public and private investment in energy infrastructure, energy efficiency and innovative management systems, including smart distribution and storage systems.

Information provision and positive engagement with citizens and stakeholders is essential for the success of this process, to include communities, public bodies, energy providers and users.

Significant investments in retrofitting existing public and private buildings to high energy efficiency standards is a priority and new building should meet the highest efficiency standards.

Meeting our energy targets and effectively transitioning towards a carbon-free society represents a huge economic and societal opportunity for the country. Clearly, the outlook for energy is very challenging. Fossil fuels make up about 90% of Ireland's current energy profile – as outlined in the Energy White Paper these need to be phased out and replaced with readily available renewable energy resources such as wind, solar and tidal. Already Ireland faces challenges in meeting its renewable energy targets. Significant ramping up of actions is required as well as much greater local involvement and input into the process.

The Energy White Paper sets out the blueprint and associated actions for Ireland's transition to a low-carbon energy future. It is clear that there are many specific challenges to address to achieve this vision, and regular reports on the status of the planned outputs would be a useful initiative to allow progress to be tracked and measured. Investment in clean and sustainable energy solutions is needed. Global energy systems will need to undergo a major transformation in the coming decades. Energy distribution and storage systems are also a factor to consider as part of the vision for energy saving, decarbonisation and community engagement.

Large-scale public and private investment in energy infrastructure, including energy efficiency and innovative energy management systems, energy distribution and smart grid systems, is required. Major investment is urgently required to transition to a multifunctional grid system that is fit for renewables including microgeneration. Sustainable energy communities could be supported to work together to significantly reduce energy-wasteful activities, and replace fossil fuels with renewable energy alternatives.

Progressive policies and information provision to support citizens to engage with the new energy future are required, as is envisaged by the White Paper. There are very clear wins for citizens in terms of energy savings by retrofitting older and less energy-efficient housing stock to reach higher energy ratings. Retrofits of the housing stock, especially older houses, as well as commercial and public buildings to reach BER grade A is a national climate change-related project that could be prioritised through more targeted action programmes. This project would also benefit householders in terms of comfort and savings on heating bills.

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Chapter 12

Environment and Agriculture

Agriculture

Introduction

Value of agriculture in Ireland

Agriculture in Ireland is economically, socially and culturally important.

Farming has been an important and integral facet of Ireland's economic, social and cultural history for many thousands of years but recent decades have seen substantial changes in how farming is carried out. These changes together with comparatively abundant natural resources have led to Ireland being a major meat, dairy and food exporting country.

Agricultural practices have shaped Ireland's countryside and landscape. Along with the production of food, farmers and farming can provide valuable ecosystem services to society such as safe, clean water, regulation of nutrient cycles, control of disease, crop pollination, and enhancement of biodiversity as well as cultural, spiritual and recreational benefits.

In recent years, the potential for agriculture and its associated agri-food industry to support growth in the Irish economy has been highlighted in two strategies: Food Harvest 2020[1] and Food Wise 2025.[2] These have been developed to increase the export and employment contribution of the sector in a manner that is compatible with sustainable growth. The Irish agri-food (agriculture, forestry and fishing) sector accounted for 7.6% of national gross value added in 2014. Primary production accounted for €4,189 million with €8,562 million coming from the manufacture of food and beverage products (DAFM, 2016a).

The Context of Irish Farming

Irish farming practice is shaped by its biophysical and climate context.

The variability in weather and soils create the biophysical environment in which farmers and land owners operate but cannot control.

1 *www.agriculture.gov.ie/foodwise2025/foodharvest2020/*

2 *www.agriculture.gov.ie/foodwise2025/*

Weather, which is a major driver of agronomic and environmental responses, is variable and the predictive power of forecasting is limited over longer periods. Variations in the magnitude of meteorological parameters can have an effect on grass and crop performance and the ability to carry out field operations.

Climate change is affecting the context in which agriculture operates. The main climate change impacts expected for the agriculture sector will result from changes in air and soil temperature, changes in rainfall patterns and extreme events. The mean annual surface air temperature has increased by approximately 0.8°C over the last 110 years and the beginning of the growing season for certain species is now occurring up to 10 days earlier.[3] Average annual national rainfall has increased by approximately 60 mm or 5% in the period 1981 to 2010, compared to the 30-year period 1961 to 1990. Typically climate models project Ireland will get wetter in Winter and drier in Summer (Nolan, 2015). However, confidence in this statement is low in scenarios where climate change is successfully limited to below 2°C and the large uncertainty in modelling of climate change for Ireland at the interface between the North Atlantic and European continent. Extreme events are likely to increase in intensity and frequency. Therefore precipitation may occur in more intense downpours together with longer dry spells, impacting on runoff volumes and water availability between rainfall events. Seasonal extremes have drawn into critical focus vulnerabilities within the agriculture sector with respect to extreme rainfall events (flooding in winter 2015/2016 including Storm Desmond, Fodder Crisis Autumn/Winter 2012/2013). Therefore, there will be higher risk of disruption of agricultural activities if adaptation measures such as water management systems are not adopted. There will remain a significant risk of emergent animal and plant diseases establishing permanent foothold on the island, as winter conditions get milder and wetter. The number of annual frost days (temperatures below 0°C) has decreased which is increasing the risk of over-wintering of pathogens.

The soils of Ireland vary in their physical, chemical and biological characteristics not only at national and regional scales but also within farms and fields. While soils can be managed there are limits to what can be achieved and controlled by management practices alone. In addition, other local characteristics, such as elevation, have a profound influence on potential productivity. Generally, the drier more productive soils of the south-east combined with lower rainfall and longer growing season provide a better platform for high output systems compared with the north-west where the wetter soils, higher rainfall and a shorter growing season increase the production challenge.

One consequence of these factors is that the more intensive grass and tillage production systems are more concentrated in the south and east while the less intensive systems dominate in the north-west.

Structure of Irish Farming

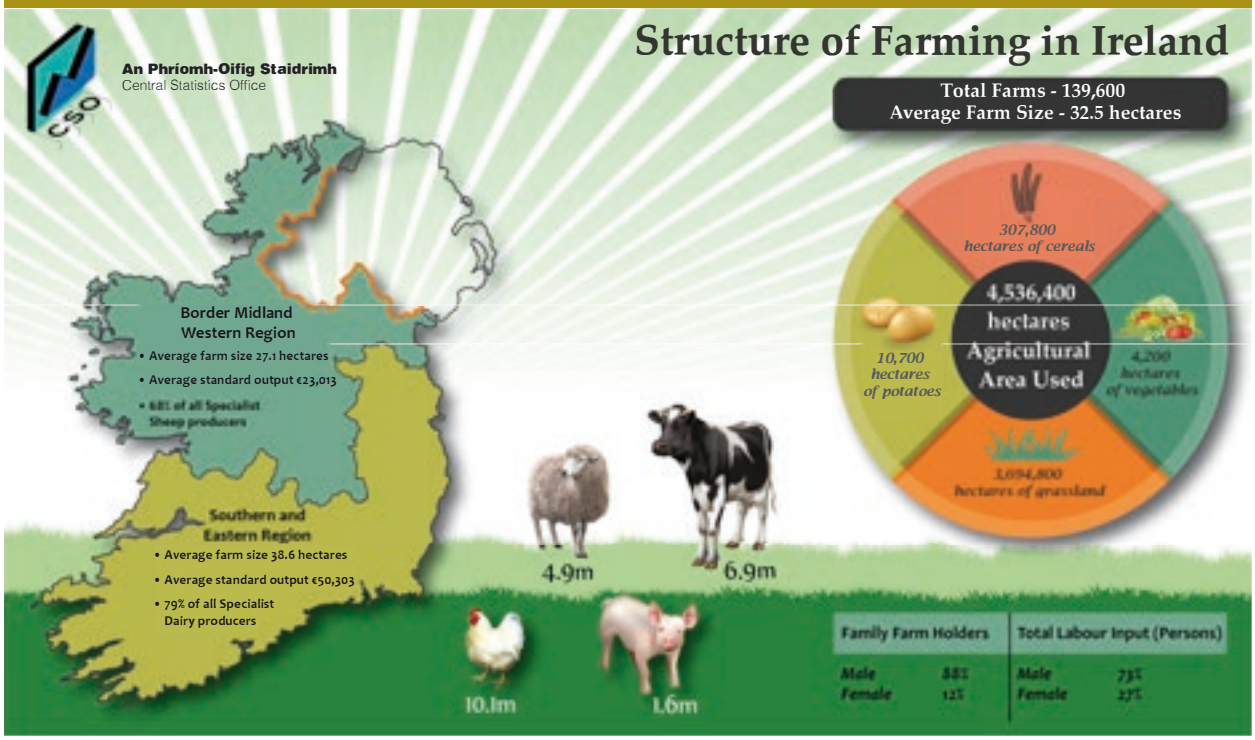
140,000 farms of varying size manage 67% of all land in the country.

Land cover data in 2012 showed that 67.35% of national land cover is agricultural, making it the largest user of land in Ireland (EPA, 2015a). The land area of Ireland is 6.9 million hectares, of which approximately 4.4 million hectares is used for agriculture. Of this figure, 3.6 million hectares, or circa 81% of total agricultural area, is devoted to grassland (pasture, hay and grass silage), with a further 0.5 million hectares, or 11% of total agricultural area, being classed as rough grazing. Some 80-90% of the diet of dairy and beef animals is composed of grass or silage that is grown on-farm. Crop production in Ireland occupies an area of approximately 0.36 million hectares and accounts for about 8% of the agricultural land area in Ireland (CSO, 2016). Approximately 25,000 farmers (17%) managed over 2 million hectares. A further 1.8 million hectares was managed by 55,000 farmers with holding sizes of between 20 and 50 hectares. Nearly half of all farmers (60,000 farmers) farmed the remaining 0.6 million hectares.

In 2013, there were 139,600 farms in Ireland (CSO, 2015). Of these farms, 78,600 (excluding pig and poultry) have an output of greater than €8,000 per year. The remaining farms include 2,000 pig and poultry farms, 50,000 small farms (with output less than €8,000 per year) and 8,000 very small farms (micro farms). There is also a tendency for farms in the south and east to be larger than those in other parts of the country. In 2013, the average farm size was 32.5 hectares (ha). The farms in the Border, Midlands and Western Region were smaller on average, at 27.1 ha, compared to 38.6 ha in the Southern and Eastern Region (Figure 12.1). More than half (52.7%) of all farms were located in the Border, Midland and Western Regions.

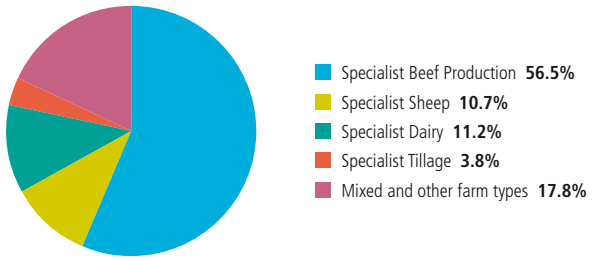
3 *www.met.ie/climate-ireland/climate-of-ireland.asp*

Figure 12.1 Structure of Farming in Ireland (Source: CSO, 2015)



In 2013, specialist beef production was the most common type of farming system, with almost 79,000 farms in this category. Dairy (15,600 farms) and specialist sheep farms (15,000 farms) were the next most common systems. There were also 5,300 specialist tillage farmers and there were approximately 2,000 farmers operating intensive pig, poultry and horticulture enterprises (CSO, 2015) (Figure 12.2).

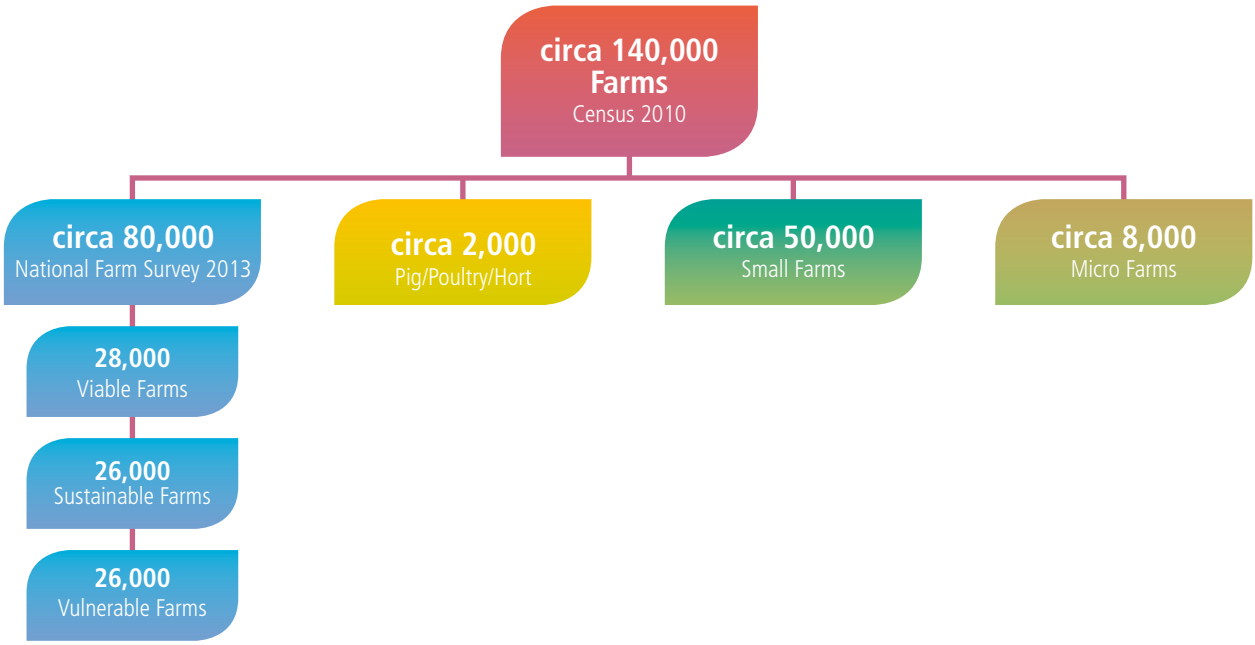
Figure 12.2 Farms by Type from the National Farm Structures Survey 2013 (Source: CSO, 2015)



Economic challenges facing the farming community

There are substantial economic challenges facing the farming community. The report of the Agri-Taxation Working Group to the Minister for Finance and the Minister for Agriculture, Food and the Marine (DAFM, 2014) estimated that, of the largest 79,000 farms in the country, just over one-third are economically viable, one-third are sustainable, but only because of off-farm income, and one-third are vulnerable in that farming is not sufficient to make the farms economically viable and off-farm employment is not locally available (Figure 12.3). In general, profitability is highest in the dairy sector with cattle rearing being the least profitable type of farming. There is, however, significant ongoing volatility in the price of agricultural commodities. When direct payments in grants and schemes are taken out of farm income, dry stock enterprises have, on average, a negative market income which indicates that a substantial percentage of direct payments go into sustaining farm enterprises in Ireland. It is within this challenging economic context that farmers are required to ensure that their operations do not have a detrimental impact on the quality of the environment.

Figure 12.3 Breakdown of Farming Enterprises and Viability Category for Teagasc National Farm Survey Farms (Source: DAFM, 2014)



Food Wise 2025

This strategy for development and sustainable intensification in primary production and value added processing is a significant challenge for the sector as it has to be achieved without damaging the environment upon which it depends.

The Food Wise 2025 strategy, published by the Department of Agriculture Food and the Marine (DAFM) in 2015[4], set out an ambitious growth projection of a 65% increase in the value of farm gate output and a 70% increase in the gross value added to be delivered by the sector by 2025. The strategy outlined significant opportunities for growth in value added of the dairy sector through innovation, value added and new premium market development, as well as an increase in volume of milk production following the abolition of EU milk quotas in 2015. Growth in the sheep and pig sectors is expected to be delivered from improved production efficiencies rather than by major increases in animal numbers. For tillage crops, growth is expected to be driven by improved production efficiencies and the extent to which new market opportunities can be realised.

Achieving growth in primary production and productivity without damaging the environment, upon which it depends, is a significant challenge. Moreover, there are current environmental challenges arising from agricultural activities that need to be addressed. Improving current performance in relation to Air Quality (Chapter 2), Climate (Chapter 3), Biodiversity (Chapter 4) and Water Quality (Chapters 5 and 8), are key environmental challenges for Ireland. Food Wise 2025 acknowledges the challenge and places great emphasis on the importance of balancing production with environmental management and protection; clearly recognising the value that a "green" environmentally sustainable agriculture sector can afford. The Food Wise strategy sets out more than 70 actions to achieve agricultural sustainability and notes that "… achieving economic competitiveness and environmental sustainability are equal pillars in the delivery of the vision". The development of a clear mechanism for tracking the implementation of these actions and assessing their effectiveness will be needed to ensure that impacts on the environment, whether positive or negative, are identified

4 *www.agriculture.gov.ie/foodwise2025/*

and managed. A Food Wise Implementation Plan has been published along with the strategy (DAFM, 2016b) and will be a key mechanism for ensuring that relevant evidence is gathered during implementation to inform decisions on achieving and maintaining a sustainable agriculture sector. In addition, a Food Wise 2025 Environmental Sustainability Committee was established in 2016 to evaluate and assess the delivery of environmental sustainability and mitigation actions in the Food Wise Implementation Plan. These developing implementation structures are welcome.

The vulnerability of the water environment and biodiversity to adverse impacts of agriculture depends on local and regional ecosystem capacity to deal with the various pressures. As such, from an environmental perspective, some areas are more suitable than others for intensification (i.e. intensification may be possible without compromising the quality of the environment) while more vulnerable areas will need more careful protection. Regional and local variations in soils, weather and biodiversity in addition to environmental commitments will place significant constraints on the achievement of the projections identified in Food Wise 2025 but which if managed correctly can create a sustainable path for Irish agriculture into the future.

Current Trends

Agriculture places a series of pressures on the natural environment.

These environmental pressures include changes to land use, emissions of nutrients and losses of pesticides from soils to waters, changes to biodiversity impacting flora and fauna and their habitats, and emissions of greenhouse gases (GHGs) and air pollutants such as ammonia. These pressures include those which impact directly on the local environment such as the water environment and habitats and those which impact on the wider scale including transboundary air pollutants and GHGs.

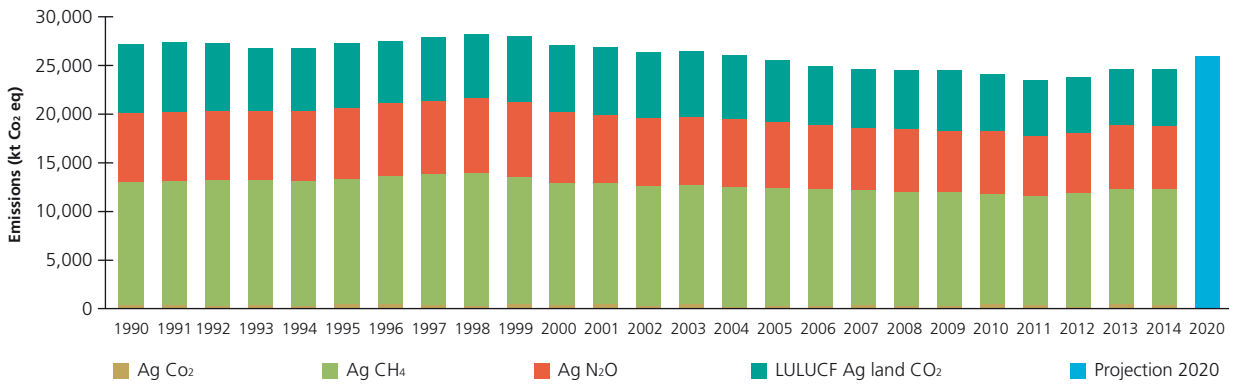
Greenhouse Gases and Agriculture

In Ireland, agriculture accounts for 32% of all greenhouse gas emissions to air.

Climate change is challenging for Irish agriculture both in the context of GHG emissions and the need for adaptation of farming practices to be more resilient to the impacts of climate change. In Ireland the Agriculture sector was directly responsible for 32.2% of national GHG emissions in 2014, mainly methane from livestock, and nitrous oxide due to the use of nitrogen fertiliser and manure management (EPA, 2016a). These direct emissions are accountable under the Effort Sharing Decision and are included in Ireland's targets for 2020 emissions reduction. In addition, agricultural land management practices can lead to both emissions and removals of GHGs associated both with biomass and soils which are reported under the Land Use and Land Use Sector (Chapter 3). Based on best available data, net impact of land management is dominated by a very significant emission of carbon dioxide due to drainage of organic soils. Although the total area involved is relatively small, at approximately 300,000 ha, the impact is large.

Agriculture accounted for over 47% of all Non-ETS emissions in 2014 (EPA, 2016b). Despite ongoing improved efficiency of production, leading to lower emissions per unit product, EPA projections estimate increasing agricultural emissions associated with Food Wise 2025 and expansion of the dairy herd. For example, projections indicate agriculture emissions will increase by 6% from 2014 to 2020 even where there is the optimum deployment of known measures and technologies to reduce emissions. The recent bulletin on Greenhouse Gas Emissions Projections to 2020 noted that the challenges associated with implementing these measures should not be underestimated. Increasing agricultural emissions at a time when Ireland is struggling to meet 2020 and 2030 emissions reduction targets may place a burden on the wider economy.

Figure 12.4 Greenhouse Gas Emissions from Agriculture and Associated Land Between 1990 and 2014 and Projection for 2020 (Source: EPA, 2016b)



Under the current EU Effort Sharing decision, Ireland has a target of 20% emissions reduction relative to 2005 compared to an EU average of 10%, from activities in the Non – Emissions Trading Sectors (Non ETS) by 2020. In July 2016, the EU announced proposals for a new Climate and Energy Framework to 2030 including a target of 30% emissions reduction for non-ETS in Ireland which is exactly the same as the proposed EU average reduction, by 2030.[5] The proposed 2030 targets remain challenging for Ireland especially in the context of limited emissions mitigation options within agriculture and projections for growth within the sector. It is important that the most effective available mitigation options are deployed, and make a meaningful contribution to meeting Ireland's non-ETS target. The sector should also engage fully with incentives to maintain and enhance sequestration within the LULUCF sector (Chapter 3), especially on those lands directly associated with agricultural production. This would enable access to the flexible mechanisms proposed under the new EU Climate and Energy Package and also support the credibility of Ireland's "Green" agri-food image.

In the Climate Action and Low-Carbon Development – National Policy Position Ireland[6] paper, the Government sets out the long term objective of "an approach to carbon neutrality in the agriculture and land – use sector, including forestry, which does not compromise capacity for sustainable food production". This is an explicit recognition of the profound challenges in decoupling food production from GHG emissions and the unique potential for carbon sequestration in biomass, soils and wood products through alternative land management and land use. At national and EU levels, there is commitment to improved reporting of the impact of land use with the development and implementation of polices and measures which demonstrate progress towards sustainable land use and enhanced carbon stock changes. In addressing these challenges Ireland must invest in structural and behavioural change to enable the transition to a carbon neutral, climate resilient environment.

Ammonia and Other Emissions to Air and Agriculture

In Ireland agriculture accounts for nearly all ammonia emissions to air.

Agriculture is a source of transboundary air pollutants including ammonia and Volatile Organic Compounds. Similar to other EU countries, the agriculture sector is the largest source of ammonia emissions to air in Ireland and accounted for 98% of total national emissions in 2014 (EPA, 2016a). The ammonia emission trend is largely determined by the cattle population and showed a steady increase to 1998. There has been some decline in the populations of cattle and sheep since 1999, as well as a decrease in fertiliser use, and this contributed to a reduction in emissions between 1999 and 2011. The ammonia emissions from the agriculture sector in 2014 were 0.9 % lower than the emission levels in 1990 and 12.4 % lower than the peak levels in 1998. Ireland has obligations under the revised National Emissions Ceiling Directive to achieve progressive reductions for ammonia by 2020 and 2030 of 1% and 5% based on a 2005 baseline (see Chapter 2). Given that ammonia emissions are largely determined by cattle numbers projected increases in the national herd present a real challenge to achieving these reductions.

Agriculture is also a source of Non-Methane Volatile Organic Compounds (NMVOCs) and particulate matter. Similar to ammonia, NMVOC emissions arise in all stages of manure management, housing, storage and land application of manures. Livestock feeding and livestock housing are sources of particulate matter. NMVOCs from agriculture account for 48 % of the national inventory total and predominantly come from manure management. Agriculture emissions of particulate matter contribute an estimated 14.5% of $PM_{2.5}$ and 44.7% of PM_{10} to national totals for these pollutants.

Biodiversity and Agriculture

Changes in agricultural practice remain one of the threats to both habitats and species and the trend in biodiversity loss in protected areas has not been halted.

Much of Ireland's rich biodiversity has evolved from agricultural land management. However, in protected areas the recent trend in biodiversity loss has not been halted and agriculture remains one of the main threats to both protected habitats and species. Insufficient data on the status of biodiversity in the other areas used for agriculture is creating a significant challenge in addressing the negative impacts and developing responses. Progress in developing our understanding of biodiversity nationally is being made via the Mapping and Assessment of Ecosystems Services project (Chapter 4). It is, however, clear that a robust baseline monitoring system and comprehensive ecosystems mapping is needed nationally to assess the overall impact of changes in agricultural practices on biodiversity in the rural environment.

In the context of protected habitats, agriculture was identified by the National Parks and Wildlife Service as a high-intensity pressure or threat in over 35% of protected habitats and as a pressure or threat in over 70% of these habitats (NPWS, 2013). In respect of protected species, agriculture was identified as a high-intensity pressure or threat for 10% of these species and as a pressure or

5 Factsheet on the Commission's proposal on binding GHG emission reductions for Member States (2021-2030) (July 2016) *www.europa.eu/rapid/press-release_MEMO-16-2499_en.htm*

6 *www.housing.gov.ie/environment/climate-change/policy/climate-action-and-low-carbon-development-national-policy-position*

threat for over 30% of them. The NPWS report concluded that the main pressures to habitats included ecologically unsuitable grazing levels such as under-grazing (or even abandonment) as well as some continued overgrazing. The report noted that grasslands, such as orchid-rich calcareous grasslands, are threatened by either intensification of farming or at the other extreme by insufficient grazing and abandonment.

High-Nature-Value (HNV) farming has developed from the growing recognition that the conservation of biodiversity depends on the continuation of low-intensity farming systems in both protected areas and other parts of the countryside. The dominant feature of HNV farming is low-intensity management, with a significant presence of semi-natural vegetation and diversity of land cover, including features such as ponds, hedges and woodland. Matin *et al.* (2016) produced a map of the likely distribution of HNV farmland based on established European indicators adapted for Ireland (Figure 12.5). This study identified a substantial proportion of farmland as having HNV potential and could inform targeted schemes to effectively support and reward the significant number of farmers whose farms deliver a wide range of ecosystem services particularly along the western seaboard.

Figure 12.5 High Nature Value Farming Potential (Source: Matin *et al.*, in press)

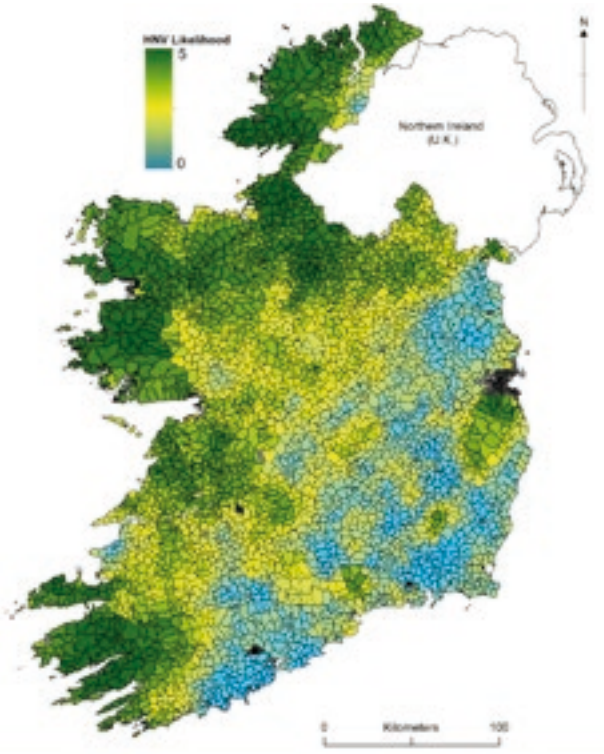
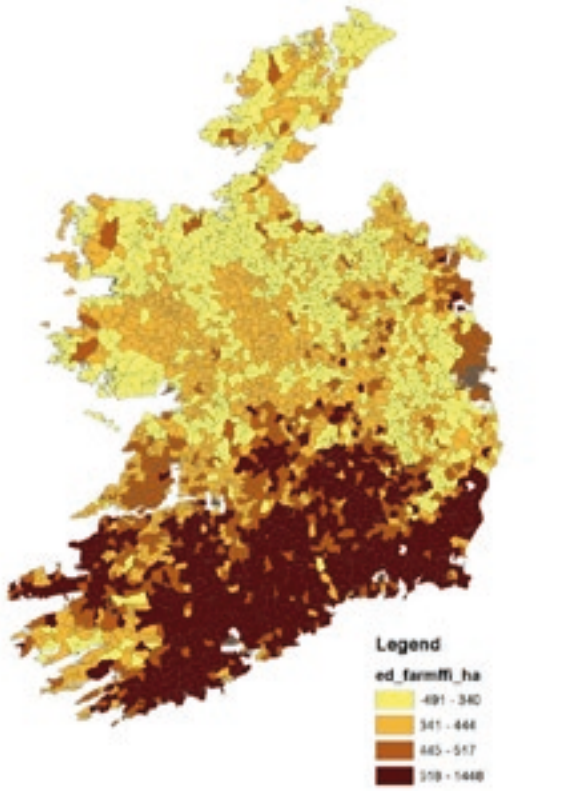


Figure 12.6 Modelled Family Farm Income per Hectare (Source: O'Donoghue *et al.*, 2014)



Modelled Family Farm Income per hectare (O'Donoghue *et al.*, 2014) found that Connaught and the border region had lower farm incomes than south of the country (Figure 12.6). When compared with farm income data it becomes apparent that the potential for maintaining HNV farming is greatest in areas with high proportions of economically vulnerable farms while also being the areas at greatest risk of losing HNV areas due to land abandonment or overgrazing. This would suggest that there is potential for incentivising the provision of other ecosystem services in these areas in addition to production-oriented ones. These benefits could be in water protection and provision of habitat for biodiversity through bankside habitat maintenance, farming for nature, and the native woodland scheme. Demonstration initiatives (such as the Burren,[7] Kerry[8] and Aran LIFE[9] projects) that target specific local sustainability issues provide evidence of how locally led community-based approaches can contribute positively to overcoming the challenge of transforming knowledge into effective actions in the agricultural sector. Moreover, the national GLAS scheme contains many initiatives that support biodiversity including protection of low-input permanent pasture, hedgerow and small orchard plantation which have important co-benefits with

7 *www.burrenprogramme.com/*

8 *www.kerrylife.ie/*

9 *www.aranlife.ie/*

regard to carbon sequestration and storage. While such a focus on protecting the current areas of high nature value is needed there is also a critical need to ensure that agricultural activities in other parts of the country are carried out in a way that will protect and enhance the environment for biodiversity.

The Burren Programme

www.burrenprogramme.com

The original BurrenLIFE project began as an innovative trial programme and tested a new model of sustainable agriculture for the Burren to conserve and renew its unique and diverse habitats. The present Burren Programme is a locally led measure under the Rural Development Programme 2014-2020 and it encompasses both results-based habitat management and complementary non-productive capital investment site works. The programme aims to deliver qualitative environmental goals on the participating holdings and payments in the scheme are based on measured deliverables. An important element of this Programme is that each farm plan is tailored to suit the needs of the individual farm, and the farmer's knowledge of his own land is paramount in this process. In previous projects in the Burren it was found that deep engagement with local farming communities has the potential for countryside and biodiversity benefits and this will continue with the new Programme.

Water Quality and Agriculture

Loss of nutrients to waters from agriculture is a significant pressure on water quality in Ireland.

Excessive nutrient losses to waters can lead to accelerated growth of algae and plants, significant ecological impacts and eutrophication in rivers, lakes and marine waters and is the most significant pollution issue for surface waters in Ireland. Agriculture was the suspected cause in 53% of river pollution in the period 2010-2012 (EPA, 2015c). While results up to the end of 2012 showed a small improvement in river water quality, preliminary results up to the end of 2015 indicate that this improvement has not been sustained and river water quality (based on Q values) has returned to the same levels found between 2007 to 2009. Importantly, the number of the highest quality river waters (Q 5 sites) has continued to decline (Chapter 5). Moreover there has been a 3% decline in the number of monitored lakes at satisfactory status since the 2007-2009 period. The preliminary analysis is also showing that no overall improvement has been found in the ecological status of transitional waters over the past 6 years. The Water Framework Directive (WFD) monitoring has noted a general decrease in levels of nitrogen with a smaller decrease in phosphorus levels in water over the last two decades nationally. Nutrient losses to waters are not uniform across the country and correlate with areas of higher human population and agricultural intensity, with the highest nutrient levels found in the south of the country (Figure 12.7). While agriculture is not the only pressure on the water environment and farmers in Ireland have made a considerable commitment to environmental measures, it is clear that supplementary action by the agriculture sector at a local and regional level will be required to improve water quality.

Ensuring that Ireland's water resources are of good quality is vital for public health, the agri-food industry and for inward investment. There is a particular challenge ahead to deliver a sustainable agricultural production system, as envisaged by Food Wise 2025, that protects our water environment for the use and benefit of all while meeting our international commitments including those under the Water Framework Directive.

Drinking Water and Agriculture

Protecting drinking water sources from diffuse pollution by Cryptosporidium and the pesticide MCPA are key issues for drinking water quality.

Activities in catchments have an impact on the quality of the source water and can, depending on the treatment available, impact on the quality of the drinking water supplied. This does not mean that additional treatment is always required but activities in the catchment should be managed to reduce risks to drinking waters.

The number of public water supplies affected by pesticides shows an increasing trend, with levels of pesticides above the drinking water standards detected in 28 supplies in 2014, compared with 17 supplies in 2013 (EPA, 2015b). In the majority of cases the herbicide MCPA, which is used to control ragwort, rush and thistle, caused the breach of the limit. There is a seasonal pattern for MCPA, with exceedances being more common during the summer and autumn months. Information on this issue is being made available to farmers (see leaflet 'Herbicide Use in Grassland'). In all cases the development of rushes can be controlled

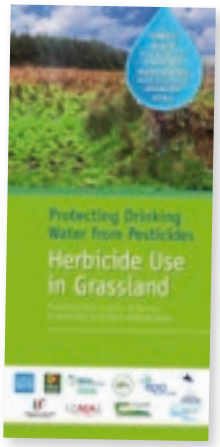
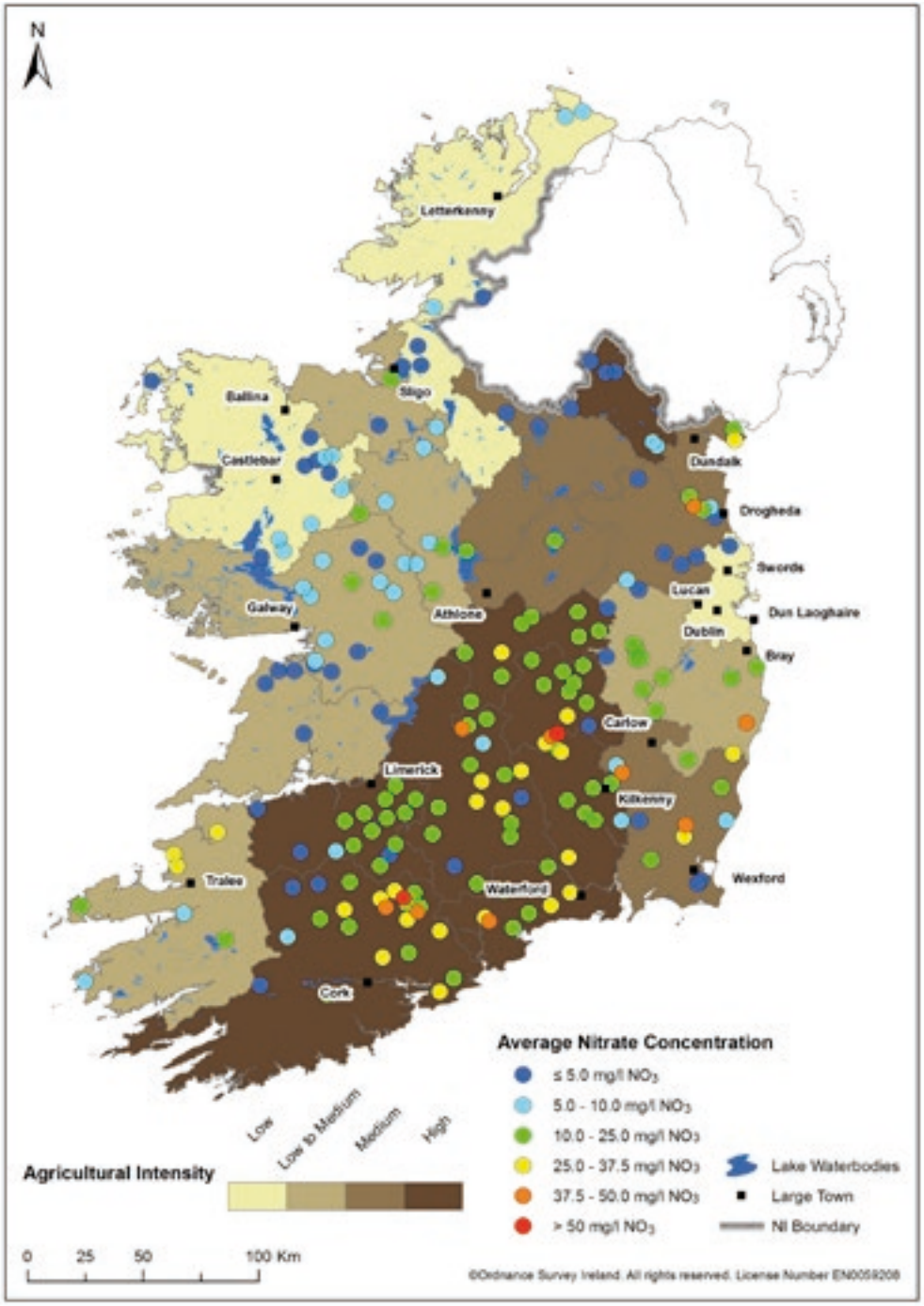


Figure 12.7 Average Nitrate Concentrations in Groundwaters (Source: EPA)



by grazing animals or by mechanical means such as mowing/topping. Since November 2015, all plant protection products (including MCPA) must be applied by registered professional users (including farmers) and as such users must have received suitable training. MCPA containing products cannot be applied within 5 metres of surface waterbodies. This should contribute to reducing contamination of water by MCPA.

Agricultural activities pose a risk of microbial contamination of drinking water from animal excreta, especially where there are poor farm management practices that lead to microbial transport to waters or where there is inappropriate land spreading near source abstraction points. This can be exacerbated by poor construction of abstraction points. The most important health indicators of drinking water quality

are its microbiological parameters and, in particular, *E. coli* and *Cryptosporidium.* In 2014, 187,804 people on 36 public water supplies were identified to be at risk from *Cryptosporidium.* Read *et al.* (2015) found that Cryptosporidium contamination of drinking water catchments in Ireland is widespread and probably mainly of animal origin. However, the majority of the species found are considered of low risk to public health. Of the species and genotypes described to date, at least eight can infect humans, with three being considered major human pathogens: *Cryptosporidium hominis*, *C. parvum* and *C. meleagridis*. While *C. hominis* is largely restricted to humans, *C. parvum* has been reported from a large range of mammals and is very prevalent in young ruminants. The third species, *C. meleagridis*, is primarily an avian parasite that occasionally infects humans. The study also found a positive relationship between rainfall events in the catchment and *Cryptosporidium* in the raw water supply, with oocyst numbers higher just after a rainfall event.

The water safety plan approach to managing drinking water supplies, which is advocated by the World Health Organization, aims to minimise the potential for entry of contaminants into water at source through catchment protection, rather than just depending on having them removed via treatment at a water treatment plant. This requires a catchment-based approach including information, education, stakeholder engagement and enforcement. Measures currently in place under the nitrates regulations and cross compliance can contribute to reducing microbial contamination of water. New targeted measures introduced under the 2014-2020 Rural Development Programme will also contribute. For example, the inclusion within GLAS[10] of actions to fence waters from cattle access protects biodiversity and reduces direct microbial inputs to waters and, therefore, the risk of microbial contamination of source drinking waters.

10 *www.agriculture.gov.ie/farmerschemespayments/glas/*

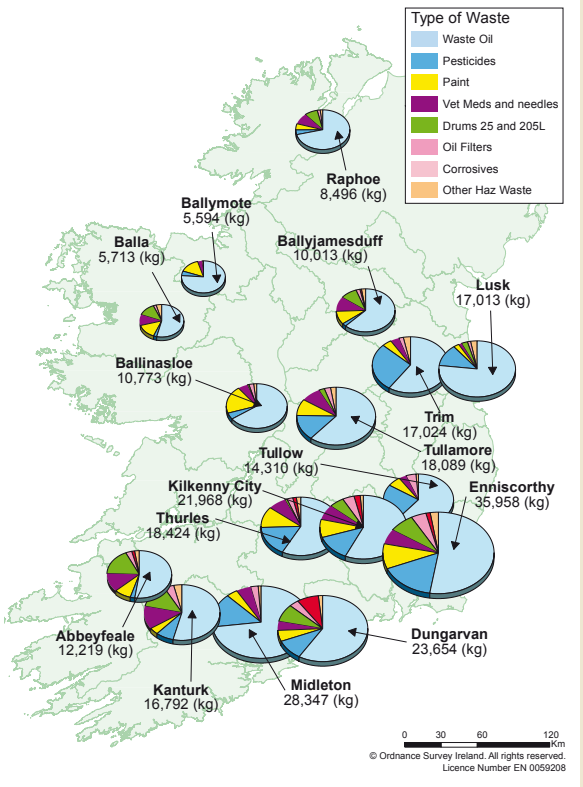
Farm Hazardous Waste Collection

A successful joint initiative to facilitate the collection, recovery and disposal of hundreds of tonnes of hazardous waste from farms.

The EPA, Teagasc, the Department of Agriculture, Food and the Marine, local authorities and waste contractors all collaborated in 2013 and 2014 in a joint initiative to facilitate the collection, recovery and disposal of farm hazardous waste. The campaign was extensively advertised and promoted by many of the project partners including Irish Farmers' Association, Irish Creamery Milk Supplier Association, Bord Bia, the Irish Farm Film Producers Group, some agricultural co-operatives and agricultural merchants.

Nearly 3000 farmers used the collection centres and a total of 264 tonnes of farm hazardous waste and 100 tonnes of waste electronic and electrical equipment and batteries were collected (figure 12.8). The main hazardous waste types presented were engine and hydraulic oil and filters, pesticides, paint, veterinary medicines, and needles and contaminated empty containers. The 32 tonnes of pesticides included insecticides, fungicides and herbicides including many that are extremely toxic to both human health and the environment. Farmers paid for the service, which confirms clearly that farmers want to manage these wastes in an appropriate manner and are willing to pay for the safe recovery and disposal of these wastes where a service exists.

Figure 12.8 Map of Farm Hazardous Waste Collections – Locations and Quantities (Source: EPA)



What's Being Done

The pressures that agriculture places on the environment are well known and a variety of actions have been implemented at EU level, national policy level and locally to address them.

These actions include Common Agriculture Policy reform; national implementation of the Nitrates Directive; sustainability initiatives including Origin Green; regulatory actions; and research and innovation in both productivity improvements and environmental management.

Common Agricultural Policy

The reform of the "Common Agricultural Policy" provides the opportunity for a move towards better targeting of action in the right places to address the environmental pressures involved.

The reforms of the Common Agricultural Policy introduced in 2015 include direct greening payments, accounting for around 30% of each farmer's single farm payment, for implementing obligatory measures such as maintenance of permanent grassland, ecological focus areas and crop diversification. These reforms reflect an awareness of the risks of unintended adverse environmental impact of previous CAP structures. There is also evidence that previous structures of the CAP encouraged intensification of agricultural production systems across Europe including Ireland, and the consolidation of land parcels and removal of hedgerows (Brouwer *et al.*, 2002). The reforms of CAP further develop Cross Compliance requirements making it necessary for lands to be eligible for direct payment to be maintained in Good Agricultural and Environmental Condition (DAFM, 2015). However, other reforms in CAP, such as removal of milk quotas, may have long term environmental impacts if the market becomes a more direct driver of farming activities. There is also a 20% allocation of Pillar II's Rural Development Programme's budget for voluntary cross cutting climate change measures under the new GLAS scheme.[11] Actions such as the Beef Data and Genomics Programme and GLAS under Pillar II are intended to focus on meaningful actions at a regional and local level. GLAS has targeted farmers in areas with high water quality for admission to the scheme indicating a welcome move towards targeting of actions to protect that element of the environment. The continuation of the Targeted Agricultural Modernisation Scheme, which provides funding for upgrade of farm facilities, may also provide benefit to the environment. It is important that incentives under Pillar I and Pillar II are consistent and complementary, for example HNV farms should not be seen to be at risk of losing eligibility status. The role of Farm Advisory Services in promotion of appropriate management is critical in this respect.

Nitrates Action Programme

Good agricultural practices for the protection of waters.

The Nitrates Directive (1991) aims to protect water quality by preventing nitrates from agricultural sources polluting ground and surface waters and by promoting the use of good farming practices. It forms an integral part of the Water Framework Directive and is one of the key instruments in the protection of waters against agricultural pressures.

The Nitrates Action Programme is required under the EU Nitrates Directive (91/676/EEC). Ireland has taken a national approach defining the nutrient sensitive area for water protection under the directive as the whole national territory meaning that it applies its programme nationally thereby providing a level of water protection across the country. Importantly Ireland has also used its national implementation of the Directive to control phosphorus, which is the key driver of freshwater eutrophication, as well as nitrogen. Under the programme there is a closed period when land spreading of slurries is prohibited, minimum storage requirements are set for various geographic zones nationally, legal limits are established for nitrogen and phosphorus use and other measures to protect waters from nutrient enrichment, e.g. nutrient management planning. In addition, the Teagasc Agricultural Catchments Programme was established with funding from the Department of Agriculture, Food and the Marine with the twin aims of protecting and improving water quality and supporting the production of high-quality food including evaluating the environmental and economic effects of the Nitrates Action Programme measures. Ireland has derogation from the livestock manure application limits on land spreading in the Directive and is obliged to monitor the impact of the Nitrates Action Programme and this derogation on water quality on an ongoing basis. This monitoring information will form part of the body of evidence that will also be used to track the impacts, both positive and negative, of the implementation of the Food Wise strategy.

Origin Green

National sustainability programme for farmers and processors.

Bord Bia's Origin Green Programme[12] was launched in 2012 as the national sustainability programme for the Irish food and drink industry. It provides sustainability programmes on a national scale for Ireland's farmers and food producers with a vision for Ireland having the lowest environmental footprint in Europe. Origin Green sets out a defined structure to demonstrate sustainable performance

11 *www.agriculture.gov.ie/farmerschemespayments/glas/*

12 *www.origingreen.ie/*

and assists farmers and food processors to set plans for further improvements. In its Sustainability Report 2015, Bord Bia reported that 38,000 on farm assessments had been completed in 2014 (Bord Bia, 2016). These assessments cover GHGs, biodiversity, water conservation and energy efficiency. The Sustainability Report also sets out the next steps for Origin Green, including plans to have up to 50,000 farmers using the Teagasc Bord Bia carbon navigator,[13] and plans for every food company to have an emissions target as part of their Origin Green plan. On biodiversity it committed to supporting the implementation of the All Ireland Pollinator Plan.[14] It also commits to working with Teagasc on a pilot project to develop a sustainability tool for remote sensing of wildlife habitats on Origin Green member farms and provide guidance to farmers on how to maintain and enhance habitat areas on their farms. The potential role of Origin Green in helping to ensure progress is made in relation to water quality is also recognised. Importantly Bord Bia has highlighted that farmer and manufacturer/processor engagement and implementation are the key challenges for Origin Green into the future.

River Basin Management Plans and the Water Framework Directive

A new catchment based approach aims to connect people and communities with their local steam, river, lake, spring or coastal water.

Agriculture is the suspected cause for over 50% of river pollution (EPA, 2015c). It is against this context that a new national river basin management plan is being prepared for the period to the end of 2021. In assisting the Minister for Housing, Planning, Community & Local Government with the preparation of the new plan, the EPA is assessing and characterising the impact of pressures, including agricultural ones, on the water environment across the country at a local and sub catchment scale. To do this, the EPA is using a suite of catchment management support tools to identify areas within catchments with higher likelihood of releasing nutrients and pollutants to waters. These areas will be targeted for interventions either to protect or improve water quality. This approach is used to identify significant pressures from all sources, including agriculture, and is an important step forward in prioritising and targeting strategies, measures and resources for integrating and optimising agronomic and environmental benefits.

A new approach to implementation called "integrated catchment management" is being used to support the development and implementation of this plan. The catchment based approach aims to connect people and communities with their local stream, river, lake, spring or coastal water. It integrates all water types and relevant disciplines, including social science, and establishes linkages with biodiversity, flood mitigation and water quality. Recognising the same implementation challenge as Origin Green, it requires close collaboration between relevant public bodies and a combination of bottom-up and top-down approaches to implementation. The development of the Catchments.ie website collaboratively by the EPA; Department of Housing, Planning, Community and Local Government; and the Local Authorities' Waters and Communities Office is providing open access to information on the water environment to all stakeholders and is a first step to improving awareness and supporting future dialogue and collaboration. It is expected that further action to develop connections between communities and public bodies involved in water management will be included in the draft River Basin Management Plan that will go for public consultation at the end of 2016.

Climate Action and Low Carbon Development Act 2015

The vision is of climate resilience and carbon neutrality for the agriculture and land use sector.

The Climate Action and Low Carbon Development Act 2015, in combination with the National Policy Position that was published in 2014 (DHPCLG, 2014), provide the framework for national actions to address climate change. It establishes a vision of climate resilience and carbon neutrality for the agriculture and land-use sector, including forestry by 2050 which does not compromise safe and sustainable food production. Under the Act, the National Mitigation Plan and the National Adaptation Framework will outline the short and longer term policies and actions at a sectoral and local level needed to achieve the shorter term targets and long term objective. Sector plans for Agriculture will need to address mitigation of agriculture, land use and forest GHG emissions and provide a framework for adaptation measures required in the agriculture sector.

13 *www.teagasc.ie/media/website/about/our-organisation/Bord-Bia-Beef-Carbon-Navigator-LR4.pdf*

14 *www.biodiversityireland.ie/wordpress/wp-content/uploads/All-Ireland%20Pollinator%20Plan%202015-2020.pdf*

Industrial Emission Licences for Pig and Poultry Enterprises/Installations

Significant improvements in production efficiency in the sector.

Substantial productivity improvements are being achieved in the Irish pig sector, with Irish pig producers now producing almost 1,500 kg of pig meat per sow compared with 1,221 kg in 1990 (DAFM, 2016a). Pig meat production has increased by 76% between 1990 and 2015 against the background of the falling size of the female breeding herd. This reflects a significant improvement in production efficiency in the sector. Moreover, the annual amount of phosphorus excreted by pigs has been reduced from 26 kg to 17 kg per sow and progeny over the last 25 years. This has been achieved through better ration formulation and the use of enzymes to improve digestibility of phosphorus. It has reduced the land area required for the spreading of pig manure. The land spreading of pig manure is regulated under the Nitrates Regulations and Nitrates Action Programme which permit manure applications above the prescribed crop's phosphorus requirements. This transitional arrangement will cease in 2017, increasing the area of land required to utilise pig manure and will create an additional challenge for the sector.

By the end of June 2016, the EPA had issued licences (Industrial Emission Licences) for 117 pig and 93 poultry enterprises/installations with a further 7 pig and 15 poultry applications on hand. Applications are still being received from farms that are and have been operating above the licensing threshold without a licence. Continued failure by these operators to become regularised places them at increasing risk of enforcement actions and risks reputational damage to Ireland's food image.

Smart Farming

www.smartfarming.ie

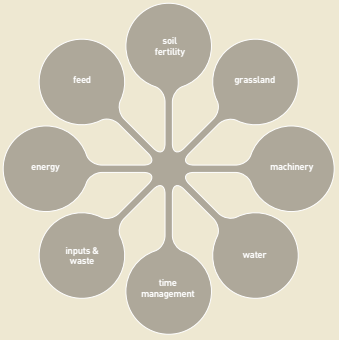
Reducing costs and protecting the environment inside the farm gate through better resource management.

Improving farm incomes and protecting the environment are the drive behind the voluntary Smart Farming green business programme. This initiative focuses on ways to reduce costs inside the farm gate and protect the environment through better resource management in eight key areas: feed, grassland, water, inputs, time management, soil fertility, machinery management and energy use. The programme is led by the Irish Farmers Association (IFA) in partnership with the EPA and brings together the knowledge of Teagasc, the Fertilizer Association of Ireland, the EPA, University College Dublin and others. Smartfarming is communicating this knowledge in a targeted way to improve farm incomes whilst also protecting the environment (Figure 12.9).

These bodies collaborated to produce a Smart Farming guide, which is a summary of top-tips to save money and reduce waste while safeguarding the environment. This guide is available through the farm directory (*www.ifarm.ie* and *www.smartfarming.ie)* . During 2014, over 600 farmers across the country participated and saw members of their discussion groups identify average cost savings of €6,600 per farm.

The Carbon Navigator tool developed by Teagasc in partnership with Bord Bia was piloted on a number of farms in 2015. The tool is designed to assist farmers in assessing their GHG status, with a focus on mitigation actions that can be taken to achieve improvements. It is being rolled out across participating Smart Farming farms during 2016. Measures adopted by participating farmers have resulted in less risk of runoff to watercourses, extended grazing of grass, better targeting of fertiliser application, reduced energy, improved water efficiency and inputs use and reduced GHG emissions and improved farm profitability.

Figure 12.9 Stakeholders Involved In and the Items Dealt With in Smartfarming Programme (Source: Smartfarming.ie)



Research Responses

Significant investment in agriculture and agri-environmental research is improving the knowledge base to underpin environmental protection and sustainable environmental development of agriculture.

In recent years both EPA and DAFM have invested heavily in agricultural and agri-environmental research aimed at improving the knowledge base to underpin policy development and application at farm level. There are two separate but linked strands of research: DAFM's Stimulus Programme and the EPA's Research Programme. Together these programmes aim to provide the knowledge to improve production efficiencies whilst also developing our understanding of the complex physical, chemical, biological, climatic, hydrological and geomorphological factors that determine emissions to air, soil and water, their potential impact on the receiving environment and effective measures to control them. Bringing these two strands together to inform policy and transferring this knowledge to the "on the ground" activities has been highlighted as a challenge and will require an integrated approach and dedicated effort. The EPA funded AgImpact project identified the importance of translating the research knowledge and outcomes into formats that can be understood by policy maker, adviser, educator, farmer and consumer stakeholder and emphasised the importance of the farm advisor in the system (Carton *et al*., 2016).

Substantial work has been undertaken by the Department of Agriculture funded Teagasc Agricultural Catchment Programme (ACP) to assess the impact of the Nitrates Action Programme measures. An important outcome is that phosphorus loss from wet soils has been identified as the most important freshwater quality pressure emphasising the need to target efforts for reducing phosphorus loss on wetter soils. This would be consistent with the approach being taken by the EPA's risk assessment approach to characterising the impact of agriculture and other pressures on the water environment. The ACP has also identified lag times between changing management and achieving good water quality in certain geographic settings resulting in a delay between improved farming practices and water quality response. While this needs to be considered it is not a basis for delaying actions to improve water quality or not implementing effective additional measures in areas with identified water quality problems caused by agriculture.

The Agricultural Greenhouse Gas Research Initiative for Ireland (AGRI-I)[15] is a consortium of researchers, students and professionals working collaboratively to improve estimation of GHG emissions and develop verified strategies to decrease GHG emissions from Irish

agriculture. AGRI-I was launched in January 2012 and is one of a number of agri-environment research projects funded by the Department of Agriculture, Food and the Marine. In addition, the EPA research programme (that is coordinated with AGRI-I) has funded a number of projects primarily aimed at improving understanding of how to accurately represent country specific characteristics of agriculture and land use in Ireland in national reporting of emissions and removals.

With respect to Climate Change Adaptation, the EPA Research programme funds regional climate modelling to provide state of the art projections of climate change and support dissemination of this knowledge to stakeholders through the development of the Climate Information Platform.

Recent research has produced country specific emission factors for nitrous oxide emissions and identified the potential for significant emissions reductions using alternative fertiliser formulations which have the added advantages of being cost neutral while achieving similar or improved yields (Harty *et al*., 2016).

Clearly there will need to be a more tailored approach to addressing agricultural pressures so that intensification takes place in appropriate parts of the country. However, rather than consider agriculture as a pressure, an alternative perspective is to consider the services it provides. Schulte *et al*. (2015) has developed a framework for considering soil functions called the Functional Land Management approach. This approach categorises the varied ecosystem services provided by soils into five functions: primary production; water purification and regulation; carbon storage and regulation; provision of a habitat for biodiversity; and cycling of nutrients. All soils can perform all of these five functions, but some soils are better at supplying selective functions. Recognising these differences in soils, Functional Land Management is a possible framework for policy-making aimed at meeting these demands by incentivizing land use and soil management practices that selectively augment specific soil functions, where required.

15 *www.agri-i.ie/*

Measuring progress in agricultural sustainability is difficult. Dillon *et al*. (2016) developed a series of farm level sustainability indicators using information from the National Farm Survey data and looking at three dimensions: environmental sustainability (relating to GHGs and nitrogen use), economic sustainability and social sustainability. While this approach and the creation of the Food Wise 2025 Environmental Sustainability Committee have promise in assisting to ensure the environmental sustainability of agriculture, the regional and local variation in the physical setting as highlighted by the ACP and EPA characterisation work indicate the complexity in achieving sustainable intensification. When considering this in the context of the knowledge and practice transfer issues highlighted by the AgImpact project and Origin Green, it is clear that the interplay between the two strands of research will require attention in the immediate future. In addressing this issue, Dillon *et al*. (2016) noted that 'There is a growing recognition of the need for interconnected policy in the area of sustainability'. It is clear that addressing these interplays will be a key challenge for farmers, public bodies, and agricultural and environmental policy-makers in the coming years.

Innovation

There have been a number of positive innovations to support the sustainable development of the agricultural sector.

Recent years have seen a number of positive innovations to support the sustainable development of the agricultural sector. PastureBase Ireland[16] is a citizen science enabled system into which farmers provide data on grass growth from their farms, which facilitates the quantification of grass growth in a range of biophysical environments. PastureBase then provides feedback that can be used by farmers to support day-to-day management decisions to improve production efficiency (getting more from less) or to evaluate longer-term performance from the farm. The Teagasc-Bord Bia Carbon Navigator tool referred to previously represents a pro-active approach to addressing resource efficiency. The newly developed Nutrient Management Planning (NMP) Online system has the potential to assist with the management of soil fertility and may allow for the tracking of spatial and temporal changes in it. Coupling NMP online with other productivity efficiency tools may help farmers to improve productivity while protecting water quality.

The *Teagasc Technology Foresight 2035* report (Teagasc, 2016) identified the potential contribution of the converging ICT technologies that can provide new, more cost-effective, integrated and streamlined systems at all levels in the agricultural value chain. New and larger datasets are now and will increasingly be collected using affordable sensor technologies that will be employed at farm level. The risks inherent in addressing and managing all the production and environmental resources can be significantly reduced when data are used to inform the decision making at all stakeholder levels. Substantial datasets are being collated via EPA work on catchment characterisation and via PastureBase, NMP online, ACP and other initiatives. Clearly future data sharing and management will be a key support to environmental protection in the context of agriculture.

Conclusion and Future Challenges

The quality of Ireland's environment plays a vital role in the quality of Ireland's agricultural produce and its marketing. It is essential to ensure the implementation of the Food Wise strategy does not result in damage to the environment and supports progressive improvement where it is already impacted. Food Wise recognises this and its vision of economic competitiveness and environmental sustainability being equal pillars is a significant step towards dealing with the tensions that can exist between environmental goals and socio-economic ones. Addressing these tensions will require a strong, reliable and independent evidence base upon which all stakeholders involved in environmental protection and agriculture development and management can depend and upon which actions can be developed and implemented. Better information and more evidence are being delivered on the interactions between agriculture, its productivity and its consequences on the environment via research and other channels. There is however a challenge in improving the sharing of this information and more importantly developing a common understanding of the interactions between agricultural management choices and their effects on the environment and the measures on how to address them.

16 *https://www.teagasc.ie/crops/grassland/pasturebase-ireland/*

The structure of Irish farming enterprises is partially but substantially predicated by the biophysical and climatic context in which these enterprises are situated. Consequently increases in primary production systems will not be uniform across the country as regional and local biophysical factors together with socio-economic considerations will determine where intensification may take place. The consideration of how farmland can provide multiple benefits within a Functional Land Management framework provides an opportunity to achieve a more holistic and positive outcome for the Irish environment and for farming communities. This would, however, require continuing the drive towards a more targeted approach than is currently employed to address the pressure agriculture places on local environments. There are substantial challenges in seeking to apply such an approach at a local scale. Incentivising location – appropriate farming that can provide a reasonable economic return such as the Burren programme may provide an exemplar of how this could be achieved. That being said there are substantial constraints on farmers, both economic and time wise to engage with environmentally positive activities given the issues of farming viability. Nevertheless there are double dividends to be achieved where certain practices such as improved nutrient management planning can save farmers money whilst also reducing the risk of nutrient loss to the environment.

The main climate change impacts expected for the agriculture sector will result from changes in air and soil temperature, changes in rainfall patterns and more extreme events. For farming, climate change will require adaptation to a new reality and this will impact on farmers more directly than most other sectors of society. Adaptation to these changes is a key consideration for Irish agriculture to be addressed in the sectoral Climate Adaptation Framework mandated under the Climate Act. The challenge of achieving GHG neutrality within the combined agriculture and land use sectors is substantial and agriculture has a pivotal role to play in combatting climate change by improving the GHG efficiency of production. The challenges associated with implementing planned policies and measures that are aimed at reducing emission should not be underestimated and will need a combination of education, incentives, resources and substantial commitment by all stakeholders to enable implementation.

There are clearly substantial current challenges in relation to improving the environment from a water quality and biodiversity standpoint. Eutrophication caused by nutrient loss from agricultural activities is the most significant pressure on the water environment and the current lack of progress with attaining improvement in water quality is a major concern. The rise of the detection of pesticides in source drinking water is a particularly worrying development. Both the World Health Organisation drinking water safety planning approach and integrated catchment management approach being developed under WFD highlight the need to address these issues in the catchment.

The AgImpact Project (Carton *et al.*, 2016) highlighted the significant challenge in developing processes to promote the application of knowledge that will deliver increased efficiency and profitability while protecting natural capital including water. This challenge is characterised within the variability of the biophysical setting and more importantly within the context of the socio-economic challenges facing farming communities including the viability of their enterprises. The study identified the need for improved communications that will build mutual trust between and within generators of knowledge, policy development stakeholders and active "on the ground" parties including farmers and advisors. Achieving improved environmental performance within this context is a major challenge and will require the building of trust and partnerships to help overcome the sectoral, natural, economic, social and demographic variability that characterises and shapes the sector and its interactions with its environment. This will require fostering collaboration across a wide number of stakeholders including the farming community.

Key High-level Messages

Ireland's environment plays a vital role in the quality of Ireland's agricultural produce and productivity. Recognising local and regional contraints and valuing the range of ecosystems service that agicultural land provides will be key to ensuring a balanced approach to the future development of Irish agriculture and rural communities.

Environmentally sustainable intensification of the agriculture sector will depend on a strong, reliable evidence base upon which all stakeholders involved in environmental protection and agriculture development and management can depend.

Adapting to and mitigating the impacts of climate change will be a key challenge for the Irish agricultural sector and the challenge of achieving GHG neutrality within the agriculture and land use sectors is profound.

Water pollution caused by the loss of nutrients and the loss of pesticides to waters from agricultural land are major concerns that need to addressed collectively by all environmental and agricultural stakeholders.

Building trust between environmental and agricultural stakeholders is a major challenge that will need to be addressed to achieve meaningful engagement on achieving economic competitiveness and environmental sustainability.

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Section V
Key Messages

Chapter 13

Environmental Challenges and Emerging Issues for Ireland

Chapter 13

Environmental Challenges and Emerging Issues for Ireland

Environmental Challenges for Ireland

Introduction

There are many positive aspects associated with Ireland's environment. Air quality is generally classified as good (EPA, 2015a). We still have good-quality water in many rivers, lakes, estuaries and coastal waters, which support important habitats and species (EPA, 2015b). Excellent progress has been made in meeting EU waste recycling, recovery and diversion targets (EPA, 2016a).

The critical role that our environment plays in delivering health benefits and significant economic advantages for our society is now beginning to be appreciated. This appreciation must be further realised through coherent and integrated national social and economic policies.

Ireland is at a crossroads as to how it addresses the global environmental challenge of climate change. In the longer term national greenhouse gas (GHG) emissions have increased when measured against 1990 levels; this is at odds with the overall achievements of the EU, where GHG emissions have decreased (EEA, 2016). In recent years national GHG emissions have decreased. However, projections of future emissions suggest that this trend will be reversed in the near future and Ireland may fail to meet the 2020 emissions targets and not be on track for necessary decarbonisation (EPA, 2016b).

Our national values system has evolved to a stage that sees conspicuous consumption as socially desirable. Moreover, the rise of individualism is dictating behaviours that are not always in the best interests of society or the environment. This is not a sustainable pathway for any nation. Recent national actions to engage communities in environmental protection and sustainable development are seen as central to delivering the future we need. This strengthening is also being led by some of our more enlightened businesses through corporate social engagement.

There are also significant water pollution risks specific to Ireland that will remain a challenge unless underinvestment in water services is reversed and measures are implemented to ensure that the intensification of the agriculture, fisheries and food sectors under Food Wise 2025 does not have a negative effect on the environment and biodiversity (EPA, 2015a,b,c).

European Perspective

European State of the Environment Report 2015

The European Environment Agency (EEA) report indicates a mixed picture in relation to achieving the EU's 2050 vision of "living well within the limits of the planet".

The EEA released its latest State of the Environment report for Europe in 2015 (EEA, 2015a). The EEA paints a varied picture in relation to achieving the EU's 2050 vision of "living well within the limits of the planet". Some areas, notably resource efficiency and the low-carbon economy, have progressed or have a mixed picture in the medium term. However, the picture for protecting, conserving and enhancing natural capital in many areas is deteriorating. A similar outlook is given for safeguarding Europe from environmental risks to health. Deteriorating trends in relation to biodiversity and climate impacts can be singled out as special causes for concern. These are global issues and not just confined to Europe. A summary of the trends identified by the EEA are presented in Table 13.1.

Table 13.1 An Indicative Summary of Environmental Trends (Source: EEA, 2015a)

	5–10 year trends	20+ years outlook	Progress to policy targets
Protecting, conserving and enhancing natural capital			
Terrestrial and freshwater biodiversity			☐
Land use and soil functions			No target
Ecological status of freshwater bodies			☒
Water quality and nutrient loading			☐
Air pollution and its ecosystem impacts			☐
Marine and coastal biodiversity			☒
Climate change impacts on ecosystems			No target
Resource efficiency and the low-carbon economy			
Material resource efficiency and material use			No target
Waste management			☐
Greenhouse gas emissions and climate change mitigation			☑/☒
Energy consumption and fossil fuel use			☑
Transport demand and related environmental impacts			☐
Industrial pollution to air, soil and water			☐
Water use and water quantity stress			☒
Safeguarding from environmental risks to health			
Water pollution and related environmental health risks			☑/☐
Air pollution and related environmental health risks			☐
Noise pollution (especially in urban areas)		N.A.	☐
Urban systems and grey infrastructure			No target
Climate change and related environmental health risks			No target
Chemicals and related environmental health risks			☐/☒

Indicative assessment of trends and outlook

- Deteriorating trends dominate
- Trends show mixed picture
- Improving trends dominate

Indicative assessment of progress to policy targets

- ☒ Largely not on track to achieving key policy targets
- ☐ Partially on track to achieving key policy targets
- ☑ Largely on track to achieving key policy targets

Note: The indicative assessments presented here are based on key indicators (as available and used in SOER thematic briefings), as well as expert judgement. The corresponding 'Trends and outlook' boxes in the respective sections provide additional explanations.

More recently, the EEA reported that EU GHG emissions continued to decrease in 2014, with a 4.1% reduction in emissions to 24.4% below 1990 levels (EEA, 2016). However, the situation in Ireland is somewhat different: the figures released point towards increasing emissions since 1990. This may indicate that Ireland is not yet meeting the challenge to build a resource-efficient, low-carbon economy.

The EEA is advocating for a shift in the way we value and protect our shared environment. Various policies and initiatives have been created to steer Europe towards a green economy. However, the assessment from the EEA shows that these policies to date have not made sufficient progress to reverse the trends predicted. The environment is not yet placed at the heart of everyday decisions and actions. This provides a challenge for all European and national institutions to work more closely together to help deliver common outcomes for a healthy environment.

Overall, the high-level challenges highlighted by the EPA throughout these chapters reflect the challenges set out by the EEA in its State of the Environment report for Europe 2015 and also in the EU 7th Environmental Action Programme (EAP). This attests to the fact that across Europe there are similar challenges in addressing identified environmental issues and ensuring a good-quality environment.

The 7th Environmental Action Programme

The 7th Environmental Action Programme provides the basis for EU wide action to enhance environmental protection in the period 2014 to 2020 and outlines a longer vision for Europe in 2050 (EU, 2013):

"In 2050, we live well, within the planet's ecological limits. Our prosperity and healthy environment stem from an innovative, circular economy where nothing is wasted and where natural resources are managed sustainably, and biodiversity is protected, valued and restored in ways that enhance our society's resilience. Our low-carbon growth has long been decoupled from resource use, setting the pace for a safe and sustainable global society."

The three key objectives of the EAP are:

- to protect, conserve and enhance the EU's natural capital
- to turn the EU into a resource-efficient, green and competitive low-carbon economy
- to safeguard the EU's citizens from environmental-related pressures and risks to health and wellbeing.

It also establishes two horizontal priority objectives:

- to make EU cities more sustainable
- to help the EU address international environmental challenges more effectively.

To deliver on these goals the EU has set a focus on four key actions:

- better implementation of legislation
- better information by improving the knowledge base
- more and wiser investment for environment and climate policy
- full integration of environmental requirements and considerations into other policies.

Challenges Outlined in the State of the Environment Report 2012

In Ireland the picture is mixed when considering progress in addressing the four main challenges outlined in the State of the Environment report 2012.

The four key challenges from the EPA's State of the Environment report 2012 are listed in Table 13.2 (EPA, 2012a). The table also provides an indicative high-level summary on progress with these challenges.

Table 13.2 Summary Report on Progress with the Four Key Challenges Listed in the State of the Environment Report 2012 (Source: EPA)

Four key challenges listed in Ireland's Environment: An Assessment 2012	Indicative summary on progress against these challenges based on information in this report (further details are included in the key messages section)
1. Valuing and protecting our natural environment	Economic value of eco-system services is a concept that has a higher profile but it is not on a routine basis integrated into business decisions and policy making. The habitats of most pressing concern are those that have reduced range and/or area, notably raised bogs and species-rich grasslands. Species most under threat include those linked to wetlands or uplands or sensitive to water pollution. Ireland has a similar challenge to Europe in halting biodiversity loss. There are also important air quality challenges to be addressed in the forthcoming air quality strategy and significant water pollution risks from urban waste water and agriculture that remain a challenge to resolve in order to meet the public and environmental health requirements for good water quality.
2. Building a resource-efficient, low-carbon economy	Ireland has significant work to do to transition to a low-carbon economy. Fossil fuels dominate our energy system and need to be phased out over the coming decades and our national GHG emissions are projected to increase. There has been a substantial increase in awareness of the value of resource efficiency and green growth to economic performance, reputation, and image, at business and national levels: nevertheless there remains an appreciable gap between awareness and implementation. Energy efficiency is more advanced than water, waste or raw materials efficiency measures. In relation to displayed behaviours, Ireland still has a long way to go to close the gap on sustainable consumption. An integrated national resource efficiency strategy is not in place. Green Public Procurement can assist addressing this challenge but remains a largely unimplemented policy device.
3. Implementing environmental legislation	Despite progress in several areas, including waste recycling and emissions from industrial facilities, Ireland still faces challenges in implementing a number of regulations and directives that are designed to protect our environment and, by extension, our health. There is poor adherence, at individual and household levels, to regulations dealing with matters such as litter, waste prevention, water use, smoky coal use, and septic tank management, that impact on our health and environmental quality.
4. Putting the environment at the centre of decision making	Information sources, such as websites with information for the public, data and map layers, have improved but it is more difficult to translate information into action on the ground that results in changes in behaviour. Good progress on Strategic Environmental Assessment of national plans and programmes. Growing awareness of sustainable behaviours through programmes such as Stop Food Waste.

Key Actions for Ireland in 2016

Following on from the information and evidence presented in earlier chapters, this section of the report highlights seven key environmental actions for Ireland. While the actions are listed as individual items, many are linked and the integration of actions across these areas will be important for the delivery of environmental protection and sustainable development. Many of these actions can also be linked to the Sustainable Development Goals from the UN.

Figure 13.1 Seven Key Environmental Actions for Ireland on the State of the Environment in 2016

SYSTEMIC MESSAGES

Environment and Health & Wellbeing

Recognition of the benefits of a good quality environment to health and wellbeing.

Climate Change

Accelerate mitigation actions to reduce greenhouse gas emissions and implement adaptation measures to increase our resilience in dealing with adverse climate impacts.

Implementation of Legislation

Improve the tracking of plans and policies and the implementation and enforcement of environmental legislation to protect the environment.

TOPIC MESSAGES

Restore & Protect Water Quality

Implement measures that achieve ongoing improvements in the environmental status of water bodies from source to the sea.

Sustainable Economic Activities

Integrate resource efficiency and environmental sustainability ideas and performance accounting across all economic sectors.

Nature & Wild Places

Protect pristine and wild places that act as biodiversity hubs, contribute to health and wellbeing and provide sustainable tourism opportunities.

Community Engagement

Inform, engage and support communities in the protection and improvement of the environment.

Key Action 1: Environment and Health and Wellbeing

Recognition of the Benefits of a Good Quality Environment to Health and Wellbeing

Environment and Health – Inextricably Linked

We need to remind ourselves that our health and wellbeing are supported by a clean and well-protected environment.

A clean and well-protected environment is a key building block to a healthy Ireland. Clean air and water are not luxury items but basic needs, and should be treated as valuable assets that need to be protected to benefit our health and also the wider economy. The state of the environment can influence our health in positive terms (e.g. amenity) but also in negative terms, because of the risks to health posed by pollution. As evidenced in this report, Ireland's environment is generally good, and it can be concluded that on the whole Ireland does present a clean, safe environment to live in. The availability of green spaces (parks, woods, countryside) and blue spaces (ponds, river banks, lakeshores and seashores), along with clean, fresh air and breathtaking landscapes, provides an enviable resource which should be valued and enjoyed. In addition to the beneficial effects of being active in these spaces, scientists have also linked exposure to nature to benefits in coping with mental stress and fatigue.

From an environmental perspective, definitions of pollution include the terms "harmful to human health"

or "endanger human health", emphasising how closely health and environmental protection are linked. One of the goals of the EPA's new corporate strategy is to promote a greater awareness of the impact of environmental quality on human health and amenity. Actions covering this area will be developed in co-operation with the National Healthy Ireland Strategy, the Health Service Executive and other stakeholders.

As explored in the Environment, Health and Wellbeing section in Chapter 3, there is a need to understand the dynamic interaction between the various dimensions of our environment that can, through different modes of exposure or experience, impact on health and wellbeing. The three key dimensions are natural environment, built environment and lifestyle–consumption. Policy solutions are at the same time simple and complex, but must be integrated completely through well thought out and cross-departmental interventions.

There are a number of issues that require action including air pollution, radon, drinking water contamination and environmental nuisances caused by odour, noise or litter. In addition, from an emerging risks perspective, we need to be vigilant in relation to climate change-induced health risks, antimicrobial resistance and new chemicals and substances.

Protecting Air Quality

We should not be complacent about our air quality in Ireland.

Reports from the World Health Organization (WHO) have shown the impact that vehicle exhaust emissions and other air pollutants are having on quality of life in many world cities (WHO, 2015). Ireland remains relatively fortunate to have better air quality than most countries in Europe, but some key challenges remain. Air pollution is estimated to have contributed to annual mortality rates which need to be addressed.[1,2] Traffic is a key pressure on air quality and is the main cause of air quality problems in our larger towns and cities. Local air quality, particularly in small Irish towns with a high dependence on coal, turf and wood for home heating, can be poor at times, and communities need much better local-level air quality information. It is now accepted that even low levels of air pollution, notably from particulates (dust), can have negative health impacts, and plans are needed across Ireland to protect and improve air quality by dealing with specific local pressures.

The move to a low-carbon and resource-efficient economy should also lead to better air quality, provided that there is strong regulation and control of the burning of renewable fuels, such as wood and biomass, which in themselves can give rise to air pollution problems. We also need to develop a better understanding of linkages between climate and air quality policies and be careful that there are not unintended consequences for the environment (i.e. not creating an environmental harm through solving a different environmental harm). The Clean Air Strategy for Ireland produced by the Department of Communications, Climate Action and Environment should be an opportunity to highlight these issues and put forward policy solutions. The adoption of WHO guideline values for air quality into Irish legislation as part of this process would provide an impetus for action to protect air quality.

Radon – a naturally occurring radioactive gas – is a risk to human health which also needs to be highlighted and brought more to people's attention. Some of our citizens are living in houses that may be making them sick, although they are not aware of it. Householders, institutions and businesses need to investigate and remediate building stock where a radon risk is determined.

Drinking Water

We need to have safe and secure supplies of drinking water. This will require significant investment.

There has been improvement in recent years in the quality of drinking water supplied by both public and group schemes, but many problems remain to be tackled to guarantee a safe and secure supply of drinking water (EPA, 2015d). There are still an unacceptable number of supplies on long-term Boil Water Notices and on the EPA's Remedial Action List. Comprehensive national strategies will be necessary to address key priorities such as disinfection, disinfection by-products, lead, pesticides and water safety planning.

Major investments are still needed in the public water sector and in the group water sector to make sure consumers are protected from risks such as cryptosporidiosis, verotoxigenic *E. coli* (VTEC), lead and trihalomethanes. More also needs to be done to highlight the risks faced by over 180,000 households which have their own private well. A multi-barrier approach that protects the source waters, including rivers, lakes and groundwater, from pollution – linked with effective treatment and operation designed to match the quality and variability of the source water – is recommended to ensure safe and secure drinking water.

Environmental Nuisance

Local action plans are needed to deal with specific problems relating to odour, noise and litter.

Nuisance, whether this is noise, odour or litter/fly-tipping of waste, is a threat to human health and wellbeing, as well as to the wider environment. These three dimensions

1 *www.euro.who.int/en/health-topics/environment-and-health/air-quality/news/news/2014/03/almost-600-000-deaths-due-to-air-pollution-in-europe-new-who-global-report*

2 *www.eea.europa.eu/media/newsreleases/many-europeans-still-exposed-to-air-pollution-2015/premature-deaths-attributable-to-air-pollution*

of nuisance are the environmental issues that generate the most complaints to the EPA and local authorities and can have negative impacts not only on health, but also on enjoyment of amenities, as well as on environmental quality.

After poor air quality, noise nuisance is the second largest environmental source of human health morbidity and mortality in the EU (EU, 2014). National planning for infrastructure (such as transport) and urban spaces must factor in appropriate protections for the population against noise impacts. Building design should likewise ensure appropriate acoustic shielding for occupants.

Local authorities receive over 60,000 environmental complaints each year from the public. The majority of these relate to litter and waste-related issues. The EPA also receives a significant number of complaints about odours emanating from industrial activities, in particular waste management, food and drink facilities. The primary responsibility rests with industrial operators to effectively control their activities. The EPA and the Local Authorities have a range of effective enforcement tools to call upon in the event of a failure by an operator to properly manage an activity.

The extent of the annoyance and amenity impairment caused by litter is clearly demonstrated by the number of complaints made to local authorities, around 40,000 a year between 2012 and 2014. While local communities and local authorities are actively involved in clean-up projects across the country, it is clear that enforcement and resources are still required to tackle ongoing litter and fly-tipping problems. This resourcing should also incorporate educational and behavioural change interventions so as to assist in normalising sustainable attitudes and practices.

Key Action 2: Climate Change

Accelerate Mitigation Actions to Reduce Greenhouse Gas Emissions and Implement Adaptation Measures to Increase Our Resilience in Dealing with Adverse Climate Impacts

Climate Change Action

Urgent action is needed around climate change, including the mitigation and adaptation work necessary to protect ourselves from its inevitable consequences.

As an island country, we need to adopt a much greater sense of urgency about:

- reducing our dependence on fossil fuels for energy, heating, and transport
- radically improving energy efficiency and
- preparing for the inevitable consequences of climate change such as flooding.

Climate change is now with us, and the sooner we act, the less damage will be done to our society, economy and environment. Planning for climate change adaptation actions is now also essential for Ireland's social and economic resilience.

Local Authority Adaptation Strategy Development Guidelines

Climate change mitigation (i.e. efforts to prevent the concentration of GHGs in the atmosphere from reaching a dangerous tipping point) is a priority. Urgent action is required to enact the UN Paris 2015 Agreement in order to reduce the risk of climate-driven changes overwhelming the capacity of most societies and ecosystems to adapt to its impacts. However, when it comes to climate change adaptation, the urgency to respond is somewhat different. While mitigation demands immediate action, adaptation requires immediate planning.

Guidelines published by the EPA during 2016 make it easier for local authorities and others to plan for the inevitable consequences of climate change (EPA, 2016c).

Actions to address climate change, through mitigation and adaptation measures can also provide economic and social opportunity through, for instance, green jobs, habitat and wetlands preservation (ecosystem services), promoting resilient communities, and sustainable competitiveness.

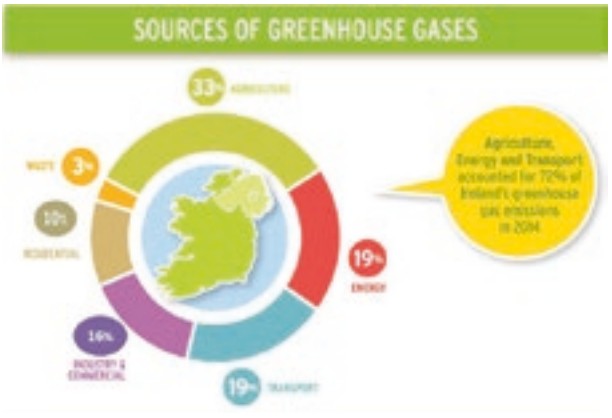
Transition to a Low-Carbon Future

There is a pressing need to develop, implement and monitor progress on measures to reduce GHG emissions and deliver resource efficiency.

The national policy position for Climate Change establishes a vision for Ireland of low-carbon transition based on an aggregate reduction in carbon dioxide (CO_2) emissions of at least 80% (compared with 1990 levels) by 2050 across the electricity generation, built environment and transport sectors; and, in parallel, an approach to carbon neutrality in the agriculture and land use sectors, including forestry, that does not compromise capacity for sustainable food production (Irl Gov, 2014).

Ambitious GHG mitigation plans with clear short-term and longer-term targets are needed in the key socio-economic areas of energy, transport, buildings, manufacturing, services and agriculture to get Ireland on a clearly defined road to a low-carbon and resource-efficient future (Figure 13.2). The Climate Action and Low Carbon Development Act 2015 sets out the legislative basis and timelines for the making of national and sectoral mitigation plans as well as a National Adaptation Framework plan, with the overall aim of reducing our GHG emissions and moving towards a low-carbon and climate-resilient future (Irl Gov, 2015). A key task will be to ensure that robust and transparent monitoring systems are in place to provide the evidence to track progress to targets that have been set across different sectors.

Figure 13.2 Ireland's Sources of Greenhouse Gas Emissions in 2014[3] (Source: EPA)



However, a paradigm shift across society and the economy is needed if Ireland is to successfully transition to a carbon-neutral future in line with the policy ambition. The emission reductions have to come from a broad base that includes all sectors.

The most recent GHG emissions data for the Emissions Trading Sector were released in early 2016 (EPA, 2016d). The figures show that the Emissions Trading sector increased its emissions. This increasing trend does not look encouraging for meeting our national goal to transition to a carbon neutral society and economy. There is a need for stronger incentives to move away from burning fossil fuels and in particular our ongoing use of coal and peat to generate electricity. For wider sectors of the economy and society not covered by the ETS, which includes transport, agriculture, waste and residential sectors, for the period 2014-2020 GHG emissions are projected to increase (EPA, 2016b). Agriculture emissions are projected to increase by 6-7% and transport is projected to increase by 10-16% on 2014 levels. Overall, total emissions are projected to be between 6-11% below 2005 levels in 2020. The target is a 20% reduction.

If Ireland takes a business as usual approach and does not introduce new policy measures to speed up progress to move away from fossil fuel we will end up having to concentrate effort over a short timeframe to meet targets which will be inefficient and high risk. In effect, Ireland will need to reduce its GHG emissions to near zero before the end of this century.

There is embodied carbon in all our production and consumption cycles, specifically in relation to raw material use. The significant levels of disposal income as well as the construction boom up to 2007 put Ireland in the bracket of being amongst the most resource inefficient people in Europe (GDP per tonne of Domestic Material Consumption). The last 5 years has seen a significant improvement in resource productivity, the challenge is to ensure that the current economic recovery does not put us back to that period of unsustainable and carbon intensive consumption. Businesses have been awakened to the economic and competitive value of resource

3 Based on National Sectoral Analysis

and sustainable business practices, however some businesses, in particular SME's, find it difficult to resource engagement with the national support services. The EPA's resource efficiency activities (*www.begreen.ie* and *www.greenbusiness.ie*) have demonstrated the economic advantage of business participation. This has also been determined through EPA funded research activities where a 2% efficiency in material consumption would yield nearly a billion euro saving for the national economy (EPA, 2013). In respect of the five main elements of resource efficiency (energy efficiency, water efficiency, raw material efficiency, waste prevention and clean technology) it is the energy area that has been most successful, principally driven by high energy costs, as well as access to finance and technical support (e.g. SEAI and others).

Energy and Transport Sectors

Major transitions in the energy and transport sectors are needed in the coming decades.

Ireland's energy systems will need to undergo a major transformation in the coming decades as part of actions to improve air quality and address and limit climate change. Fossil fuels, which make up about 90% of Ireland's current energy profile, need to be phased out and replaced by renewable energy resources such as wind, solar and tidal. Large-scale public and private investment in energy infrastructures, including energy-efficient and innovative energy management systems, energy distribution and smart grid systems, is needed to enable this transition. Progressive engagement with stakeholders and the public including information provision will be required as part of this transition. The government White Paper on *Ireland's Transition to a Low Carbon Energy Future 2015 – 2030* sets out a blueprint for the energy sector that sets about addressing these challenges.

There are very clear wins for the public in energy savings by retrofitting older and less energy-efficient housing stock to reach higher energy ratings (SEAI, 2016). Retrofits of the housing stock, especially older houses, as well as commercial and public buildings to reach a Building Energy Rating (BER) grade A is a national climate change-related project that could be prioritised through more targeted action programmes. This project would also benefit householders in terms of comfort and savings on heating bills.

In relation to transport, there needs to be support for a modal shift from the private car to an efficient sustainable transport system through a more proactive and systematic approach to land use and transport planning. Wider policy measures are needed to promote significant increases in alternative fuels and electric vehicle usage. Ireland needs to develop a mix of planning, infrastructural investment and fiscal measures to bring about a reduction in transport demand. Over the next 30 years Ireland will need to incrementally electrify its national urban public transport system. For larger urban areas, we need to work on many different levels to have a much more integrated network, with right of way given to transport modes that reduce air pollution and GHG emissions.

Key Action 3: Implementation of Legislation

Improve the Tracking of Plans and Policy and the Implementation and Enforcement of Environmental Legislation

Implementing Environmental Legislation

Progress in closing out compliance with some key directives is slow.

The implementation of environmental legislation was one of the four key challenges highlighted in the State of the Environment report 2012. It is a key driver to meeting our national and international commitments and to ensuring a thriving, clean environment. Legal responsibility rests with industry, economic sectors and all of society to meet environmental obligations and not cause pollution.

The EPA and the local authorities are the main bodies responsible for implementing environmental legislation. Other Government departments and authorities have implementation roles in relation to legislation covering specific environmental areas, such as biodiversity and wildlife legislation (National Parks and Wildlife Service), fisheries protection (Inland Fisheries Ireland, Marine Institute, Sea Fisheries Protection Authority) and environmental health (Health Service Executive).

Despite progress in several areas, including waste recycling and emissions from industrial facilities, Ireland still faces challenges in implementing a number of regulations and directives. Ireland faces open EU complaints or infringement proceedings in relation to the Drinking Water Directive and the Urban Waste Water Treatment Directive. This is an area where significant investment is needed to upgrade treatment facilities and networks. The second cycle of the River Basin District Plans are delayed and sustained progress is needed to restore water bodies not meeting "good" status. And as outlined in the chapter on climate urgent work is needed to reduce GHG emissions. The European Commission has also begun infringement proceedings against Ireland for failing to complete the designation requirements for its Special Areas of Conservation.

Enforcement of Environmental Legislation

Continued enforcement and engagement to change attitudes and behaviours is required.

Environmental enforcement bodies should continue to target key environmental risks and non-compliance with permits and licences in order to drive environmental improvements. Appropriate odour control and the requirement to have robust and secure financial provisions in place to manage environmental liabilities are two key issues for waste and industrial sites.

Odour control in parts of the waste management and food and drinks sectors needs to improve. These sectors accounted for approximately 98% of all odour complaints made to the EPA during 2015, with 10 sites accounting for 75% of all complaints. Inspections conducted by the EPA have found poor management and storage of waste at some waste facilities, which is leading to unacceptable odour nuisance and an increased risk of fires. The EPA has committed to use enforcement powers to bring the operators of these facilities into line and ensure that they improve their environmental performance.

Litter and fly-tipping also account for the majority of environmental complaints made to local authorities. These figures illustrate that litter and fly-tipping are issues that still need attention. Continued enforcement, as well as initiatives to promote positive attitudes and behaviours, is required. Citizen involvement in reporting environmental pollution or related environmental issues provides on-the-ground information for public bodies to act on. Various phone lines, apps or web-based systems are now operated by public bodies to make reporting easier and instant (Figure 13.3).

The prevention and remediation of environmental damage at contaminated sites, and from the closure of authorised activities, is a strategic priority for the EPA. To this end, operators under various authorisation regimes (waste, industrial emissions directive and integrated pollution control licensing, and dumping at sea permitting) are required to make adequate financial provision for the potential environmental liabilities associated with:

- closure and restoration/aftercare and
- response to, and completion of remedial measures in the event of an incident.

The State has stepped in to manage remediation at major waste infrastructural sites where companies ceased to trade resulting in significant cost to the public purse. The EPA has published two recent sets of guidance on measuring and providing for environmental liabilities, with the general aim that financial provisions must be *Secure, Sufficient and Available.*

Figure 13.3. The EPA has developed a phone app, called *See it? Say It!*[4] to help people to report environmental pollution (Source: EPA).

Emissions from Industrial Facilities

Emissions of pollutants from large industrial activities are not all reducing.

The regulation of emissions from large industrial facilities of pollutants to air and water is showing a mixed trend of both increases and decreases for various parameters, with large urban waste water treatment plants the major industrial source of releases of the nutrients nitrogen and phosphorous to waters.[5] The mineral and waste water management sectors reported the largest quantity of pollutant releases in 2014. For air we are seeing the positive impact of higher penetration of renewables in power generation in addition to the improvements in abatement measures over the last number of years.

Monitoring National Plans and Programmes

Strategies and sector plans should be written with a commitment to report publically and regularly on environmental performance against relevant environmental indicators.

Many economic sectors have strategies in place for growth or change. Implementation of these strategies can come with potential environmental risks and challenges. It is now recognised that monitoring the environmental performance of sector strategies is necessary to ensure that growth strategies are sustainable in the long term.

Strategies should be written with a commitment to report publicly and regularly on their environmental performance against relevant environmental indicators. This will make the strategies more robust and provide for increased environmental accountability and transparency during implementation. A strategy review mechanism should kick in if the performance monitoring demonstrates an unfavourable situation for Ireland's sustainability.

4 See It Say It: Environmental Protection Agency, Ireland

5 PRTR Registers – National: *www.epa.ie/enforcement/prtr/map/* European: *http://prtr.ec.europa.eu/#/home*

Understanding and Dealing with Wider Environmental Risks

We need to develop new ways of understanding and dealing with emerging and systemic risks that take the precautionary principle into account.

Many specific environmental issues are regulated on a site by site basis, for example the licensing of an industrial facility or the management of a protected area. However, across the wider environment there are also systemic risks, such as diffuse water pollution or decline in species populations. We need to develop new approaches to be able to tackle these risks effectively. The EEA and recent EU research point towards the need to learn new ways to identify emerging risks (EEA, 2013; EU, 2016). The provision of timely environmental data is crucial to the early identification of these wider risks.

Mapping and Understanding our Land Use Patterns

Good planning decisions are those that are integrated and also provide for a better environment.

The challenge is to design a future urban environment with public appeal that incorporates climate-proofing aspects, along with green areas and wild spaces for wildlife and people, while also meeting the needs of the population. Forward strategic planning for land use and new infrastructure is needed to ensure that growth is sustainable and does not add to the environmental pressures that are already evident, such as the gradual loss of wetlands over the past two decades or capacity issues in delivering drinking water and treating urban waste water.

Land is subject to many often competing sectoral demands. National policies, such as in forestry, agriculture, peatlands and the built environment, influence land use change and resource management. Establishing and implementing an integrated national land cover, land use and habitat mapping programme is essential to assist in reporting and assessing the impact of different land cover and land use types on the environment. By integrating the National Landscape Strategy into land use planning, sustainable landscape management practices can also be progressed.

A National Catchment-Based Flood Risk Assessment and Management (CFRAM) Programme is under way to assess the existing flood risk of inland watercourses and coastlines in Ireland. The CFRAM Programme co-ordinated by the Office of Public Works is a programme where active participation and consultation with local communities should lead to better outcomes to tackle flooding while minimising impacts on the wider environment. The programme should link work between directives, for example between the Water Framework Directive and the Floods Directive, in order to achieve the co-ordinated protection of water resources.

Key Action 4: Restore and Protect Water Quality

Implement Measures that Achieve Ongoing Improvement in the Environmental Status of Water Bodies from Source to the Sea

New Approaches Needed to Protect Water Quality

Protecting and improving our waters will present significant challenges in the future.

Water protection measures are needed to ensure that we continue to have healthy rivers, lakes and estuaries and clean beaches in order to protect human health, to preserve fish and biodiversity and to allow our important water resources to be a driver for sustainable jobs and tourism. While Ireland's waters might be among the best in Europe, we are still a long way from meeting the full legal requirements of the Water Framework Directive, against which water quality is measured. Preliminary results indicate that there has been no overall improvement in water quality over the first river basin cycle (2009–2015). The target of a 13.6% improvement in the ecological status of surface waters (from the 2009 baseline) by 2015 was not achieved. Water quality improvements are required at approximately 50% of rivers, lakes and estuaries that are impacted by pollution or other pressures (EPA, 2015b). The two main suspected causes of pollution in rivers are agriculture and municipal sources, accounting for 53% and 34% of cases, respectively (EPA, 2015b). Physical modifications, such as barriers to fish migration, are also a key pressure that needs to be tackled.

While overall the length of unpolluted river channel has remained relatively constant there has been a substantial loss in the highest quality river sites (i.e. Q value of 5). In the most recent monitoring period (2013-2015) only 21 sites were classified as the highest quality river sites (0.7%

of sites) compared with 584 between 1987 and 1990 and 82 between 2001 and 2003. This is an area where substantial effort is required to protect the few remaining highest quality river sites and return impacted ones back to their earlier extremely high quality.

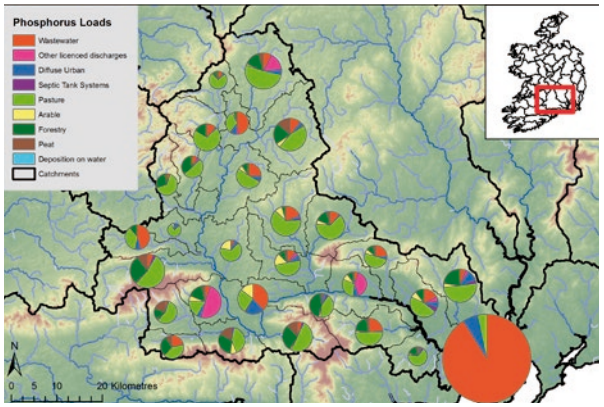
The findings from farm inspections carried out to implement the Good Agricultural Practices Regulations indicate that improvements are needed in the management of manures and organic fertilisers on farms. The new catchment risk-based approach being promoted by the EPA to identify potential Critical Source Areas (CSAs) of pollution is designed to focus water management measures where they will be most effective. This will be particularly important in ensuring that agricultural expansion plans under Food Wise 2025 are achieved in an environmentally sustainable manner.

Urban waste water is still one of the principal pressures on water quality in Ireland. There is a need for continued investment in water services in urban areas, where many waste water treatment facilities are listed on EPA priority lists for improvements. This investment is needed to provide, upgrade and manage the sewer networks and treatment facilities necessary to treat sewage and industrial water to the standard needed to protect human health, and water quality in our rivers, lakes and coastal areas. This investment is also needed to reverse the recent decline in capital expenditure and address the fact that, in many urban areas, waste water treatment does not meet the requirements of the Urban Waste Water Treatment Directive or the standards set in EPA authorisations (EPA, 2015c). The four priority issues that must be addressed are (1) to provide the necessary infrastructure and optimise the operation and maintenance of all plant and equipment, (2) to eliminate the discharge of raw sewage, (3) to implement plans to prevent pollution by waste water discharges and restore affected waters to good quality and (4) to carry out improvements identified in risk assessments to protect freshwater pearl mussels and shellfish waters.

The recent regulation of septic tanks is an example of how local action can make a difference to the protection of human health and the environment. The inspections of septic tanks by local authority staff, as part of the National Inspection Plan, have for the first time provided data on the performance of individual septic tanks (EPA, 2015f). The results show that many of these systems are not properly maintained, yet there are simple steps that homeowners can take to keep their systems operating properly.

Recent research as part of the Towards Integrated Water Management (TIMe) project indicates that water bodies are an important part of people's lives, with 71% of people surveyed visiting a water body at least once a month (EPA, 2015g). The overwhelming majority of the respondents in the survey felt that local communities should have a say in how the water environment is managed. One of the main measures now being implemented to improve and protect water quality is the use of an integrated and evidence-based approach to managing water catchments. This new approach will require much better targeting of interventions such as the identification of the sources of nutrient loadings to catchments (see Figure 13.4 as an example), to restore and protect water quality as well as a greater community involvement in protecting and managing our water resources.

Figure 13.4 Sources of Phosphorus in the Suir Sub-Catchments (Source: EPA)



The Marine Environment and Seas Around Ireland

Integrating coastal and estuarine policies with nature and water protection would bring benefits for environmental protection.

Ireland's marine territory is one of the largest in the European Union being nearly 10 times its land area. It is highly productive and provides a sustaining foundation for a rich mosaic of marine life. Ireland's marine environment has remained relatively unpolluted; however, the level of environmental stress both from internal and external sources has increased.

Untreated sewage is discharged at 36 estuarine or coastal locations. The "treated" effluent discharged from 10 of the country's large waste water treatment plants to estuarine or coastal water failed to meet effluent quality standards. Overall, 71% (46 out of 65) of the urban areas that have inadequate treatment or do not meet mandatory EU standards discharged to estuarine or coastal locations in 2015 (D. Shannon, EPA, August 2016, personal communication).

Marine litter is now a global issue and the impacts can be seen on even the remotest of our beaches. While litter is a key marine environment and biodiversity challenge,

its generation and prevention are linked to a variety of human activities and policy areas, such as waste and waste water management, product design, shipping, fisheries policies, consumption and behavioural patterns. Successful implementation of a comprehensive targeted waste policy is a prerequisite to avoid plastic litter entering the marine environment. We place a high value on our beaches in Ireland and it is unacceptable that some of our beaches and coastlines are still being polluted by sewage and other sources of material discarded by people.

The sustainability of fish catches continues to be an issue with 26% of commercial fish stocks overfished (Marine Institute, 2015). Out of 72 commercial stocks, 36% are considered to be sustainably fished. Overfished stocks have declined to 26%, and 38% remain at an unknown status. Nineteen per cent of commercial species are considered to have been depleted.

Other stresses on our coastal environment are wider and link to the impacts of climate change. From a climate perspective, rising sea temperature, ocean deoxygenation, rising sea levels and ocean acidification (the effects of which are being seen in Irish waters) are major causes of concern worldwide. The rich coastal marine grasses (i.e. *Zostera* spp.) and kelp forests are significant carbon sinks (as well as important biodiversity reservoirs) that need protection and enhancement.

One of the key aspects of many of the environmental challenges facing our estuaries and coasts is that they cut across many sectors, environmental themes and organisations. Issues covered in this report on the marine area point towards the need to protect coastal, estuarine and marine areas through better integration of the actions required under the Water Framework Directive, Bathing Water Directive (2006/7/EC), Urban Waste Water Directive, Marine Strategy Framework Directive (2008/56/EC), Maritime Spatial Planning Directive (2014/89/EU) and Nature Directives (2009/147/EC and 92/43/EEC).

Key Action 5: Sustainable Economic Activities

Integrating Resource Efficiency, Sustainability Ideas and Performance Accounting across Economic Sectors

Resource Management and the Circular Economy

We must move our material flow economy from a linear to a circular one in which materials are captured for reuse at the end of a product's productive life.

In a world of finite resources and a growing population it has never been more important to evolve our national economy and society to become sustainably competitive. This requires us to become resource efficient and sustainable in how we produce and consume. Ireland has in recent years dramatically reduced the waste consigned to landfill (1 Mt less municipal waste to landfill in the last 5 years) and produced less household waste per capita than the European average.

We could and need to be doing better. CSO data published in 2016 would suggest that 500,000 national households do not implement waste prevention in the operation of their homes, and 51,000 households do not participate in legal waste management practices.

The use of Green Public Procurement to drive a market response to resource efficiency and the green economy, as articulated in national policy, has been largely unsuccessful to date, principally due to implementation weaknesses across all government and public body procurement units (Irl Gov, 2013).

A positive national response to the EU Circular Economy package would be to articulate a national resource efficiency plan that draws together the different stakeholders, integrates the elements currently ongoing, identifies investment needs, and sets policy objectives.

As economic prosperity returns we must work harder to ensure our unsustainable consumption patterns of the past do not return. We must move our material flow economy from a linear to a circular one in which materials are captured for reuse at the end of a product's productive life. This evolution will create opportunity in the green economy and ensure that Ireland can move towards sustainable and competitive prosperity. Many good things happen at local level and these need to be normalised across society.

Waste Management Capacity

If Ireland is largely dependent on an export market for treatment of our recyclable waste, and has no developed national capacity, we are vulnerable to external forces.

Ireland has pioneered economic initiatives which have changed consumer behaviour and prevented waste (e.g. the plastic bag levy). Our National Waste Prevention Programme is well established and an example of best practice (EEA 2014, 2015b). Ireland should seek to be innovative in embracing the concept of the circular economy to drive sustainable competitiveness and maximise green growth opportunities.

Ireland is largely dependent on export market for treatment of our recyclable waste, and has limited developed national capacity. Consequently we are vulnerable to external forces such as competition, capacity, currency fluctuations and any changes to policy in the EU. The DECLG discussion paper titled *Exporting a Resource Opportunity? Measures to Maximize Resource Efficiency and Jobs in Ireland* contributes to putting forward solutions to resolving this self-sufficiency gap in dealing with the waste generated in our homes and businesses.

Ireland has some notable waste infrastructure deficits, such as the lack of a hazardous waste landfill, and has limited current available capacity in other infrastructure. Built landfill capacity is at a critical state with potentially less than 1 year's capacity, based on the 2015 fill rate. There was a 10-fold increase in residual waste exported for use as a fuel in the period between 2010 and 2014.

Another challenge will be adequately addressing how we safely manage and recover End-of-Life Vehicles and Batteries and Accumulators. Coordinated and concerted effort by producers, compliance schemes, regulators and the waste industry will be necessary to address this risk. In addition, Local and Regional Authorities will need to achieve the targets set out in their 2015-2021 Regional Waste Management Plans.

Corporate Social Responsibility

Business and institutional leaders have a social responsibility to become thought and action leaders in delivering the low-carbon sustainable society and economy we need.

The economy is dependent on a healthy and well-protected environment to be competitive and to grow. Clean water, effective waste water and waste management and clear rules on environmental performance all support the economy. Systemic change is needed to realise a transition to a low-carbon, resource-efficient economy and society. There is growing evidence of decarbonisation, resource efficiency and green growth in the national economic performance. This type of change needs, however, to happen at a much faster and more sustained pace. Business and institutional leaders need to measure and report on their environmental footprint alongside their economic performance and have a social responsibility to become leaders in delivering the low-carbon sustainable society and economy we need.

Environmentally Harmful Subsidies

The EU roadmap includes a milestone that "by 2020 environmentally harmful subsidies will be phased out, with due regard to the impact on people in need".

Environmentally harmful subsidies (via taxation, transfers, or other market interventions) are causing environmental harm. This is not sustainable. A recent International Monetary Fund (IMF) report states that environmentally harmful subsidies aggravate climate change and worsen local pollution and congestion; for example, in Ireland, we spend $1.2 billion on fossil fuel subsidies, or $261 per head (IMF, 2015). This is just one example of subsidies that distort the market and stifle innovation.

The EU Resource Efficiency Roadmap (2011) requests that urgent attention be applied to the phasing out, by 2020, of environmentally harmful subsidies at a national level. Environmentally harmful subsidies lead to higher levels of waste and, polluting emissions (including climate change gases), inefficient resource extraction and negative impacts on biodiversity.

In Ireland, this requires the identification, and phasing-out (or reformulating), of existing subsidies, transfers, state aids and tax exemptions which offer support for emissions that contribute to harming the environment (i.e. negative environmental externalities).

Agriculture

We need policies to promote the right farming in the right place.

One of the key challenges for the agriculture sector is to foster the vision of the right farming in the right place. With the plans for expansion of agricultural output under Food Wise 2025, there is a need to ensure sustainability of the sector for both economic growth and environmental protection. This planned growth cannot be uniform across the country, and regional and local factors need to determine where intensification will take place. This will require a more location-specific and prioritised actions to address the pressure agriculture places on the environment.

The environmental credentials of agriculture, along with aquaculture, need to be measurable and benchmarked to demonstrate our commitments to expanding in a manner that would not result in long-term degradation of our natural environment (EPA, 2015h). This would be bad for both the agri-sector and Ireland as a whole. Projects implementing this benchmarking process, such as the Bord Bia Origin Green programme (Bord Bia, 2015), are under way.

Mitigating GHG emissions and adaption to climate change will be key considerations for Irish agriculture in the coming years. It is clear that climate change will require adaption to a new reality and this will impact on farmers, as on all sectors of society.

We must also support continued collaborative research to inform decision making that may affect soils, land use and landscapes. Ireland has a rich and productive soil resource that supports significant food production and other social, economic and environmental uses, and it is important that we protect this precious resource for future generations.

Putting the Environment at the Centre of Decision Making

Information sources, such as websites with guidance, data and map layers, have increased but it is more difficult to translate information into action on the ground that results in changes in behaviour.

Putting the environment at the centre of decision making is a key challenge, given the competing demands placed on our environment by today's society. Ensuring that the environment is at the centre of decision making is not just a task for business and policymakers, it is also a choice for all consumers. The 2012 State of the Environment report outlined some of the challenges this poses and how even we, as individuals, can make changes that will have a collective impact, and thus position the environment at the centre of decision making.

The Strategic Environmental Assessment (SEA) process is a key tool for putting the environment at the heart of decision making by providing for protection of the environment and contributing to the integration of key environmental considerations in plan and programme making. Over the past 4 years, engagement by key sectors in the SEA process has increased significantly. The SEA process has developed further and is now an integral part of the decision-making process in relation to key national plans across a range of economic sectors (EPA, 2012b).

Four years on, there is still a need to increase efforts at all levels in environmental decision making and the need for a more integrated approach to environmental monitoring and protection. In the area of biodiversity, for example, we should develop better clarity in the roles and responsibilities of our government agencies with respect to biodiversity protection. A step towards this would be better co-ordination and integration of the relevant EU directives that protect biodiversity, water and the marine environments.

Key Action 6: Nature and Wild Places

Protect Pristine and Wild Places that Act as Biodiversity Hubs, Contribute to Health and Wellbeing, and Provide Tourism Opportunities

Valuing and Protecting our Natural Environment

We need to protect our remaining wild places and high-status water bodies as a safe place for wildlife and people.

There are very few places in Ireland that have not been impacted by human activity and our landscape reflects the shifting patterns of human activity over many centuries and millennia. We need to protect our remaining wild places and high-status water bodies from further deterioration so that they remain a safe place for wildlife and people, and as a legacy for future generations. Through ecological restoration and other conservation strategies, we can also restore damaged habitats to near-pristine condition. Conserving what we already have, and restoring habitats such as our damaged boglands, will help provide wild areas that protect biodiversity, contribute to the health and wellbeing and provide significant tourism opportunities. There are risks

to species and habitats from climate change but the need to develop climate adaption strategies, for example in dealing with flood risk, may also bring opportunities to develop amenities and wetlands and not just hard engineering solutions.

Valuing and protecting our natural environment was one of the four key challenges highlighted in the 2012 State of the Environment report. The current assessment is that habitat and biodiversity loss remain a risk and there is a need to develop initiatives to engage society and incorporate nature protection in decision making.

In relation to species and habitats in Ireland that are considered threatened across Europe and protected under the Habitats Directive, 52% of species are in favourable status but only 9% of habitats are in favourable status. One of the species of greatest concern is the pollution-sensitive freshwater pearl mussel. Red List species are those identified in most need of conservation interventions. Of 185 birds that breed and/or winter in Ireland, 37 were placed on the Red List and 90 on the Amber List, based on conservation status. The iconic Curlew is now one of these threatened breeding birds.

Ireland has lost most of its highest quality river sites in the last three decades, with only 21 sites now remaining. The loss of these sites (i.e. highest biological quality site) is not a legacy that we should be leaving for future generations. Lakes and estuaries are also still under threat from pollution with the latest preliminary water quality results showing a reduction in lake quality and no improvement overall in estuaries. Ireland is now at a stage where urgent and effective measures to control pressures on water quality from agricultural and waste water is needed if we are to protect and improve water quality. In the absence of such measures the remaining highest quality river sites could become extinct from the Irish landscape.

There is a need to bring biodiversity into the mainstream through Biodiversity Action Plans, robust biodiversity monitoring systems/mapping and new approaches such as the ecosystem approach/natural capital accounting, where appropriate, in the development of policies, plans and strategies. Efforts to increase public awareness of biodiversity could be strengthened as the appreciation of biodiversity and its link to everyday life is necessary if efforts to protect nature are to be successful. There are also wider biodiversity issues that need consideration, such as the need to protect bee populations, as reported on over the past few years in a number of strategies and plans (NBDC, 2015).

In Ireland some future challenges are emerging in relation to climate change, to add to the key pressures on species and habitats as outlined in Chapter 4. Increased land use change as the economy recovers may lead to further habitat loss and/or fragmentation through, for example, risks to wetlands. Initiatives such as Food Harvest 2020 and Food Wise 2025 will have to be monitored and analysed to a high level to ensure that these plans are implemented in an environmentally sustainable way. The impacts of climate change and the continuing threat of invasive species are areas that also need to be monitored and guarded against.

Key Action 7: Community Engagement

Inform, Engage and Support Communities in the Protection and Improvement of the Environment

Environmental Information – Evidence and Knowledge

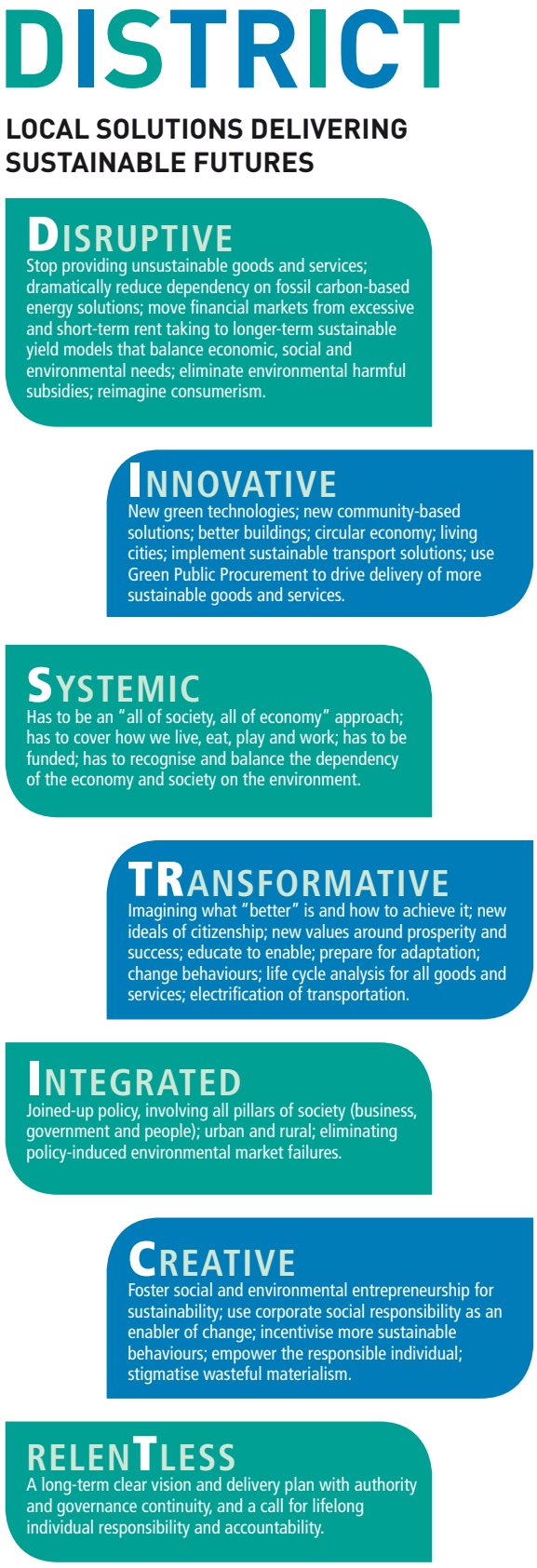
We need to continue to develop better provision of online, up-to-date and accessible information on the environment.

Information and evidence are key to making effective decisions that place the environment at the core of the decision-making process. A positive development in recent years has been the increase in the provision of information sources. Government, the EPA and the Central Statistics Office websites now provide user-friendly information for business and/or consumers. Examples include the EPA's Ireland Environment, Splash and BeGreen web resources, as well as co-delivered web resources (the EPA with local authorities, HSE, IFA) such as Live Green, Catchments.ie, Green Healthcare, Local Prevention and Smart Farming. There are also numerous NGO-delivered resources (many of which are supported by the EPA) including the Community Reuse Network (CRNI),[6] ECO-UNESCO[7] and An Taisce[8]. Operating in parallel with these information sources are EPA-funded public awareness activities such as Stop Food Waste and EcoEye.

In developing information sources, we should also be reminded of the recommendation from the EEA that "that public communication alone cannot bring about a society-wide transition as outlined in the EU's policy objectives of 'living well within the limits of our planet.' But by embracing recent innovations in communication technologies and insights from behaviour science, communications can complement other policy tools and rally support for environmental measures" (EEA, 2015a).

6 *www.crni.ie*
7 *www.ecounesco.ie*
8 *www.antaisce.ie*

Figure 13.5 DISTRICT - Local Solutions Delivering Sustainable Futures (Source: EPA)



Engaging Communities

Work and protection at a local level will contribute to the overall state of the environment in Ireland.

We need to get more involved locally and be informed about environmental issues. It is the work and protection at a local level that contributes significantly to the overall state of the environment in Ireland. To make progress on many of the environmental challenges we will need widespread public engagement and participation. We have many good examples to build on in Ireland, such as Tidy Towns, Pride of Place and Green Schools. We all own the environment and have a responsibility for its care and protection: after all, our health and wellbeing depend on it. At the core of this ambition is the need to engage the public in debating and defining behaviours and citizenship for a sustainable future. While our current model of citizenship is strongly rooted in our citizens and related to culture, there is room to expand our thinking into a more proactive approach to caring for our local environment, the preservation and quality of places we live in, and more joined up social responsibility.

There are encouraging signs that more local and community-based projects such as the Burren Life[9] and the Dunhallow Life Programmes[10] can act as template projects to maintain and improve biodiversity and river habitats water in sensitive farming areas. Similar programmes run by Eco-Unesco and An Taisce's Green Schools are successfully engaging our young people. The challenge here is to replicate these types of projects through policy support and incentives elsewhere across the country in order to multiply the benefits for the environment.

Final Remarks

Ireland's economy and economic policy are clearly making positive moves in relation to planning and have achieved some limited success in decarbonisation and resource efficiency; however, there is still considerable scope for improvement. The economic downturn evidently forced us to become more efficient as a nation: the challenge now is whether we can maintain that competitive advantage into the future. What is clear is that our economic prosperity is intimately dependent on the quality of, and services provided by, our environment. The 2014 EU Eurobarometer survey on environmental attitudes in the EU noted that 83% of Irish people surveyed believed that protection of the environment can boost economic growth.[11]

A future sustainable business model is not just one that merely stops providing unsustainable goods or services,

9 *www.burrenlife.com*

10 *www.duhallowlife.com*

11 *www.ec.europa.eu/public_opinion/archives/ebs/ebs_416_fact_ie_en.pdf*

but also one that requires economic entities to engage – for example through corporate social responsibility practices (including sustainability reporting) or similar business-led codes of conduct – with their environment and their communities in order to protect and nurture the interdependencies and in so doing will ensure enduring competitiveness and growth. Government departments have significant responsibility too: to plan for, design and integrate social, educational and infrastructural systems that support our ambition to become a carbon-neutral, climate-resilient and sustainably competitive society. Our economic and social development principles and practice must move to an operational norm of "beyond compliance" involving systemic eco-innovation.

We are now at a stage that requires governance, corporate and citizenry solutions and interventions that are:

Disruptive, **I**nnovative, **S**ystemic, **Tr**ansformative, **I**ntegrated, **C**reative and Relen**t**less

So, what is stopping us in adopting DISTRICT solutions? A mixture of risk aversion, economic lock-in, individualisation, short-term planning, fear of change, policy conflict, etc., but most of all perhaps an absence of the necessary commitment and integrated long-term bigger picture planning needed to drive the scale and nature of the transformational change required. We need brave, well informed, determined, committed and enduring leadership within our homes, our businesses, our communities, and most especially in our governance structures. After all, our future is everyone's responsibility.

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Acronyms/Abbreviations

ABP	animal by-products
ACP	Agriculture Catchments Programme
AD	anaerobic digestion
ADHD	attention deficit hyperactivity disorder
AMR	antimicrobial resistance
AWB	artificial water body
BaP	benzo(a)pyrene
BER	Building Energy Ratings
BIM	Bord Iascaigh Mhara
BMW	biodegradable municipal waste
BNM	Bord na Móna
BoCCI	Bird of Conservation Concern in Ireland
BOD	biochemical oxygen demand
CAFE	Clean Air for Europe (EU Directive)
CAP	Common Agricultural Policy
C&D	construction and demolition
CBD	Convention on Biological Diversity
CCRP	Climate Change Research Programme
CEC	Council of the European Communities
CEFRAM	Catchment-based Flood Risk Assessment and Management
CER	Commission for Energy Regulation
CEU	Council of the European Union
CFC	chlorofluorocarbon
CFP	Common Fisheries Policy
CH_4	methane
CHP	Combined Heat and Power
CLRTAP	Convention on Long-Range Transboundary Air Pollution
CNG	Compressed Natural Gas
CO	carbon monoxide
CO_2	carbon dioxide
CO_2eq	carbon dioxide equivalent
COP21	Climate Change meeting in Paris
CORINE	Coordination of Information on the Environment
CSA	Critical Source Areas
CSO	Central Statistics Office
Cu	copper
DAFF	Department of Agriculture, Fisheries and Food
DAFM	Department of Agriculture, Food and the Marine
DAHG	Department of Arts, Heritage and the Gaeltacht
DCCAE	Department of Communications, Climate Action and Environment
DCENR	Department of Communications, Energy and Natural Resources
DDT	dichlorodiphenyltrichloroethane
DECLG	Department of the Environment, Community and Local Government
DETI	Department of Enterprise, Trade and Innovation
DHPCLG	Department of Housing, Planning, Community & Local Government
DJEI	Department of Jobs, Enterprise and Innovation
DMC	domestic material consumption
DO	dissolved oxygen
DOH	Department of Health
DOT	Department of Transport
DPER	Department of Public Expenditure and Reform
DPSIR	Driving forces; pressures; states; impacts; responses
DTTAS	Department of Transport, Tourism and Sport
DWWTS	Domestic Waste Water Treatment Systems
EAP	Environmental Action Programme
EC	European Commission
ECJ	European Court of Justice
EEA	European Environment Agency
EIA	Environmental Impact Assessment
ELC	European Landscape Convention
ELD	Environmental Liabilities Directive
ELV	end-of-life vehicle
EP	European Parliament
EPA	Environmental Protection Agency
EPI	Economic Policy Instrument
EPR	Extended Producer Responsibility
eq	equivalent

ESRI	Economic and Social Research Institute
ETS	Emissions Trading Scheme
EU	European Union
EV	Electric Vehicle
FDI	foreign direct investment
GAP	Good Agricultural Practice
GDP	Gross Domestic Product
GES	Good Environmental Status
GHG	greenhouse gas
GLAS	Green, Low-carbon, Agri-environment Scheme
GMO	Genetically modified organism
GNP	Gross National Product
GPP	Green Public Procurement
GSI	Geological Survey of Ireland
GVA	Gross Value Added
H_2SO_4	sulphuric acid
HFC	Hydrofluorocarbons
HGV	Heavy Good Vehicles
HNV	High Nature Value
HSE	Health Services Executive
IAS	invasive alien species
IBAL	Irish Business Against Litter
ICES	International Council for the Exploration of the Sea
ICCT	International Council and Clean Transportation
ICMSA	Irish Creamery Milk Supplier Association
ICT	information and communications technology
IEC	Industrial Emissions Directive
IFA	Irish Farmers Association
IFNC	Irish Forum on Natural Capital
IPCC	Intergovernmental Panel on Climate Change
IPPC	Integrated Pollution Prevention and Control
ITS	Intelligent Transport System
IUCN	International Union for the Conservation of Nature
JRC	Directorate General Joint Research Centre, European Commission
kt	kilotonne
ktoe	tonnes of oil equivalent
$kWh/m^2/yr$	kilowatt hours per metre square per year
LAWCO	Local Authority Water & Community Office
LIEN	Large Industry Energy Network
LLAES	Locally led Agri-environment Schemes
LNG	Liquified natural gas
LULC	Land use and land cover
MAES	Mapping and Assessment of Ecosystem Services
MBM	Meat and bone meal
MCPA	4-(2 methyl-4-chlorophenoxy) acetic acid - Post emergence herbicide
MS	Member State
MSW	municipal solid waste
MSFD	Marine Strategy Framework Directive
Mt	million tonnes
NACE	European Classification of Economic Activities
NAP	Nitrate Action Programme
NBDC	National Biodiversity Data Centre
NCA	natural capital accounting
NEEAC	National Energy Efficiency Action Plan
NEAR	Nature and Environment to Attain and Restore Health
NEC	National Emissions Ceiling (EU Directive)
NERT	National Exposure Reduction Target
NESC	National Economic and Social Council
NF_3	nitrogen trifluoride
ng/m^3	nanograms per cubic metre
NGO	non-governmental organisation
NGV	Natural Gas Vehicles
NH_3	ammonia
NHA	Natural Heritage Area
NHWMP	National Hazardous Waste Management Plan
Ni	nickel
NIEA	Northern Ireland Environment Agency
NLS	National Landscape Strategy
NMVOC	non-methane volatile organic compound
N_2O	nitrous oxide
NO	nitric oxide
NO_2	nitrogen dioxide
NO_3	nitrate
NO_x	nitrogen oxides
NPWS	National Parks and Wildlife Service
NRA	National Roads Authority

NREAP	National Renewable Energy Action Plan
NSDB	National Soil Database
NTA	National Transport Authority
NTFSO	National TransFrontier Shipments Office
NWCPO	National Waste Collection Permit Office (Offaly County Council)
NWS	Native Woodland Scheme
NWPP	National Waste Prevention Programme
O_3	ozone
ODS	ozone depleting substance
OECD	Organisation for Economic Co-operation and Development
OEE	Office of Environmental Enforcement (EPA)
OPW	Office of Public Works
OREDP	Offshore Renewable Energy Development Plan
OSi	Ordnance Survey Ireland
P	phosphorus
PAF	Prioritised Action Framework for Natura 2000
PAH	polycyclic aromatic hydrocarbon
PBTS	persistent, bioaccumulative and toxic substances
PCB	polychlorinated biphenyl
PEAS	priority environmental assets
PFC	Perflurocarbons
pkm	passenger kilometres
PM	particulate matter
pNHA	proposed Natural Heritage Area
POP	persistent organic pollutant
PPCP	pharmaceutical and personal care product
ppm	parts per million
PPNs	Public Participation Networks
PPs	plans and programmes
PRI	Producer Responsibility Initiative
PRP	Pollution Reduction Programme
PSO	Public Service Obligation
PV	photovoltaic
RAL	Remedial Action List
RBD	River Basic District
RBMP	River Basin Management Plan
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals (EU Directive)
Reg.	Regulation
REPS	Rural Environment Protection Scheme
RES-E	renewable energy in electricity generation
RES-H	renewable energy in heat
RES-T	renewable energy in transport
RPII	Radiological Protection Institute of Ireland
RSPB NI	Royal Society for the Protection of Birds (Northern Ireland)
SAC	Special Area of Conservation
SEA	Strategic Environmental Assessment
SEAI	Sustainable Energy Authority of Ireland
SF_6	sulphur hexafluoride
SFPA	Sea Fisheries Protection Authority
S.I.	Statutory Instrument
SO_2	sulphur dioxide
SPA	Special Protection Area
STRIVE	Science, Technology, Research and Innovation for the Environment
SWAN	Sustainable Water Network
t	tonne
TEA	Tipperary Energy Agency
TEEB	The Economics of Ecosystems and Biodiversity
THM	trihalomethane
UN	United Nations
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
VOC	volatile organic compound
VTEC	verotoxigenic *E. coli*
VRT	Vehicle Registration Tax
WEEE	Waste Electrical and Electronic Equipment
WEI	water exploitation index
WERLA	Waste Enforcement Regional Lead Authorities
WFD	Water Framework Directive
WHO	World Health Organisation
WSIP	Water Services Investment Programme
WWTP	waste water treatment plant
µg/l	micrograms per litre
µg/m_3	micrograms per cubic metre
µm	micrometre

An Ghníomhaireacht um Chaomhnú Comhshaoil

Tá an Ghníomhaireacht um Chaomhnú Comhshaoil (GCC) freagrach as an gcomhshaol a chaomhnú agus a fheabhsú mar shócmhainn luachmhar do mhuintir na hÉireann. Táimid tiomanta do dhaoine agus don chomhshaol a chosaint ó éifeachtaí díobhálacha na radaíochta agus an truaillithe.

Is féidir obair na Gníomhaireachta a roinnt ina trí phríomhréimse:

Rialú: *Déanaimid córais éifeachtacha rialaithe agus comhlíonta comhshaoil a chur i bhfeidhm chun torthaí maithe comhshaoil a sholáthar agus chun díriú orthu siúd nach gcloíonn leis na córais sin.*

Eolas: *Soláthraímid sonraí, faisnéis agus measúnú comhshaoil atá ar ardchaighdeán, spriocdhírithe agus tráthúil chun bonn eolais a chur faoin gcinnteoireacht ar gach leibhéal.*

Tacaíocht: *Bímid ag saothrú i gcomhar le grúpaí eile chun tacú le comhshaol atá glan, táirgiúil agus cosanta go maith, agus le hiompar a chuirfidh le comhshaol inbhuanaithe.*

ÁR bhFREAGRACHTAÍ

CEADÚNÚ

Déanaimid na gníomhaíochtaí seo a leanas a rialú ionas nach ndéanann siad dochar do shláinte an phobail ná don chomhshaol:

- saoráidí dramhaíola *(m.sh. láithreáin líonta talún, loisceoirí, stáisiúin aistrithe dramhaíola)*;
- gníomhaíochtaí tionsclaíocha ar scála mór *(m.sh. déantúsaíocht cógaisíochta, déantúsaíocht stroighne, stáisiúin chumhachta)*;
- an diantalmhaíocht *(m.sh. muca, éanlaith)*;
- úsáid shrianta agus scaoileadh rialaithe Orgánach Géinmhodhnaithe *(OGM)*;
- foinsí radaíochta ianúcháin *(m.sh. trealamh x-gha agus radaiteiripe, foinsí tionsclaíocha)*;
- áiseanna móra stórála peitril;
- scardadh dramhuisce;
- gníomhaíochtaí dumpála ar farraige.

FORFHEIDHMIÚ NÁISIÚNTA I LEITH CÚRSAÍ COMHSHAOIL

- Clár náisiúnta iniúchtaí agus cigireachtaí a dhéanamh gach bliain ar shaoráidí a bhfuil ceadúnas ón nGníomhaireacht acu.
- Maoirseacht a dhéanamh ar fhreagrachtaí cosanta comhshaoil na n-údarás áitiúil.
- Caighdeán an uisce óil, arna sholáthar ag soláthraithe uisce phoiblí, a mhaoirsiú.
- Obair le húdaráis áitiúla agus le gníomhaireachtaí eile chun dul i ngleic le coireanna comhshaoil trí chomhordú a dhéanamh ar líonra forfheidhmiúcháin náisiúnta, trí dhíriú ar chiontóirí, agus trí mhaoirsiú a dhéanamh ar leasúchán.
- Cur i bhfeidhm rialachán ar nós na Rialachán um Dhramhthrealamh Leictreach agus Leictreonach (DTLL), um Shrian ar Shubstaintí Guaiseacha agus na Rialachán um rialú ar shubstaintí a ídíonn an ciseal ózóin.
- An dlí a chur orthu siúd a bhriseann dlí an chomhshaoil agus a dhéanann dochar don chomhshaol.

BAINISTÍOCHT UISCE

- Monatóireacht agus tuairisciú a dhéanamh ar cháilíocht aibhneacha, lochanna, uiscí idirchriosacha agus cósta na hÉireann, agus screamhuiscí; leibhéil uisce agus sruthanna aibhneacha a thomhas.
- Comhordú náisiúnta agus maoirsiú a dhéanamh ar an gCreat-Treoir Uisce.
- Monatóireacht agus tuairisciú a dhéanamh ar Cháilíocht an Uisce Snámha.

MONATÓIREACHT, ANAILÍS AGUS TUAIRISCIÚ AR AN GCOMHSHAOL

- Monatóireacht a dhéanamh ar cháilíocht an aeir agus Treoir an AE maidir le hAer Glan don Eoraip (CAFÉ) a chur chun feidhme.
- Tuairisciú neamhspleách le cabhrú le cinnteoireacht an rialtais náisiúnta agus na n-údarás áitiúil *(m.sh. tuairisciú tréimhsiúil ar staid Chomhshaol na hÉireann agus Tuarascálacha ar Tháscairí)*.

RIALÚ ASTAÍOCHTAÍ NA nGÁS CEAPTHA TEASA IN ÉIRINN

- Fardail agus réamh-mheastacháin na hÉireann maidir le gáis cheaptha teasa a ullmhú.
- An Treoir maidir le Trádáil Astaíochtaí a chur chun feidhme i gcomhair breis agus 100 de na táirgeoirí dé-ocsaíde carbóin is mó in Éirinn.

TAIGHDE AGUS FORBAIRT COMHSHAOIL

- Taighde comhshaoil a chistiú chun brúnna a shainaithint, bonn eolais a chur faoi bheartais, agus réitigh a sholáthar i réimsí na haeráide, an uisce agus na hinbhuanaitheachta.

MEASÚNACHT STRAITÉISEACH TIMPEALLACHTA

- Measúnacht a dhéanamh ar thionchar pleananna agus clár beartaithe ar an gcomhshaol in Éirinn *(m.sh. mórphleananna forbartha)*.

COSAINT RAIDEOLAÍOCH

- Monatóireacht a dhéanamh ar leibhéil radaíochta, measúnacht a dhéanamh ar nochtadh mhuintir na hÉireann don radaíocht ianúcháin.
- 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 cosanta ar an radaíocht a sholáthar, nó maoirsiú a dhéanamh ar sholáthar na seirbhísí sin.

TREOIR, FAISNÉIS INROCHTANA AGUS OIDEACHAS

- Comhairle agus treoir a chur ar fáil d'earnáil na tionsclaíochta agus don phobal maidir le hábhair a bhaineann le caomhnú an chomhshaoil agus leis an gcosaint raideolaíoch.
- Faisnéis thráthúil ar an gcomhshaol ar a bhfuil fáil éasca a chur ar fáil chun rannpháirtíocht an phobail a spreagadh sa chinnteoireacht i ndáil leis an gcomhshaol *(m.sh. Timpeall an Tí, léarscáileanna radóin)*.
- Comhairle a chur ar fáil don Rialtas maidir le hábhair a bhaineann leis an tsábháilteacht raideolaíoch agus le cúrsaí práinnfhreagartha.
- Plean Náisiúnta Bainistíochta Dramhaíola Guaisí a fhorbairt chun dramhaíl ghuaiseach a chosc agus a bhainistiú.

MÚSCAILT FEASACHTA AGUS ATHRÚ IOMPRAÍOCHTA

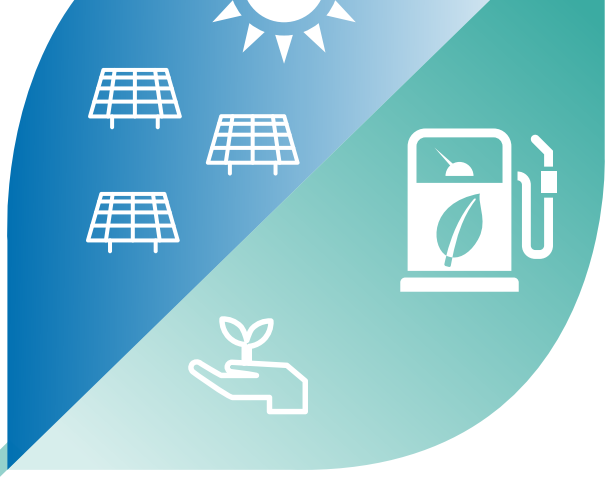
- Feasacht chomhshaoil níos fearr a ghiniúint agus dul i bhfeidhm ar athrú iompraíochta dearfach trí thacú le gnóthais, le pobail agus le teaghlaigh a bheith níos éifeachtúla ar acmhainní.
- Tástáil le haghaidh radóin a chur chun cinn i dtithe agus in ionaid oibre, agus gníomhartha leasúcháin a spreagadh nuair is gá.

BAINISTÍOCHT AGUS STRUCHTÚR NA GNÍOMHAIREACHTA UM CHAOMHNÚ COMHSHAOIL

Tá an ghníomhaíocht á bainistiú ag Bord lánaimseartha, ar a bhfuil Ard-Stiúrthóir agus cúigear Stiúrthóirí. Déantar an obair ar fud cúig cinn d'Oifigí:

- An Oifig um Inmharthanacht Comhshaoil
- An Oifig Forfheidhmithe i leith cúrsaí Comhshaoil
- An Oifig um Fianaise is Measúnú
- An Oifig um Cosaint Raideolaíoch
- An Oifig Cumarsáide agus Seirbhísí Corparáideacha

Tá Coiste Comhairleach ag an nGníomhaireacht le cabhrú léi. Tá dáréag comhaltaí air agus tagann siad le chéile go rialta le plé a dhéanamh ar ábhair imní agus le comhairle a chur ar an mBord.



ENVIRONMENTAL PROTECTION AGENCY

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