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Climate Resilient Ireland

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Rialtas na hÉireann
Government of Ireland

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.

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- 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 (CAFÉ) 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)*.

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- Preparing Ireland's greenhouse gas inventories and projections.
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- Funding environmental research to identify pressures, inform policy and provide solutions in the areas of climate, water and sustainability.

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

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- 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 Radiation Protection and Environmental Monitoring
- 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.

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Climate Resilient Ireland

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EPA Research Report

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DISCLAIMER

The EPA Research Programme addresses the need for research in Ireland to inform policymakers and other stakeholders on a range of questions in relation to environmental protection. These reports are intended as contributions to the necessary debate on the protection of the environment.

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Executive Summary

The Climate Action and Low Carbon Development Act 2015 is the first climate change law in Ireland. The Act sets out a National Transition Objective with the goal of achieving a "low carbon, climate resilient and environmentally sustainable economy by the end of the year 2050". The achievement of this goal is to be guided by a National Mitigation Plan and a National Adaptation Framework. While the terms mitigation and adaptation are defined in Article 1 of the Act, the terms "low carbon" and "climate resilient" are not defined. This study sets out to provide an understanding of the term "climate resilient Ireland", drawing on national and international science, policy and practice.

The National Climate Change Advisory Council will review progress towards the National Transition Objective on an annual and periodic basis. A common understanding of what constitutes a climate resilient Ireland will therefore be needed to assist the Council in its deliberations.

This report proposes that a climate resilient Ireland can be understood as follows:

> A climate resilient Ireland is on a pathway to sustainable development. That is, climate resilient pathways are being actively pursued that reduce climate change and its impacts, manage risk, and promote sustainable development. This includes a coherent approach to adaptation and mitigation with effective institutions, governance, adequate resources, legal and regulatory frameworks, regular vulnerability assessments, climate action planning (national, sectoral and local level), access to information and strengthened adaptive capacity in place.

Climate resilient pathways encompass economic, social and environmental resilience. As a result, a 2050 vision for a sustainable Ireland should be developed, which articulates economic, social and environmental goals and engages all shareholders in the action needed to achieve a prosperous, safe, sustainable and equitable Ireland for present and future generations. Indicators will need to be developed as part of this process to allow progress towards the goals to be measured and tracked. Ongoing work on adaptation indicators will inform this work, as will efforts to develop national indicators for the Sustainable Development Goals, as mandated by the 2030 Agenda. Likewise, working back from 2050, shorter term plans will be needed to achieve the vision and these will not be confined to adaptation and mitigation plans; instead they require a comprehensive and far-reaching refresh of national policymaking.

This report finds that a narrow focus on climate change adaptation will not be adequate to deliver a climate resilient Ireland. Instead, a more transformative approach to short-, medium- and long-term decision making focused on all aspects of sustainability will be required.

The Climate Change Advisory Council's first report reiterates the transformations needed to achieve the low-emission, climate resilient future that is essential for climate security and prosperity. As a result, the climate resilient pathways that Ireland pursues should be informed by the following eight factors:

1. making all development sustainable development;
2. coherence;
3. transformation;
4. urgency;
5. making every investment count;
6. capturing the co-benefits;
7. learning by doing;
8. fairness.

The reports highlights areas where further work is needed to strengthen adaptive capacity. These include a comprehensive national vulnerability assessment; a national climate risk assessment; a costing of adaption actions; an inventory of adaptation actions; a national prioritisation process; continued strengthening of capacity at the sectoral and local levels for adaptation planning; designating a lead organisation for data gathering, analysis and dissemination; and the

full deployment of “Climate Ireland” (https://www.climateireland.ie/).

Ireland is at the beginning of the transition to a low-carbon, climate resilient society. It has many of the elements in place needed to drive this transition and transform the economy and society. While the transition needs to be carefully managed to be fair and effective, the opportunities it provides will be innumerable if the co-benefits are captured and a common vision mobilises support from all quarters of Irish society.

1 Concepts and Approaches – Climate Resilient Ireland

The Climate Action and Low Carbon Development Act 2015 (Government of Ireland, 2015) is the first climate change law in Ireland. The Act sets out a National Transition Objective with the goal of achieving a "low carbon, climate resilient and environmentally sustainable economy by the end of the year 2050". The achievement of this goal is to be guided by a National Mitigation Plan and a National Adaptation Framework. While the terms mitigation and adaptation are defined in Article 1 of the Act, the terms "low carbon" and "climate resilient" are not defined. This study sets out to provide an understanding of the term "climate resilient Ireland", drawing on national and international science, policy and practice.

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1.1 Ireland

The National Climate Change Adaptation Framework (DECLG, 2012) is subtitled "Building Resilience to Climate Change" and therefore acknowledges that adaptation actions both reduce vulnerability and increase resilience to the impacts of climate change. In the glossary, resilience is defined as "a capability to anticipate, prepare for, respond to, and recover from significant multi-hazard threats with minimum damage to social wellbeing, the economy, and the environment". This definition is also used by the US Environmental Protection Agency and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Australia.

The Framework defines adaptation as "the adjustment or preparation of natural or human systems to a new or changing environment, with the aim of moderating harm or exploiting beneficial opportunities". This is based on the definition of climate change adaptation by the Intergovernmental Panel on Climate Change (IPCC, 2007a). The Framework also notes that climate change adaptation comprises all spontaneous responses and planned action taken to cope with the impacts of changing climate conditions. The framework highlights that adaptation is needed to tackle current climate variability and to anticipate possible future changes, with the aim of cost-effectively reducing risk and damage and exploiting any potential benefits.

Importantly, the National Climate Change Adaptation Framework also recognises the link between adaptation and mitigation. Mitigation ultimately reduces greenhouse gas emissions and thereby reduces climate risk. Thus, more mitigation means less adaptation and ensures that adaptation is feasible for both human and natural systems. However, it is accepted that, even if the world succeeds in limiting and then reducing greenhouse gas emissions, the climate system will continue to respond to the atmospheric build-up of greenhouse gases over past decades, so adaptation is inevitable. Hence, planning for the short- and longer term impacts of climate change is not only good practice but also a wise strategy.

In the section of the Framework on local adaptation plans, it is noted that adaptation strategies need to develop and express a vision for a well-adapted local community that is resilient to the impacts of climate change. In this way adaptation is established as a strategy to build resilience in the face of climate change.

The National Policy Position on Climate Action and Low Carbon Development (DCCAE, 2012) describes the National Low-carbon Roadmap and the National Climate Change Adaptation Framework as "the means through which the government will develop and progress, mitigation and adaptation policy in order to enable the State to pursue and achieve transition to a low-carbon, climate resilient and environmentally sustainable economy in the period to 2050". The policy position describes low-carbon development as being 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

- an approach to carbon neutrality in the agriculture and land use sector, including forestry, which does not compromise capacity for sustainable food production.

No equivalent description is given of the climate resilient or environmentally sustainable economy components of the transition. However, in that document, as with the Act (Government of Ireland, 2015), the assumption seems to be that climate resilience relates primarily to the adaptation to and reduction of climate risk.

1.2 Europe

At the European Union (EU) level, the overall aim of the EU Adaptation Strategy (EC, 2013a) is to contribute to a more climate resilient Europe. This means enhancing the preparedness and capacity to respond to the impacts of climate change at local, regional, national and EU levels; developing a coherent approach; and improving co-ordination (EC, 2013a). The Strategy states that "In line with the Europe 2020 Strategy, the Adaptation Strategy will help the EU move towards a low-carbon and climate resilient economy, and will promote sustainable growth, stimulate climate resilient investment and create new jobs" (EC, 2013a, p. 5). Actions 7 and 8 of the Strategy relate directly to resilience – focusing on resilient infrastructure and resilient finance.

The guidelines (EC, 2013b) that accompany the EU Adaptation Strategy define resilience as "the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organisation, and the capacity to adapt to stress and change". This is based on the IPCC definition of resilience as set out in the Fourth Assessment Report in 2007 (IPCC, 2007b).

The EU Adaptation strategy has three objectives: (1) promoting action by Member States; (2) "climate-proofing" action at the EU level; and (3) promoting better informed decision making. The action on the climate-proofing objective makes specific reference to resilient infrastructure and this is expanded on further in the accompanying document (EC, 2013c). The guidance for Member States emphasises that owing to the long lifespan of many buildings and other infrastructure, and their great economic value, their preparedness and resilience to future impacts of climate change are critical. The report emphasises that adaptation matters when constructing new infrastructure and when adapting existing infrastructure. In the case of new infrastructure, climate resilience can be ensured by locating, designing and operating an asset with the current and future climate in mind. This is important, given the extended lifespan of at least 20 years of large infrastructure, so that investment decisions present value for money in the long term. In addition, existing infrastructure can be made more climate resilient by retrofitting and/or ensuring that maintenance regimes incorporate resilience to the impacts of climate change over an asset's lifetime. The Commission working document provides guidance to Member States and the private sector on how to address these aspects of climate resilience to inform more sustainable investments.

The Dutch *Climate Agenda: Resilient, Prosperous and Green* (Ministry of Infrastructure and the Environment, 2013) outlines an approach focused on a combined approach to climate adaptation (by designing a resilient physical environment and preparing society for the consequences of climate change) and mitigation (by reducing greenhouse gas emissions). Here, as in the Irish setting, resilience is a result of climate change action – the culmination of actions on adaptation and mitigation.

1.3 International

At the international level the approach to resilience is largely informed by the work of the IPCC. The report of Working Group II of the Fifth Assessment Report (IPCC, 2014a) presents the most recent thinking on climate resilience, drawing on research and practice from around the world.

As already noted, the IPCC defined resilience in 2007 in the Fourth Assessment Report (IPCC, 2007a).

IPCC definition

> Resilience is the ability of a system to return to a pre-disturbed state without incurring any lasting fundamental change. Resilient resource systems recover to some normal range of operation after a perturbation.

However, the Fifth Assessment Report (IPCC, 2014a) goes further to unpack the concept of resilience.

Chapter 20 of the Working Group II report is titled "Climate-resilient pathways: adaptation, mitigation, and sustainable development" (IPCC, 2014b) and presents climate resilience as a pathway to achieving sustainable development. It describes climate resilient pathways as strategies, choices and actions that reduce climate change and its impacts. It also includes actions to ensure that effective risk management and adaptation are implemented and sustainable.

Importantly, this approach to resilience recognises the links between adaptation and mitigation. This approach is informative in the Irish context, as it demonstrates that climate resilient pathways depend on progress on mitigation. In fact, adaptation actions implemented in isolation will have a more limited impact than those that are shaped with mitigation and sustainable development in mind. In addition, there are limits to adaptation if mitigation is insufficient and this in turn reduces the options for climate resilient pathways. The links with sustainable development are also important in the Irish context; the 2015 Act (Government of Ireland, 2015) includes in the National Transition Objective the goal of an environmentally sustainable economy. The IPCC notes that transformations are needed to promote sustainable development pathways in the context of climate change and that these transformations will be political, economic and socio-technical. The IPCC also notes that there will be ethical and equity aspects of these transformations, meaning that options chosen will have to consider risks and trade-offs, including how best to achieve fairness and to protect human rights.

This approach to resilience goes beyond natural systems to include social and economic systems. It also recognises that human and socio-ecological systems can build resilience through adaptation, mitigation and sustainable development. *The timing of the transformation is critical.* While delayed action will reduce the options for climate resilient development in the future, strategies and actions can be pursued now that will move towards climate resilient pathways while simultaneously improving livelihoods, social and economic wellbeing, and promoting responsible environmental management. Capturing these win–win options is a real opportunity for climate and sustainable development policy in Ireland. This will be explored further in Chapter 4.

Figure 1.1, from the report of Working Group II of the IPCC Fifth Assessment (IPCC, 2014a), illustrates climate resilient pathways. In (a), our world is threatened by multiple stressors that affect resilience, including climate change, climate variability, land use change, degradation of ecosystems, poverty and inequality, and cultural factors. Panel (b) depicts the opportunity space and includes the decision points and pathways that lead to a range of possible futures (c) with differing levels of resilience and risk. The decision points (d) result in actions or failures to act throughout the opportunity space, and together they constitute the process of managing or failing to manage risks related to climate change. This leads to (e) climate resilient pathways (in green) that lead to a more resilient world through adaptive learning, increasing scientific knowledge, effective adaptation and mitigation measures, and other choices that reduce risks. The pathways that lower resilience are in red (f) and involve insufficient mitigation, maladaptation, failure to learn and use knowledge, and other actions that lower resilience. These low-resilience pathways can be irreversible in terms of possible futures.

Climate resilient pathways are development trajectories that combine adaptation and mitigation to realise the goal of sustainable development.

Finally, it is important to stress the links between sustainable development and climate resilience. Sustainable development was defined by the World Commission on Environment and Development (Brundtland Commission) in 1987. Sustainable development is "development which meets the needs of current generations without compromising the ability of future generations to meet their own needs" (World Commission on Environment Development, 1987). This approach to sustainable development was the basis for the Rio Declaration (UN, 1992), which led to the creation of the United Nations (UN) Framework Convention on Climate Change (UNFCCC). Most recently, "Transforming our world: the 2030 Agenda for Sustainable Development", adopted in 2015, and containing 17 Sustainable Development Goals (SDGs), makes clear the links between climate change and sustainable development (UN, 2015a). The report acknowledges that climate change is one of the greatest challenges of our time and that its adverse impacts undermine the ability of all countries to achieve sustainable development. Goal 13

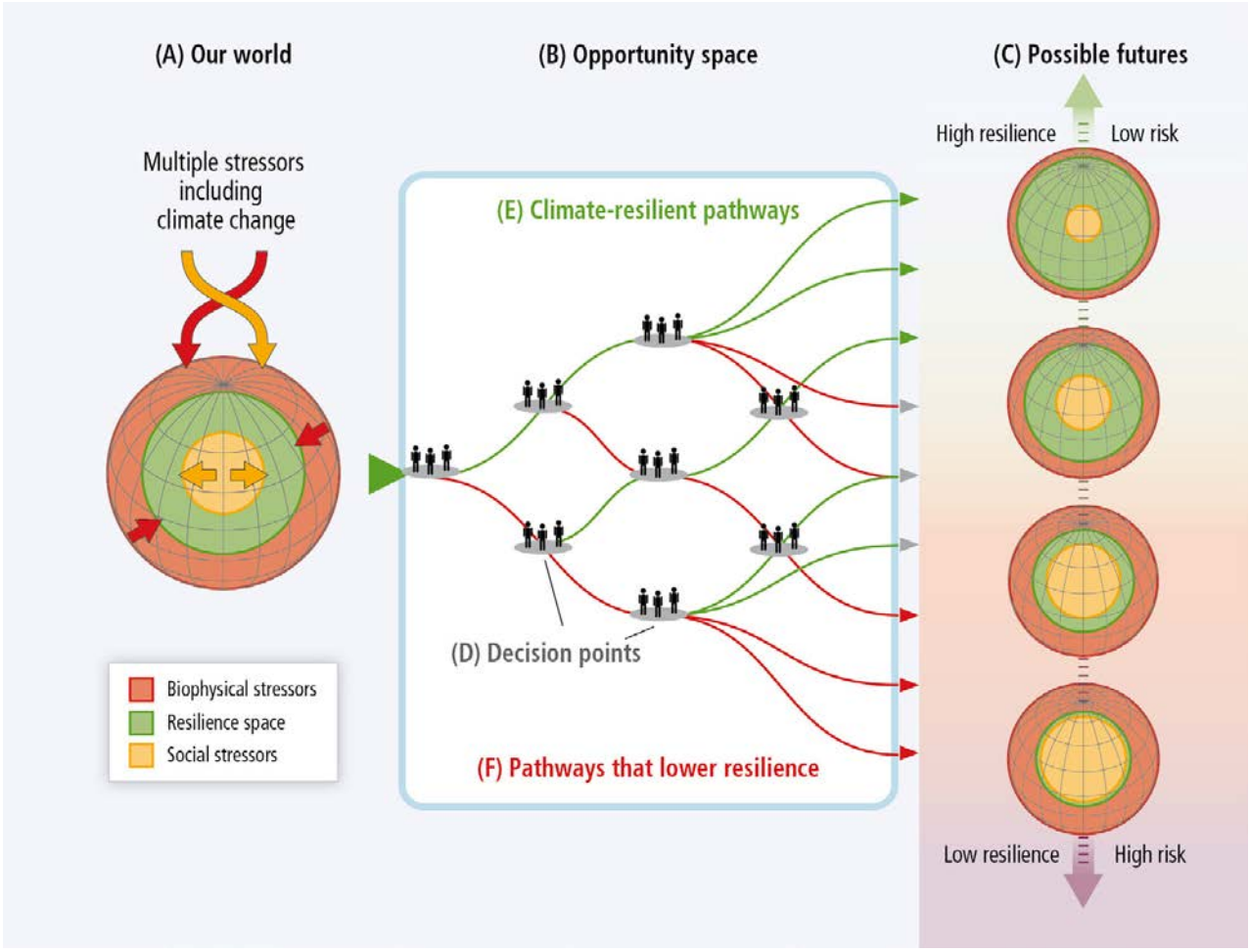

Figure 1.1. Opportunity space and climate-resilient pathways. (a) Our world is threatened by multiple stressors that impinge on resilience from many directions, represented here simply as biophysical and social stressors. Stressors include climate change, climate variability, land-use change, degradation of ecosystems, poverty and inequality, and cultural factors. (b) Opportunity space refers to decision points and pathways that lead to a range of (c) possible futures with differing levels of resilience and risk. (d) Decision points result in actions or failures-to-act throughout the opportunity space, and together they constitute the process of managing or failing to manage risks related to climate change. (e) Climate-resilient pathways (in green) within the opportunity space lead to a more resilient world through adaptive learning, increasing scientific knowledge, effective adaptation and mitigation measures, and other choices that reduce risks. (f) Pathways that lower resilience (in red) can involve insufficient mitigation, maladaptation, failure to learn and use knowledge, and other actions that lower resilience; and they can be irreversible in terms of possible futures. Reproduced from IPCC, 2014a, Fifth Assessment Report, Working Group II, Chapter 1, p. 182, Figure 1.5. © Intergovernmental Panel on Climate Change, 2014.

addresses climate action specifically and the approach to the SDGs as a whole is to emphasise their integrated nature with progress on one goal affecting progress on the others.

The relationship between climate action and sustainable development is also given significant attention in the Fifth Assessment Report of the IPCC. In Chapter 4 of the report of Working Group III (IPCC, 2014c), the sustainable development and equity aspects of climate change mitigation are explored. The chapter states that sustainable development "is intimately connected to climate change". The IPCC recognises that "the climate threat constrains possible development paths, and sufficiently disruptive climate change could preclude any prospect for a sustainable future", therefore "a stable climate is one component of Sustainable Development". The report

also finds that mitigation and adaptation measures can strongly affect broader sustainable development and equity objectives, so understanding the relationships between the various policy areas is critical to the design of effective policies (IPCC, 2014c).

As outlined in the section related to the report of Working Group II, above, the links and synergies between adaptation and mitigation and sustainable development underpin the pathways to climate resilience (IPCC, 2014b). In addition, the work of Working Group II on disaster risk (IPCC, 2014d) presents evidence that indicates that disaster risk management and adaptation policy can be integrated, reinforcing and supportive if well-co-ordinated. The Working Group also find that "including disaster risk management in resilient and sustainable development pathways is facilitated through integrated, systemic approaches that enhance capacity to cope with, adapt to, and shape unfolding processes of change, while taking into consideration multiple stressors, different prioritized values, and competing policy goals".

The IPCC concludes that the interactions between climate change mitigation and adaptation and disaster risk management will have a major influence on resilient and sustainable pathways, with local actions having global consequences. The challenge for Ireland is to ensure that these synergies inform the implementation of the Climate Act so as to maximise the short-term benefits in terms of socio-economic development and the longer term benefits in terms of reduced vulnerability. Ultimately, the choices Ireland makes today can reduce or exacerbate climate vulnerability. There are many approaches and pathways to a sustainable and resilient future – the challenge is to consider the risks and trade-offs of policy options and the opportunity is to capture the synergies in order to maximise opportunities for present and future generations.

2 The International Policy Context

The international policy context for climate resilience is informed by the Paris Agreement adopted in December 2015.

The Agreement entered into force on 4 November 2016 and the first Conference serving as the Meeting of the Parties to the Agreement (CMA1) took place during the United Nations Climate Change Conference (COP22) in Morocco (WRI, 2016).[1] Ireland ratified the Agreement on 4 November 2016 and is legally bound to fulfil the commitments made in Paris. The EU as a whole ratified the Agreement on 5 October 2016.

The Paris Agreement (UN, 2015b) has three linked objectives, set out in Article 2, which aim to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty:

(a) holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognising that this would significantly reduce the risks and impacts of climate change;

(b) increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production; and

(c) making finance flows consistent with a pathway towards low greenhouse gas emissions and climate resilient development.

The second objective aims to foster climate resilience and sees a role for both adaptation and mitigation in achieving this goal. The three objectives are interlinked and this is recognised in subsequent articles. For example, in Article 7.4, Parties recognise that the current need for adaptation is significant and that greater levels of mitigation can reduce the need for additional adaptation efforts, and that greater adaptation needs can involve greater adaptation costs.

The Paris Agreement places adaptation and mitigation on an equal footing for the first time in an international agreement. Article 7.1 establishes an 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 temperature goal referred to in Article 2". This goal recognises the links to mitigation and sustainable development, signalling a move away from the sectoral approach to adaptation, mitigation and sustainable development that has dominated to date (Larsen *et al*., 2012). It also recognises that progress towards the temperature goal of well below 2°C and pursing 1.5°C determines the potential for adaptation and the costs of adaptation.

The Paris Agreement is universal in nature and so it commits all countries to preparing nationally determined contributions (NDCs – these are primarily mitigation commitments but can also include adaptation actions) and adaptation communications. In addition, all countries are committed to adaptation planning that includes the preparation and implementation of National Adaptation Plans and may include measures to build the resilience of socio-economic and ecological systems. Ireland will report on its progress in implementing the Paris Agreement through its national communications and will be required to progressively update its NDC every 5 years. It will do this as part of the EU. It is worth noting that the European intended NDC (INDC),[2] submitted before the Paris climate summit in 2015, referred only to the EU's mitigation action and not to adaptation or resilience building.

Ireland, like all countries of the world, is also committed to achieving the 17 SDGs by 2030. Implementation of the SDGs began in January 2016 and the goals address resilience in multiple ways that are of relevance to Ireland's goal of climate resilience. Goal 13 on climate change addresses resilience directly. Target 13.1 is to "Strengthen resilience and

1 https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement (accessed 19 October 2016).

2 http://www4.unfccc.int/Submissions/INDC/Published%20Documents/Latvia/1/LV-03-06-EU%20INDC.pdf (accessed 19 July 2016).

adaptive capacity to climate-related hazards and natural disasters in all countries." Resilience is also part of Goal 9 on building resilient infrastructure and of Goal 11 on inclusive, safe, resilient and sustainable cities. Goal 2 on ending hunger includes a target to ensure sustainable food production systems and implementation of resilient agricultural practices that increase productivity and production by 2030. Overall, the agenda 2030 and the framing of the goals commits all counties to take the bold and transformative steps needed to urgently shift the world onto a sustainable and resilient path.

Ireland's plans for SDG implementation are outlined in a recent Organisation for Economic Co-operation and Development (OECD) report *Better Policies for Sustainable Development 2016: A New Framework for Policy Coherence* (OECD, 2016). The report emphasises integration of the SDGs into existing policies and strategies and broad stakeholder engagement, while signalling that deliberations are ongoing as to the institutional and governance arrangements to be put in place for SDG implementation, monitoring and review. At present Irish policy on sustainable development is guided by a government framework, *Our Sustainable Future: A Framework for Sustainable Development in Ireland* (Government of Ireland, 2012). References to resilience in the framework refer largely to economic resilience and sustainable public finance. There are also references to making critical infrastructure resilient and to building resilience to climate change through the Irish Aid programme, both of which are in the context of climate resilience.

The Sendai Framework for Disaster Risk Reduction (UN, 2015c), also adopted in 2015, sets out goals and priorities for reducing disaster risk and building resilience. The Framework's goal is to:

> Prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience.

In this approach, as in the IPCC's framing, strengthened resilience is the outcome of actions to reduce vulnerability and increase preparedness – in this instance to all types of hazard, including climate change. As with the Paris Agreement and Agenda 2030, the links between disaster risk reduction and sustainable development are recognised as a guiding principle of the Sendai Framework. Paragraph 19 (h) states that "Disaster risk reduction is essential to achieve sustainable development", while paragraph 19 (j) recognises that addressing the underlying drivers of disaster risk contributes to sustainable development. The Framework has four priorities and the third is "investing in disaster risk reduction for resilience", which focuses on financial mechanisms to promote risk reduction. The Framework sets out actions at national, regional and global levels to reduce disaster risk. Ireland is expected to implement the Framework nationally to better understand and prepare for risks while strengthening governance to manage disaster risk and enhancing preparedness, recovery, rehabilitation and reconstruction. A key concept from the Sendai Framework is to "Build Back Better" (UN, 2015c). This involves rehabilitating and reconstructing infrastructure to be future proof and climate proof, but it also has a socio-economic dimension, contributing to resilience building by integrating disaster risk reduction into development measures to make nations and communities resilient to disasters.

As a result of the agreements adopted in 2015, including the Paris Agreement and Agenda 2030, but also the Sendai Framework for Disaster Risk Reduction, Ireland and the rest of the world have entered a new era of sustainable development that recognises the threats posed by climate change and charts a course to low-carbon, climate resilient development.

3 Resilience to Climate Change in Ireland

3.1 Impacts of Climate Change

There is a growing field of research outlining the current and expected impacts of climate change in Ireland. A summary of potential climate change impacts was published in 2009 in a State of Knowledge Report (Desmond *et al*., 2009). This summarised the work of Met Éireann, the National University of Ireland Maynooth and material from the IPCC Fourth Assessment Report. The report found that temperatures in Ireland had increased by 0.7°C since 1890, that is, an average of 0.06°C per decade (high confidence), and projected future temperature increases in the range of 1–3°C to 2100, compared with the 1961–2000 average (medium confidence). In terms of precipitation the report notes a significant increase in total rainfall in the north and west; many stations also show precipitation increases in March and October (medium confidence). Future projections are for wetter winters in the west and drier summers in the south-east (medium confidence).

The *Status of Ireland's Climate 2012* (Dwyer, 2012) compiled information on over 40 variables across the atmospheric, oceanic and terrestrial domains, detailing trends in everything from rainfall amounts to ocean temperature and changes in land cover. It found that the annual average surface air temperature in Ireland has increased by approximately 0.8°C over the last 110 years.

Since then, studies have been carried out on more specific impacts, such as the impact on phenology (Donnelly *et al*., 2012), hydrology (Murphy *et al*., 2013) and biodiversity (Coll *et al*., 2013). Also in 2013, Met Éireann published a synthesis of knowledge on observed and expected climate impacts for Ireland (Met Éireann, 2013). Depending on the greenhouse gas emission scenarios, the projected changes in Irish climate and related impacts include:

- continued warming, particularly in the winter and summer seasons;
- more extreme weather conditions, including storms and rainfall events;
- an increased likelihood of river and coastal flooding;
- wetter winters and drier summers, the latter possibly leading to water shortages; and
- changes in the types and distribution of species.

Table 3.1 gives an overview of the observed and expected climate impacts based on Met Éireann (2013) and as presented in Ireland's Sixth National Communication (DECLG, 2014) and *Ensemble of Regional Climate Model Projections for Ireland* (Nolan, 2015).

The National Adaptive Capacity Assessment (Desmond and Shine, 2011) found that enough information exists on climate impacts to start climate change adaptation planning and to implement priority actions. It is also recommended that a national vulnerability assessment be carried out.

A 2013 assessment of current and future vulnerabilities to climate change in Ireland (Coll and Sweeney, 2013) identified the first-generation vulnerabilities for Ireland based on a sensitivity analysis across key sectors. The study used impacts-first assessment (top down) and vulnerability/threshold-first approaches (bottom up) to determine the vulnerability of sectors and found that the three most vulnerable sectors in Ireland are biodiversity and fisheries; water resources and the build coastal environment; and forestry and agriculture. Table 3.2 illustrates vulnerability by sector based on a stakeholder assessment (expert level) of sensitivity and adaptive capacity to determine vulnerability.

3.2 Current Capacity to Adapt

The findings of the 2013 vulnerability assessment (Coll and Sweeney, 2013) show that there is a need to increase resilience in most sectors in Ireland, owing to high levels of sensitivity to impacts and/or low levels of adaptive capacity.

The 2011 National Adaptive Capacity Assessment (Desmond and Shine, 2011) provided an overview of Ireland's readiness and ability to adapt to climate impacts. It found that Ireland was at the early stages of the adaptation process and made a number of recommendations to increase adaptive capacity. These recommendations are presented in Table 3.3 with an

Table 3.1. Observed and expected climate impacts in Ireland

	Observed impacts	Projected impacts
Temperature	Temperatures have increased by about 0.8°C over the period 1990–2012, an average of about 0.07°C per decade	Average temperatures will rise by about 1.5°C (RCP4.5 scenario) by mid- century (or 1–1.6°C compared with 1981–2008 according to Nolan, 2015) and up to 3°C by 2100 compared with the 1961–1990 average
Precipitation	Mean annual precipitation over the period 1981–2010 has increased by 5% relative to the 1961–1990 period	Wetter winters (9–14% increase in precipitation for RCP8.5 by mid-century); drier summers (20% reduction for RCP8.5 by mid-century)
Extreme events	There is evidence of an increase in the frequency of days with heavy rain (10 mm or more) over the period 1981–2010 relative to the period 1961–1990	Increase in the frequency of heavy rainfall, particularly in winter (increase of approximately 20% in winter and autumn, according to Nolan, 2015)
Sea levels	During the satellite era, a sea level rise of 3.5 cm per decade	A rise of 50 cm to 2100 is projected for Ireland, consistent with projections from regional and global models (Olbert *et al*., 2012). For Europe, the IPCC Fifth Assessment Report estimates sea level rise at 80 cm for the RCP 8.5 scenario for the period 2081–2100 compared with 1986–2005
Environment	Ecological impacts have been observed in species such as butterflies (e.g. a northward expansion of the population since the 1970s); impacts on key phonological phases associated with trees/ plants, birds and insects have also been observed (1990–1999)	Advance of the “bud burst” day for birch trees (e.g. up to 10 days earlier in the 2080s relative to the 1990s in the north-east of the country, but little change expected in the south-west). Nolan (2015) predicts an increase in growing season by 35–40 days per year for mid-century compared with the period 1981–2000

RCP, representative concentration pathway.

Table 3.2. Assessment of sectoral vulnerability to climate change

Sector	Sensitivity	Adaptive capacity	Vulnerability
Agriculture	Potentially sensitive	High	Not particularly vulnerable
Biodiversity	Highly sensitive	Low	Vulnerable
Built environment	Highly sensitive	Medium	Potentially vulnerable
Coastal	Sensitive	Low–medium	Potentially vulnerable
Energy	Sensitive	High	Not particularly vulnerable
Fisheries	Highly sensitive	Low–medium	Vulnerable
Forestry	Sensitive	Medium	Potentially vulnerable
Transport	Sensitive	Medium–high	Not particularly vulnerable
Water	Highly sensitive	Medium	Potentially vulnerable

Reproduced from Coll and Sweeney (2013).

added column showing how these recommendations have been addressed since the assessment was completed.

The analysis in Table 3.3 reveals that a number of steps have been taken to increase Ireland’s adaptive capacity since 2011. This signals a growing resilience to climate change through institutional strengthening, increased knowledge and awareness, and planning. However, building capacity to address climate risks and plan for adaptation remains a challenge. While there have been project-based efforts to provide training and capacity building for local authorities and sectoral departments, this work needs to be institutionalised and strengthened if adaptive capacity is to be increased.

A recent assessment of Ireland’s preparedness for climate change adaptation (EC, 2015), conducted by the European Commission, confirmed the need to

Table 3.3. Current status of recommendations made in the 2011 National Adaptive Capacity Assessment

Adaptation function	Key recommendations	Current status
Assessment	Carry out a national vulnerability assessment to enable adaptation planning and the implementation of adaptation actions	Initial assessment of first-generation vulnerabilities completed 2013. Full vulnerability assessment still required
	Develop a national approach to climate risk assessment	Climate risk assessment not yet completed. National climate change risk assessment commissioned by the EPA (January 2017)
		The national risk assessment (all risks) was most recently updated in 2017 by the Department of Defence[a]
	Cost priority adaptation options identified at local, sectoral and national levels	A desk-based study has been carried out (Bullock *et al*., 2014). A follow-up small-scale study on costing adaptation in Ireland was conducted by McDermott, 2015)
		No full-scale economic assessment yet. Ongoing reach by McDermott (UCC) on costs of flood impacts
	Inventory adaptation actions, processes and case studies at local and national levels to allow experience sharing and lesson learning	Small-scale study under way by Dwyer (UCC) (2016)
Prioritisation	Undertake a national prioritisation process, which can be adjusted as new information becomes available	An initial prioritisation was included in the national vulnerability assessment (Coll and Sweeney, 2013). This was further developed as part of the National Risk Assessment 2017
Co-ordination	Establish a national high-level body on climate change adaptation drawing on a pool of relevant expertise	National Expert Advisory Council established by the Climate Action and Low Carbon Development Bill. The Council has an adaptation sub-committee[b]
		The National Climate Change Adaptation Committee (co-ordinated by the DCCAE) meets on a monthly basis. Its membership includes all sectors identified in DCCAE (2017) and other relevant national players (e.g. the EPA, CCMA)
	Strengthen institutional capacity to address adaptation to climate change	Institutional capacity in government departments and local authorities is starting to be strengthened to meet requirements of the 2015 Act. See for example the Local Authority Adaptation Support Wizard[c] and representation on the national adaptation steering group (above)
		Efforts to build capacity have yet to be formalised/institutionalised
Information management	Continue to develop the knowledge base through sustained commitment to data gathering and monitoring systems	Met Éireann and the Marine Institute are responsible for weather and marine observations. EPA-funded research also collects data. However, this approach is vulnerable unless placed on a programmatic basis
	Assign a lead organisation to oversee data gathering, analysis and dissemination	Not yet. See above comment
	Develop a prototype climate information system linked to the EU clearing house on climate change impacts and adaptation	Climate Ireland is now online and is being further developed. It is still in a reach/project phase and is yet to be made operational and placed on a sustainable footing
	Use the platform or another medium to share experiences and help develop best practice case studies	Not yet

Table 3.3. Continued

Adaptation function	Key recommendations	Current status
Climate risk reduction	Develop guidelines on how to integrate climate change into policies, plans and programmes	Guidelines for local authorities were published in 2016 (Gray, 2016) Guidelines for government departments in development
	Update assessment tools (e.g. EIA, SEA, AA) to enable climate change adaptation to be integrated into policies, plans and programmes	A guidance note on integrating climate change into SEA was published by the EPA in 2015 (EPA, 2015)
	Integrate climate change adaptation into policies, plans and programmes at all levels of government	Not yet
	Develop process/effectiveness indicators for monitoring and review purposes	Indicators under development as part of an EPA research project

AA, Appropriate Assessment; CCMA, County and City Management Association; DCCAE, Department of Communications, Climate Action and Environment; EIA, Environmental Impact Assessment; EPA, Environmental Protection Agency; SEA, Strategic Environmental Assessment; UCC, University College Cork.

[a]http://www.defence.ie/website.nsf/NRA2017 (accessed 1 May 2018).

[b]http://www.climatecouncil.ie/

[c]http://www.climateireland.ie/climatetool/toolmain_LA_2.html (accessed 14 October 2016).

strengthen adaptive capacity and identified several areas of weakness in the national approach:

- lack of stakeholder (e.g. interest groups, scientists and general public) involvement in the preparation of adaptation policies;
- lack of transboundary co-operation to address common challenges with relevant countries;
- insufficient knowledge transfer by way of education and training materials on climate change adaptation concepts and practices;
- insufficient progress on adaptation options consistent with the results of sectoral risk assessments – and with measures and good practices identified in similar contexts;
- lack of mechanisms to co-ordinate disaster risk management and climate change adaptation;
- dedicated and adequate funding resources have not yet been identified and made available to implement adaptation action;
- insufficient progress on mainstreaming adaptation into priority and key national planning and sectoral policymaking; particular emphasis is needed on insurance or alternative policy instruments, where relevant, to provide incentives for investments in risk prevention;
- insufficient progress on systems to monitor and report on climate change adaptation, including adaptation-related expenditures, via relevant indicators.

It is now urgent to address these shortcomings. Global emissions continue to grow and global temperatures to rise, with a resulting increase in climate risk. In order to build resilience to future climate impacts, Ireland will need to continue to intensify its efforts to build adaptive capacity and manage climate risk, in tandem with steps to reduce emissions. Recent weather-related disasters including storms (Storm Darwin, February 2014; Storm Ophelia, October 2017; and Storm Emma, March 2018) and floods (winter 2015–2016) have revealed how vulnerable the Irish transport and energy infrastructure, housing stock, agriculture and health sectors, among other things, are to climate change.

3.3 Future Capacity to Adapt

The *Draft National Risk Assessment 2016: Overview of Strategic Risks*, published by the Department of the Taoiseach, registers climate change and extreme weather events as an environmental risk (DoT, 2016). The report notes that "there is a risk of failure to invest effectively or sufficiently in both mitigation and adaptation measures required to help minimise or address the impacts of this climate change." The next step is to translate this recognition of risk into policy, action and investment.

The National Risk Assessment conducted by the Department of Defence in 2012, and updated most

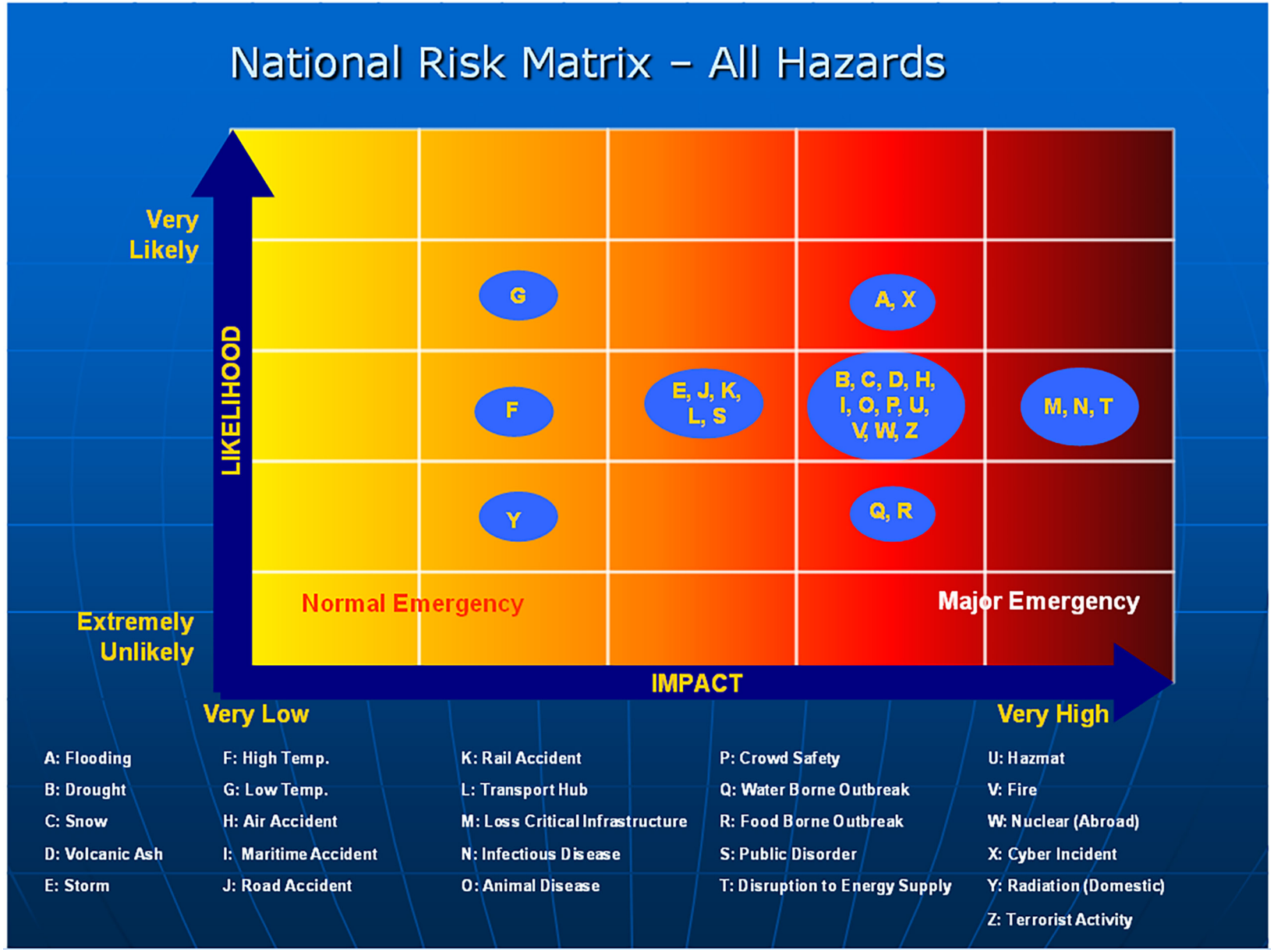

Figure 3.1. National Risk Matrix. Reproduced from DoD, 2012.

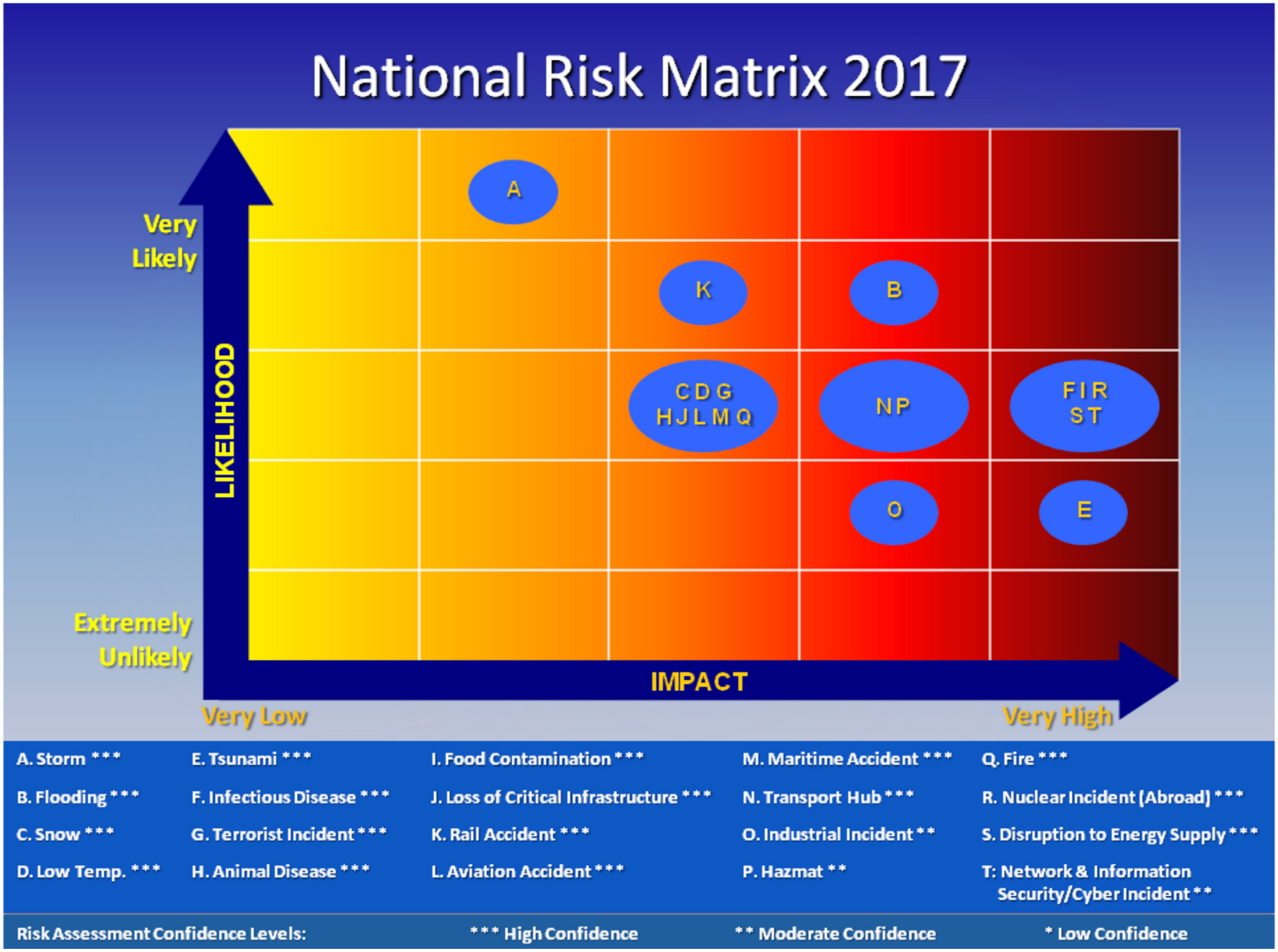

Figure 3.2. National Risk Matrix. Reproduced from DoD, 2017.

recently in 2017, includes a national matrix of all hazards (Figure 3.1). In the 2017 matrix (Figure 3.2) the risk of flooding remains the same as in 2012 (likely and with a high impact) while the risk associated with storms increases (from moderate likelihood and impact, to very likely with a low impact). In 2012 droughts were assessed as a likely occurrence while they are absent from the 2017 assessment. The disruption of energy supply was judged to be high impact in 2012 and 2017, and falls into the "major emergency" category. However, the fact that extreme weather events such as storms and floods may well be the cause of this disruption to energy is not articulated.

With each of the first 6 months of 2016 setting records as the warmest respective month globally in the modern temperature record (which dates back to 1880; NASA, 2016), the Earth is undoubtedly in what is called the Anthropocene. The 6-month period from January to June 2016 was also the planet's warmest half-year on record, with an average temperature 1.3°C warmer than in the late 19th century. According to NASA data, 2017 was the hottest year on record without an El Niño event[3] and March 2018 was one of six warmest Marches on record (NASA).[4] The need to reduce emissions, build resilience and adapt to the impacts of climate change has never been greater.

As a nation, Ireland has started to increase its resilience to climate change by enhancing understanding of climate risks, strengthening adaptive capacity and putting in place a legislative framework, institutions and planning requirements to both reduce emissions and adapt to climate impacts.

However, there continues to be inadequate co-ordination between those responsible for risk management and emergency planning and those responsible for climate risk management. This is an issue identified for action in the National Climate Change Adaptation Framework (DCCAE, 2017), which states that "early warning systems need to be devised and put in place that will integrate extreme events (e.g. flooding, cold snaps, heat waves) into existing emergency planning and response mechanisms." However, the draft fiche for Ireland in the Directorate-General for Climate Action preparedness scoreboard finds that "There is not an integration of [disaster risk reduction] and [Climate Change Adaptation] policies in Ireland, although there are plans to promote it" (EC, 2015). Climate risk cannot be managed separate from other risks. The SDGs, the Sendai Framework for Disaster Risk Reduction and the Paris Agreement, all adopted in 2015, remind us that disaster risk management and climate change adaptation must be planned for coherently. A co-ordinated approach to emergency planning in a climate-affected world will be pivotal for responding to extreme weather events and increasing resilience.

Ireland's future capacity to adapt will depend on sustained investment in data, in planning and in adaptation measures to reduce climate risk. It will also depend on the level of warming to be adapted to and whether the global community achieves the goals set in the Paris Agreement to keep global temperature rise to well below 2°C above pre-industrial levels and to pursue the target of 1.5°C. That is why the approach proposed to resilience in this paper constantly makes links between adaptation and mitigation.

3 https://earthobservatory.nasa.gov/IOTD/view.php?id=91604

4 https://climate.nasa.gov/news/2714/march-2018-was-one-of-six-warmest-marches-on-record/

4 Climate Resilient Pathways in Ireland

With temperature increases in Ireland expected to reach 1.5°C by mid-century[5] and 3°C by the end of the century compared with the 1961–1990 average (Met Éireann, 2013), the need to urgently adopt climate resilient pathways is evident.

The IPCC describes climate resilient pathways as development trajectories that combine adaptation and mitigation to realise the goal of sustainable development. These pathways include political, economic and socio-technical strategies, choices and actions that promote sustainable development pathways in the context of climate change. The pathways chosen will have ethical and equity aspects, so the options chosen will have to consider risks and trade-offs, including how best to achieve fairness and to protect human rights.

Climate resilient pathways have the potential to deliver co-benefits for broader societal goals on energy, health and quality of life. These pathways will have to adopt a coherent approach to mitigation, adaptation, disaster risk reduction and the wider imperative of sustainable development. A narrow focus on climate change adaptation will not be adequate to deliver a climate resilient Ireland. Instead a more transformative approach to short-, medium- and long-term decision making focused on all aspects of sustainability will be required. The choices made today will determine how the goal of a low-carbon, climate resilient and environmentally sustainable economy can be met by 2050.

Working Group II of the IPCC presented elements of climate resilient pathways in Chapter 20 (IPCC, 2014b) of their contribution to the Fifth Assessment report (Box 4.1). At present Ireland has some way to go to have all of the required elements in place to pursue climate resilient pathways.

4.1 Elements of Climate Resilient Pathways in Ireland

4.1.1 Awareness and capacity

In the context of awareness raising and capacity there is more work to be done to raise social awareness of climate risk, provide consistent leadership for sustainability and to develop capacities for risk management. The Climate Act 2015 will help to integrate measures to reduce greenhouse gas emissions into national development strategies and it has taken initial steps towards institutional change.

In addition, training and guidance have started to be provided to local authorities on an ad hoc project basis to support them in integrating climate change adaptation into their planning. However, additional efforts will be needed to build institutional capacity in order to develop integrated climate change strategies in all sectors and at all levels and to ensure that these are part of mainstream economic and political decision making. This work will also have to include the private business sector and local communities. Building the capacity of all stakeholders will be critical to demonstrating a sustained and consistent commitment to achieving the goals set out in the 2015 Act.

4.1.2 Resources

In terms of resources, Ireland has made huge strides since 2011 in terms of data, analysis, knowledge and climate information. However, resources and commitments are needed to place these systems on a long-term, sustainable footing. Moreover, the information platform Climate Ireland must be helped to evolve into a fully operational resource for decision makers at all levels.

5 Based on an ensemble of downscaled high-resolution climate simulations, based on medium–low and high-emission scenarios (Met Éireann, 2013).

Box 4.1. Selected elements of climate resilient pathways

Awareness and capacity
A high level of social awareness of climate change risks
A demonstrated commitment to contribute appropriately to reducing net greenhouse gas emissions, integrated with national development strategies
Institutional change for more effective resource management through collective action
Human capital development to improve risk management and adaptive capacities
Leadership for sustainability that effectively responds to complex challenges
Resources
Access to scientific and technological expertise and options for problem solving, including effective mechanisms for providing climate information, services, and standards
Access to financing for appropriate climate change response strategies and actions
Information linkages in order to learn from experiences of others with mitigation and adaptation
Practices
Continuing development and evaluation of institutionalized vulnerability assessments and risk management strategy development, and refinement based on emerging information and experience
Monitoring of emerging climate change impacts and contingency planning for responding to them, including possible needs for transformational responses
Policy, regulatory, and legal frameworks that encourage and support distributed voluntary actions for climate change risk management
Effective programs to assist the most vulnerable populations and systems in coping with impacts of climate change

Reproduced from IPCC, 2014b. Chapter 20, p.1113. © Intergovernmental Panel on Climate Change, 2015.

In terms of access to finance for climate response strategies and actions, some resources have been made available for flood risk management (Office of Public Works, 2016) but overall greater investment is needed in climate action across all sectors and at all levels. This is to some extent about additional resources but to a greater extent about wise use of existing resources so that every investment made from now on is future and climate proofed to yield maximum co-benefits in the short and long term. This is the approach advocated by the Global Commission on the Economy and Climate[6] in their reports published in 2014, 2015 and 2016 (Global Commission on the Economy and Climate, 2014, 2015, 2016). The 2016 report advocates investing in sustainable infrastructure as the key to tackling the three main global challenges: (1) reigniting growth; (2) delivering on the SDGs; and (3) reducing climate risk. The report states that "transformative change is needed now in how we build our cities, produce and use energy, transport people and goods, and manage our landscapes." Resilient pathways are part of this transformation in Ireland and in all countries.

In terms of information linkages and sharing experiences, it is important to note that there is no best practice on how to achieve climate resilience at the national level. All countries are learning by doing, including Ireland, and there is a real opportunity for Ireland to be a leader and to enhance its global position. Critical to a learning by doing approach is documenting what works and what does not, and sharing these experiences nationally and internationally so that learning is incremental and the approach transformative. This picks up on the recommendation made in the 2011 National Adaptive Capacity Assessment (Desmond and Shine, 2011) to create an inventory of actions, processes and case studies to allow lesson learning and experience sharing.

6 http://newclimateeconomy.net/ (accessed 20 October 2016).

4.1.3 Practices

While Ireland has completed an initial national vulnerability assessment it does not yet have a system of institutionalised vulnerability and risk assessments nor a complete system for contingency planning. Policy, regulatory and legal frameworks are being developed and the 2015 Act is an important milestone. While some sectors have started to draft sectoral adaptation plans (see, for example, the Adaptation Plan for the Agriculture and Forest Sector prepared by the Department of Agriculture, Food and the Marine; DAFM, 2017) under the 2012 National Climate Change Adaptation Framework, there is some way to go before these constitute voluntary climate risk management actions. The National Adaptation Framework (DCCAE, 2017) makes the production of sectoral adaptation plans a requirement for all government departments. Finally, programmes have yet to be developed to assist the most vulnerable populations and systems to cope with the impacts of climate change. Equity is an aspect of climate policymaking and action that has yet to be fully addressed in the Irish context.

Overall, Ireland has put in place some of the enabling conditions for climate resilient pathways but it is at the start of what the IPCC calls the transformation needed to promote sustainable development pathways in the context of climate change.

The core elements of this transformation that can guide climate resilient pathways in Ireland are listed below. They are informed by the research analysed and presented in the earlier sections of this report:

1. **Make all development sustainable development –** a climate resilient Ireland is not possible in the absence of sustainable development. Agenda 2030 commits all countries to achieving the 17 SDGs by 2030. Sustainable development has to be the over-riding policy framework for action on climate change. This means that Ireland needs a comprehensive plan to achieve the SDGs that guides all planning and development at the national level and provides a context for climate action. The commitment in the Climate Act to an environmentally sustainable economy is an important signal in this regard.
2. **Coherence –** plans and actions to manage climate risk and increase resilience must be closely linked with plans to reduce greenhouse gas emissions. Without actions to reduce greenhouse gas emissions, actions to adapt to climate change and increase resilience will be for nought. Ireland's actions to reduce emissions are a core component of a climate resilience pathway. In addition, coherence between climate change strategies and strategies to implement disaster risk reduction as per the 2015 Sendai Framework will be critical for effective action and is an area in which Ireland has considerable progress to make. More broadly, policy coherence will be critical to climate resilient pathways, as climate action is part of every sector of decision making from transport and health, to agriculture and energy. *All* policies will have to contribute to achieving the goal of a low-carbon, climate resilient Ireland and critically *climate change and sustainable development need to inform mainstream national economic and development policy*. They cannot be seen as add-ons or supplements to national planning, as they have been in the past. To be transformative, all economic activity needs to be guided by the commitment to sustainable development. The sectoral adaptation plans and mitigation measures required by the Climate Act are a step towards greater coherence and the use of the climate change guidelines for Strategic Environmental Assessment (EPA, 2015) produced by the EPA should also help to ensure greater policy coherence.
3. **Transformation –** the transition needed to realise a low-carbon, climate resilient Ireland is considerable. Working Group III of the IPCC Fifth Assessment Report states that "Stabilizing greenhouse gas (GHG) concentrations will require large scale transformations in human societies, from the way that we produce and consume energy to how we use the land surface" (IPCC, 2014d). Working Group II adds that "To promote sustainable development within the context of climate change, climate-resilient pathways may involve significant transformations" (IPCC, 2014b). Business as usual will neither achieve Ireland's emissions targets nor build resilience to climate

impacts. The transition requires a transformation of our energy, food, transport, water and industrial systems**.** *It will be important to develop a national vision of what a transformed Ireland would look like by 2050 and the steps needed over the coming years and decades to achieve that vision*. This should be an integral part of the policy vision for the National Adaptation Framework currently being developed by the Department of Communications, Climate Action and Environment (DCCAE).

4. **Urgency – start now –** the IPCC reminds us that "delayed action in the present may reduce options for climate resilient pathways in the future" (IPCC, 2014b). Action to reduce greenhouse gas emissions, achieve sustainable development and increase resilience must start now or thresholds may be passed that exceed the resilience of natural and human systems. For Ireland this means meeting our 2020 targets, setting ambitious 2030 targets and planning now for a pathway to emissions neutrality by 2050. The earlier Ireland acts to increase resilience and reduce emissions, the lower the costs both in terms of adaptation and mitigation (Stern, 2006; Global Commission on the Economy and Climate Change, 2014, 2015, 2016). Delaying national action now means incurring higher costs in the future and passing the responsibility to future generations, which is generally considered both unfair and unjust (see Page, 2008; Shue, 2013).

5. **Making every investment count –** as advised by the Global Commission on the Economy and Climate, every investment in infrastructure from now on should be sustainable, that is, compatible with social and environmental goals so that it contributes to enhanced social wellbeing. Infrastructure in this case includes both traditional types of infrastructure (everything from energy to public transport, buildings, water supply and sanitation) and natural infrastructure (such as forest landscapes, wetlands and watershed protection). So any investment Ireland makes in building new infrastructure or retrofitting existing infrastructure should be low-emission, resource-efficient and resilient in order to provide value for money. The investment choices Ireland makes in the next 2–3 years will start to lock-in for decades to become either a climate-smart, inclusive growth pathway, or a high-carbon, inefficient and unsustainable pathway.

6. **Capturing the co-benefits –** the IPCC stresses the fact that many of the actions needed to reduce emissions and build resilience also have benefits in terms of human wellbeing and human security. In economic terms there are some climate actions that are win–win and have no regrets, whereby the investment made generates net social benefits whether or not there is climate change. Climate resilient pathways capture opportunities to achieve sustainable development while also reducing emissions and increasing resilience. In the Irish context this could be things like:

    - using waste and residue to create new sources of low-emission bioenergy with co-benefits in terms of reducing waste and reducing emissions from waste;
    - investing in sustainable land management to maximise the potential for carbon sequestration while enhancing biodiversity and the natural environment;
    - investing in low-emission energy solutions with co-benefits for human health through reduced air pollution;
    - investing in zero-emissions transport systems with co-benefits in terms of reduced congestion and improved health (better air quality, more physical exercise).

7. **Learning by doing –** the IPCC recognises that an adaptive learning approach is part of climate resilient pathways, as they are iterative processes for managing change within complex systems. No country has achieved sustainable development, carbon neutrality or climate resilience. Every country is learning as human-induced climate change is something all countries are coping with for the first time. The critical thing is to act now, to start and to actively learn and share this learning along the way. If some actions designed to increase resilience actually lead to maladaptation[7] it is important to stop and change course. If

7 Any changes in natural or human systems that inadvertently increase vulnerability to climatic stimuli, an adaptation that does not succeed in reducing vulnerability but increases it instead (Noble *et al*., 2014).

actions to reduce emissions inadvertently reduce air quality and undermine the achievement of SDG 3 (health), it is important to revise the strategy. On the other hand, if actions to increase resilience have unanticipated co-benefits, these can be replicated and the experience shared. Learning by doing requires a strong system of documenting and monitoring actions so that progress can be demonstrated and lessons learned.

8. **Fairness –** climate change disproportionally affects the most vulnerable people in society. Research from the UK shows that people living in social housing, the unemployed, the disabled, the young, the elderly and people with weak social networks are among the most vulnerable to climate impacts (Joseph Rowntree Foundation, 2011). This means that climate actions need to be designed to protect the most vulnerable people in society and to reduce the risk of climate policies inadvertently burdening the poorest (Joseph Rowntree Foundation, 2014). For example, Ireland's carbon tax was designed to minimise increases in income or employment taxes, which tend to slow economic recovery, while increasing resources for low-income residents (Convery *et al.*, 2013). The IPCC notes that the pathways chosen will have to consider risks and trade-offs, including how best to achieve fairness and protect human rights. Fairness is also critical to getting broad-based public support for climate action, which is critical if the 2°C and 1.5°C temperatures goals are to be met.

5 Conclusions and Recommendations

The National Climate Change Advisory Council issued its first report (Climate Change Advisory Council, 2016) while this research was being conducted. While the focus of the Council's report is on national mitigation policy, it does make some observations on adaptation that support the findings in this report. The Council recognises that communications, capacity building and support are needed to build national resilience. It stresses the need to clarify management, ownership and assessment of adaptation options through the forthcoming National Adaptation Framework to strengthen adaptation governance. It also stresses, as this report does, the need to operationalise Climate Ireland as an information platform to assist government departments and local authorities with adaptation planning. It emphasises the need to prioritise adaptation measures and develop a framework for investment decision making – echoing recommendations made by the National Adaptive Capacity Assessment in 2011 (Desmond and Shine, 2011).

This report seeks to inform the work of the Council in monitoring progress towards the 2050 goals set out in the Climate Act 2015. The report proposes that a climate resilient Ireland can be understood as follows:

> A climate resilient Ireland is on a pathway to sustainable development. This is, climate resilient pathways are being actively pursued that reduce climate change and its impacts, manage risk and promote sustainable development. This includes a coherent approach to adaptation and mitigation with effective governance, institutions, adequate resources, legal and regulatory frameworks, regular vulnerability assessments, climate action planning (national, sectoral and local levels), access to information and strengthened adaptive capacity in place.

Climate resilient pathways encompass economic, social and environmental resilience. As a result, a 2050 vision for a sustainable Ireland should be developed, which articulates economic, social and environmental goals and engages all stakeholders in the action needed to achieve a prosperous, safe, sustainable and equitable Ireland for present and future generations. Indicators will need to be developed as part of this process to allow progress towards the goals to be measured and tracked. Ongoing work on adaptation indicators (Kopke *et al*., in preparation) will inform this work, as will efforts to develop national indicators for the SDGs, as mandated by the 2030 Agenda. Likewise, working back from 2050, shorter term plans will be needed to achieve the vision and these will not be confined to adaptation and mitigation plans; instead they require a comprehensive and far-reaching refresh of national policymaking.

This report finds that a narrow focus on climate change adaptation will not be adequate to deliver a climate resilient Ireland. Instead a more transformative approach to short-, medium- and long-term decision making focused on all aspects of sustainability will be required.

The Climate Change Advisory Council's first report (Climate Change Advisory Council, 2016) reiterates the transformation needed to achieve the low-emission, climate resilient future that is essential for climate security and prosperity. As a result, the climate resilient pathways Ireland pursues should be informed by the following eight factors presented in Chapter 4:

1. making all development sustainable development;
2. coherence;
3. transformation;
4. urgency;
5. making every investment count;
6. capturing the co-benefits;
7. learning by doing;
8. fairness.

In terms of future work, Table 3.3 highlights the areas where further work is needed to strengthen adaptive capacity. These include a comprehensive national vulnerability assessment; a national climate risk assessment; a costing of adaption actions; an

inventory of adaptation actions; a national prioritisation process; continued strengthening of capacity at sectorial and local levels for adaptation planning; designating a lead organisation for data gathering, analysis and dissemination; and the full deployment of Climate Ireland.

In addition the assessment of Ireland's position vis-à-vis the elements of climate resilient pathways presented by the IPCC shows that more work is needed to:

- Raise awareness and capacity – raise social awareness of climate risk, provide consistent leadership for sustainability; develop capacity for risk management; and build capacity to integrate climate change into sectoral strategies.
- Mobilise resources – investment in climate action including future proofing all investments in infrastructure; establish systems to capture learning; and further investment in climate information and knowledge, including its dissemination to all stakeholders.
- Strengthen planning and accelerate action – a regular and institutionalised vulnerability and risk-assessment process, built on regulatory and legal frameworks to work towards voluntary climate risk-management actions by all stakeholders from citizens and business to local authorities and government departments. Climate and sustainable development policies and plans will need to identify the most vulnerable people in society and ensure that they are protected from any adverse effects of climate change and climate policy, as well as being designed to ensure a fair and just transition to a low-carbon, climate resilient Ireland.
- Strengthen governance arrangements – horizontal and vertical co-ordination are crucial for effective planning and delivery of actions.

Ireland is at the beginning of the transition to becoming a low-carbon, climate resilient society. It has many of the elements in place needed to drive this transition and transform the economy and society. While the transition needs to be carefully managed to be fair and effective, the opportunities it provides are innumerable if the co-benefits are captured and a common vision mobilises support from all quarters of Irish society.

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Abbreviations

EU	European Union
IPCC	Intergovernmental Panel on Climate Change
NDC	Nationally determined contribution
SDG	Sustainable Development Goal
UN	United Nations

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
- Oifig um Chosaint Radaíochta agus Monatóireachta Comhshaoil
- 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.

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Climate Resilient Ireland

Author: Tara Shine

Identifying Pressures

This study looks at Ireland's preparedness for climate impacts in the context of the National Transition Objective, established by the Climate Action and Low Carbon Development Act 2015, to achieve a "low carbon, climate resilient and environmentally sustainable economy by the end of the year 2050". The concept of resilience is unpacked and approaches to resilience from the EU and internationally are presented. An assessment is made of Ireland's current resilience and capacity to adapt. There is an urgent need to capture the synergies between sustainable development and climate action to increase resilience given Ireland's commitment to Agenda 2030, achieving the Sustainable Development Goals (SDGs) and implementation of the Paris Agreement.

Informing Policy

A climate resilient Ireland can be achieved and this report proposes how. A climate resilient Ireland is a pathway to sustainable development, i.e. climate resilient pathways are being actively pursued that reduce climate change and its impacts, manage risk and promote sustainable development. A narrow focus on climate change adaptation will not be adequate to deliver a climate resilient Ireland. An effective approach should be informed by sustainable development, coherence (e.g. with mitigation), urgency, transformation, making every investment count, capturing the co-benefits, learning by doing and fairness.

Further work is needed to strengthen adaptive capacity, including national vulnerability and climate risk assessments, costing, prioritising and creating an inventory of adaptation actions, capacity building and the full deployment of Climate Ireland.

Developing Solutions

Ireland is at the beginning of the transition to a low-carbon, climate resilient society. Although the transition needs to be carefully managed to be fair and effective, the opportunities it provides are innumerable if the co-benefits are captured.

To achieve climate resilience, a 2050 vision for a sustainable Ireland should be developed that articulates economic, social and environmental goals and engages all stakeholders to achieve a prosperous, safe, sustainable and equitable Ireland for present and future generations. Working back from 2050, shorter term plans will be needed to achieve the vision and these will not be confined to adaptation and mitigation plans; instead, they require a comprehensive and far-reaching refresh of national policymaking.

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