



**Roinn Cumarsáide, Gníomhaithe  
ar son na hAeráide & Comhshaoil**  
Department of Communications,  
Climate Action & Environment

# National Adaptation Framework

Planning for a Climate Resilient Ireland





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## Message from An Taoiseach

Climate change is real and is happening now. People throughout Ireland have already experienced firsthand the potential impact of climate change, particularly through floods and storms and the damage that can ensue. Events like these, and the expected increase in their frequency, highlight the need for adaptation measures to help the country cope with the effects of climate change.

The scale and complexity of what we face demands a coordinated approach at both national and international levels. Climate change presents very significant challenges for Ireland, both in terms of mitigating our emissions and achieving national and international binding targets, as well as adapting to the effects of a changing climate.

The Paris Agreement sets out a new path in the global effort to combat climate change including how we adapt to its effects. These global efforts are further enhanced by the UN Sustainable Development Goals which have a specific focus on Climate Action. Ireland is fully committed to concerted multilateral action to tackle climate change through these processes and thereby playing our part in contributing to global climate action.

We have a vision of an Ireland with a competitive, low-carbon, climate-resilient and environmentally sustainable economy by 2050, and Ireland's first National Mitigation Plan, published in July 2017, represents an important step in achieving our low carbon transition.

However, no matter how successful these mitigation efforts prove to be, it is very likely that Ireland will still face substantial impacts of climate change due to past emissions. We need to prepare for these impacts in the years ahead. Early action is imperative in order to minimise risks to human health, economic development, property, infrastructure and ecosystems.

Ireland's first statutory National Adaptation Framework sets out a pathway to achieving a more resilient economy and society which is capable of dealing with the enormous challenges climate change is likely to present. This Framework, and its constituent Sectoral Adaptation Plans, will inform the significant capital investment in flood adaptation measures to be made over the lifetime of the Ten-Year Capital Plan. This includes €430 million which is already provided for under the Government's Catchment Flood Risk Assessment (or CFRAM) Programme. This Programme shows that it is feasible for the Government to protect up to 90% of at risk properties, in the 300 areas studied. Work to protect 12,000 at risk properties is already underway with 10 flood defence schemes currently under construction and a further 25 schemes at the design and planning stage.

I commend Minister Naughten for developing this National Adaptation Framework which sets out the challenges climate change presents for Ireland and will help build resilience across the country. The Government will continue to support this work through the National Dialogue on Climate Action, the National Planning Framework and the 10 Year Capital Investment Plan.

**Leo Varadkar, T.D.**

*An Taoiseach*



## Foreword by Minister

The challenges presented by climate change are unprecedented, both in terms of the potential scale of the impacts and the level of transformation required. For Ireland, these impacts are in line with global trends and may include sea level rise, increased risk of flooding and increased intensity of extreme weather events. The level of destruction and disruption caused by Storm Ophelia in October 2017 underscores the need to prioritise climate adaptation action here in Ireland and plan ahead effectively for a climate resilient future.

Global efforts to reduce Greenhouse Gas emissions will play an essential role in limiting the extent of future climate change. The publication of our first National Mitigation Plan in July 2017 represents an important contribution to this process in setting out a roadmap to decarbonise our economy. However, no matter how successful these efforts prove to be, the effects of climate change will continue to impact on both our economy and society. The need for effective climate proofing is therefore both urgent and essential in achieving a successful transition to a climate resilient economy and society by 2050.

This statutory National Adaptation Framework (NAF) sets out the national adaptation strategy which aims to reduce Ireland's vulnerability to these impacts. The role of key sectors including local government is set out in the context of how Ireland can develop climate resilience while also recognising the need to ensure coordination of adaptation actions across sectors and Government Departments and Agencies. It is essential that this whole-of-government approach be supported through the mainstreaming of adaptation into all national plans and policies such as the National Planning Framework and Ireland's Capital Investment Plan.

In order to reach the goal of a climate resilient economy and society by 2050, the NAF also recognises that adaptation actions will be required by the whole of society including the private sector and individual citizens. In order to support adaptation actions at all levels the NAF aims therefore to create an enabling environment by encouraging dialogue and supporting adaptation research in relevant areas. This will build on work already underway or completed in respect of providing guidelines and information platforms which will support the development of sectoral adaptation plans and help individuals and businesses to reduce their own risk profiles.

In order to support the goal of engaging with all levels of Irish society, the development of this Framework was informed by a six week public consultation. In addition, the National Dialogue on Climate Action (NDCA) will continue to increase awareness of climate change and adaptation actions and in doing so will provide an ongoing platform for engagement in how Ireland plans ahead for climate resilience.

Adaptation plans and strategies prepared under this Framework, and the Framework itself, will be reviewed in line with the Climate Action and Low Carbon Development Act 2015. This will ensure that we adopt an iterative approach to adaptation planning which is informed by the latest scientific evidence thus enabling Departments, Agencies and Local Authorities to modify or escalate adaptation actions as appropriate.

**Denis Naughten, T.D.**

*Minister for Communications, Climate Action and Environment*

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# Overview and Key Messages

## Introduction

Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and oceans have warmed, the amounts of snow and ice have diminished, sea levels have risen, and the concentration of greenhouse gases has increased (IPCC, 2013). Regardless of how successful efforts to reduce emissions of the greenhouse gases (GHGs) that are driving climate change (climate change mitigation) prove to be, the impact of climate change will continue over the coming decades because of the delayed impacts of past and current emissions. There is no choice, therefore, but to take adaptation measures to deal with the unavoidable consequences of climate change and the associated economic, environmental and social costs.

Observations show that Ireland's climate is changing in terms of sea level rise, increases in average temperature, changes in precipitation patterns and weather extremes. The observed scale and rate of change is consistent with regional and global trends and these changes are projected to continue and increase over the coming decades. Climate change will have diverse and wide ranging impacts on Ireland's environment, society and economic development, including managed and natural ecosystems, water resources, agriculture and food security, human health and coastal zones. Sufficient robust information now exists nationally to further progress the process of implementing adaptation actions and increasing social, economic and environmental resilience to climate change.

## Climate Change Responses

The global climate change challenge warrants a substantial response from the international community. A significant body of international and EU climate change policy now exists to guide the development of national policy. The Paris Agreement, Agenda 2030 Sustainable Development Goals and the Sendai Framework for Disaster Risk Reduction, all pursue a common goal of low carbon, climate resilient sustainable development. The European Commission published a White Paper on adapting to climate change in 2009, which was followed by publication of the EU Adaptation Strategy in April 2013. The EU Adaptation Strategy has an overall aim of contributing to a more climate-resilient Europe. It is currently under review with a view to assessing how effective the strategy has been in facilitating EU wide progress on adaptation. The review is scheduled to conclude in 2018.

The most immediate risks to Ireland which can be influenced by climate change are predominantly those associated with changes in extremes, such as floods, precipitation and storms (e.g. Storm Ophelia in 2017 and Storm Eleanor in 2018). We therefore need to consider our response to the more immediate short term impacts of climate change (e.g. emergency planning and how we respond to extreme weather events) while also building long-term resilience (climate change adaptation).

In response to the 2009 EU White Paper on adapting to climate change, the then Department of Environment, Community and Local Government published a National Climate Change Adaptation Framework (NCCAF) in December 2012. The publication of the NCCAF was the first step in developing a comprehensive national policy position within which adaptation measures to address the impacts of climate change could be taken and planned.

This non-statutory, but Government approved, Framework mandated the development and implementation of sectoral adaptation plans and local authority adaptation strategies which, together, would form part of the national response to the impacts of climate change.

The policy in relation to climate adaptation, first set out in the NCCAF, was subsequently restated in the *National Policy Position on Climate Action and Low Carbon Development* published in April 2014.

### ***“National climate policy in Ireland –***

- ***recognises the threat of climate change for humanity;***
- ***anticipates and supports mobilisation of a comprehensive international response to climate change, and global transition to a low-carbon future;***
- ***recognises the challenges and opportunities of the broad transition agenda for society; and***
- ***aims, as a fundamental national objective, to achieve transition to a competitive, low-carbon, climate-resilient and environmentally sustainable economy by 2050.”***

The National Policy Position provides a high-level policy direction for the adoption and implementation by Government of plans to enable the State to pursue the transition to a low carbon, climate resilient and environmentally sustainable economy by 2050; statutory authority for these mitigation and adaptation plans was subsequently provided for in the Climate Action and Low Carbon Development Act 2015 (“the 2015 Act”).

As envisaged by the National Policy Position, the evolution of climate policy in Ireland will be a dynamic, iterative process, based on the adoption by Government of a series of national mitigation plans and national adaptation frameworks over the period to 2050 with the ultimate objective of achieving the National Transition Objective by 2050. The plans will be continually updated, as well as being reviewed on a structured basis at appropriate intervals, and at a minimum, every five years.

Ireland’s first National Mitigation Plan (NMP) was published on 19 July 2017 and sets out, on a whole-of-government basis, what Ireland is doing and is planning to do to further our transition to a low carbon, climate resilient and environmentally sustainable economy by 2050.

This National Adaptation Framework (NAF), which was developed and approved in accordance with Section 5 of the Climate Action and Low Carbon Development Act 2015 complements the mitigation approach by addressing the climate resilience challenge.

The Climate Change Advisory Council (CCAC), which was established under the Climate Action and Low Carbon Development Act 2015 is an independent advisory body tasked with assessing and advising on how Ireland is making the transition to a low carbon, climate resilient and environmentally sustainable economy by 2050. The Act provides that the Minister must consult with the Climate Change Advisory Council when developing a NAF. The Minister must also publish a draft NAF for a period of statutory public consultation. These consultative processes have taken place. The Council's recommendations and comments on the consultation draft have been considered in the preparation of this Framework.

### **Purpose and Scope of the National Adaptation Framework**

Essentially, adaptation is the approach for addressing the current and future risks posed by a changing climate. The aim of adaptation is to reduce the vulnerability of our environment, society and economy and increase resilience. Adaptation also brings opportunity through green growth, innovation, jobs and ecosystem enhancement as well as improvements in areas such as water and air quality.

In accordance with the 2015 Act, this National Adaptation Framework specifies the national strategy for the application of adaptation measures in different sectors and by local authorities in their administrative areas in order to reduce the vulnerability of the State to the negative effects of climate change and to avail of any positive effects that may occur. This NAF and its successors will therefore set out the context to ensure local authorities, regions and key sectors can assess the key risks and vulnerabilities of climate change, implement climate resilience actions and ensure climate adaptation considerations are mainstreamed into all local, regional and national policy making.

Adaptation under this Framework should seek to minimise costs and maximise the opportunities arising from climate change. Adaptation actions range from building adaptive capacity (e.g. increasing awareness, sharing information and targeted training) through to policy and finance based actions. Adaptation actions must be risk based, informed by existing vulnerabilities of our society and systems and an understanding of projected climate change. Adaptation actions taken to increase climate resilience must also consider impacts on other sectors and levels of governance.

A number of resources are now in place to assist with adaptation planning. These include the online resource, Climate Ireland, Sectoral Guidelines for Planning for Climate Change Adaptation and Local Authority Climate Change Adaptation Strategy Development Guidelines. Such resources provide decision support tools and advice to assist key sectors and local government in developing their responses to the impacts of climate change. Some sectors (i.e. Agriculture and Forestry, Transport, Energy and Flood Risk Management) have already developed non-statutory plans under the 2012 Framework.

In implementing this National Adaptation Framework and the sectoral plans required under it, it will be extremely important to create an appropriate enabling environment. Within this context the respective roles of spatial planning (i.e. National Planning Framework), national capital spending, local government, civil society (i.e. the National Dialogue on Climate Action), the private sector and research will be critical in ensuring a successful outcome.

While progress is evident in creating an enabling environment for climate resilience, some barriers remain in respect of effective implementation. The key to overcoming these barriers is to promote enhanced coordination of sectors, institutions and processes involved in climate related actions while also providing for an appropriate long term funding strategy to enable coherent and effective implementation.

This NAF does not identify specific locations or propose adaptation measures or projects in relation to sectors. Respecting the principle of subsidiarity, detailed adaptation measures will be developed across sectors and local government, in accordance with the NAF. In this regard, it will be important for sectors to reflect their key priorities within the annual budgetary and estimates processes.

The structure of the National Adaptation Framework is as follows:

**Chapter 1** provides a summary of observed and projected climate change globally as well as the international and European policy drivers for adaptation to climate change. It then presents a summary of observed and projected climate change impacts in Ireland and a summary of some of the impacts that may arise in Ireland as a result of those changes.

**Chapter 2** sets out the progress on climate change adaptation planning in Ireland to date, including work undertaken at sectoral and local government level and initiatives engaging civil society and research.

**Chapter 3** provides guiding principles for adaptation at national level and steps to create an enabling environment for adaptation planning. It sets out the sectors for which adaptation plans under the NAF are proposed, along with proposals for local authority or regional level adaptation strategies.

**Chapter 4** outlines how the Framework will be implemented with revised Governance and reporting arrangements and actions and supporting objectives to be progressed.

## Sectoral Planning and Coordination

Certain sectors are likely to face similar adaptation challenges and opportunities. Close cooperation between sectors is critical in ensuring a coherent whole-of-government approach to resilience. Such an approach will also be important in identifying broad thematic areas for the sectors to work collaboratively as the process of adaptation planning becomes more embedded. This will ensure that conflicts are minimised and that synergies are realised.

The sectors and lead departments identified for the development of sectoral adaptation plans are set out in the table below:

**Table 1 Sectors and Lead Departments**

Theme	Sector Level	Lead Department for Sectoral Adaptation Plans
<b>Natural and Cultural Capital</b>	Seafood	Department of Agriculture, Food and the Marine
	Agriculture	
	Forestry	
	Biodiversity	Department of Culture, Heritage and the Gaeltacht
	Built and Archaeological Heritage	
<b>Critical Infrastructure</b>	Transport infrastructure	Department of Transport, Tourism and Sport
	Electricity and Gas Networks	Department of Communications, Climate Action and Environment
	Communications networks	
<b>Water Resource and Flood Risk Management</b>	Flood Risk Management	Office of Public Works
	Water Quality	Department of Housing, Planning and Local Government
	Water Services Infrastructure	
<b>Public Health</b>	Health	Department of Health

Local understanding is also crucial to getting adaptation right. Adaptation is an important consideration for local authorities, businesses and the general public in terms of developing the capability to mainstream climate change adaptation within all areas of existing local authority activity. In particular, building resilience to the impacts of climate at a local level for communities and businesses can be achieved in an effective manner if it is integrated into existing planning policy structures (city and county Development Plans etc.). The NAF sets the context for local adaptation strategies and also explores how local authorities might adopt a joint or regional approach to adaptation planning.

### Governance

Arising from the 2012 NCCAF, a National Adaptation Steering Committee was established in 2014 and includes representation from the key sectors and agencies. The aim of the Committee is to provide assistance and guidance to the various sectors (including local government) in the development of their sectoral/local level adaptation plans.

The Steering Committee will be reviewed and restructured to ensure that a coordinated, comprehensive and coherent approach to implementing actions under the NAF is adopted by the relevant sectors. The NAF sets out the governance arrangements required to coordinate adaptation responses, including a revised Sectoral Adaptation Steering Committee reporting to the Government's High Level "Climate Action" Steering Group, which is being established under the National Mitigation Plan and will be chaired by the Minister.

### Key Actions under the Framework

In addition to actions required to fulfil legal obligations required under the Climate Action and Low Carbon Development Act 2015 (e.g. preparation of sectoral adaptation plans), there are several additional actions proposed which will help ensure a targeted approach to achieving climate resilience into the future. These include;

- Putting in place revised governance and reporting arrangements
- Formalising the status of existing guidelines
- Formalising long term operational support for key sectors
- Facilitating the establishment of regional local authority climate action offices
- Increasing awareness around climate adaptation and resilience
- Integrating climate adaptation into key national plans and policies

These actions will need to be underpinned by supporting objectives for the Framework including, assessing key risks and vulnerabilities, developing indicators, better coordination of national research priorities, ongoing reporting at National, EU and international level, increased alignment with strategic emergency planning, and further analysis of the implications of climate change and adaptation for the private sector.

### Next Steps

Under the Climate Action and Low Carbon Development Act 2015, within three months of the approved NAF being laid before each House of the Oireachtas, the Government will request Ministers identified within this Framework submit to the Government a sectoral adaptation plan which will specify the adaptation policy measures the Minister in question proposes to adopt. These sectoral adaptation plans must then be submitted to the Government for approval within a specified period. The NAF and the sectoral plans produced under it will form part of an iterative process and will be revised at a minimum every five years to reflect developments in scientific knowledge and to facilitate the modification and escalation of adaptation actions as necessary.

# Chapter 1 Introduction and Policy Context<sup>1</sup>

### Key Messages

- Warming of the global climate system is unequivocal and it is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century.
- Observations show that global average temperatures have increased by 0.85°C (in the range 0.65 to 1.06°C) since 1850.
- In recent decades, changes in climate have caused impacts on natural and human systems on all continents and across the oceans.
- Increasing magnitudes of warming increase the likelihood of severe, pervasive and irreversible impacts.
- Uncertainties exist in relation to the extent and rate of future climate change. Addressing uncertainties is a challenge, but should not be read as an excuse for inaction as there is overall agreement on the robustness of trends and projections.
- The impacts and risks of climate change can be reduced and managed through mitigation and adaptation actions.
- Adaptation actions must be risk based, informed by the vulnerabilities of exposed societies and systems and an understanding of projected climate change.
- Changes in Ireland's climate are in line with global trends. Temperatures have increased by about 0.8°C since 1900, an average of about 0.07°C per decade over that period, and changes in precipitation regimes, sea level rise and extreme events (storms, flooding, sea surges and flash floods) are also being observed.
- Climate change will have diverse and wide ranging impacts on Ireland's environment, society, economic development, including managed and natural ecosystems, water resources, agriculture and food security, human health and coastal infrastructures and zones.
- The overall trend in Ireland is consistent with global patterns of change, with a high degree of climate variability and associated uncertainties in relation to extreme events.
- Sufficient robust information exists nationally to further progress the process of implementing adaptation actions and increasing social, economic and environmental resilience to climate change.

<sup>1</sup> The information on past and future climate in this chapter is a synthesis of a more detailed set of ongoing and project impacts on climate change from *A Summary of the State of Knowledge on Climate Change* (Desmond et al., 2017) as well as climate modelling work undertaken in *Ensemble of regional climate model projections for Ireland* EPA Research Report No. 159. (Nolan, 2015).

### Introduction

This chapter begins by providing a summary of observed and projected climate change globally as well as the International and European policy drivers for adaptation to climate change. It then presents a summary of observed and projected climate change in Ireland and a summary of some of the impacts that may arise in Ireland as a result of those changes.

### Climate Change

The fifth assessment report of the Intergovernmental Panel on Climate Change (IPCC, 2013) concluded that there is at least a 95% probability that the global warming of the last 50 years is a result of human activities, with the main contribution to this warming coming from the burning of fossil fuels. As a result, levels of atmospheric greenhouse gases (GHGs) are now 30% higher than at any time during the last 800,000 years.

***Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentration of greenhouse gases have increased. (IPCC, 2013)***

The science is therefore clear that human influence has been the dominant cause of observed climate warming since the mid-20th century. Observations show that global average temperatures have increased by 0.85 °C (in the range 0.65 to 1.06 °C) since 1850 (IPCC, 2013).

The impacts are evident on all continents and across the oceans with evidence of climate change impacts clearest in natural systems (IPCC, 2014). The projections of future global and regional climate change indicates that continued emissions of GHGs will cause further warming and changes in the components of the climate system. The largest unknown is the effectiveness of global climate policy in reducing emissions of GHGs (climate change mitigation).

***According to the IPCC (2013), it is extremely likely that more than half of the observed increase in global average temperature from 1951 to 2010 was caused by increases in GHG concentrations brought about by human activities. Human influence has been detected in warming of the atmosphere and the oceans, in changes in the global water cycle, in reductions in snow and ice, in global mean sea level rise, and in changes in some climate extremes.***

### Global Climate Change: Observed

Significant monitoring and assessment has been carried out and continues to be carried out in terms of documenting observed climate impacts as they affect our atmosphere, oceans, sea level and cryosphere.<sup>2</sup>

**Atmosphere:** each of the last three decades has been successively warmer at the Earth's surface than any of the preceding decades since 1850. In the Northern Hemisphere, 1983-2012 was likely the warmest 30-year period of the last 1400 years.

**Ocean:** ocean warming dominates the increase in energy stored in the climate system, accounting for more than 90% of the energy accumulated between 1971 and 2010. On a global scale, the ocean warming is largest near the surface, and the upper 75m warmed by 0.11°C (0.09 to 0.13°C) per decade over the period 1971 to 2010.

**Cryosphere**<sup>3</sup>: over the last two decades, the Greenland and Antarctic ice sheets have been losing mass, glaciers have continued to shrink almost worldwide and Arctic sea ice and Northern Hemisphere spring snow cover has continued to decrease in extent.

**Sea level:** the rate of sea level rise since the mid-19<sup>th</sup> century has been larger than the mean rate during the previous two millennia. Over the period 1901 to 2010, global mean sea level rose by 0.19m (0.17 to 0.21m).

### Global Climate Change: Projected

#### How do scientists predict future climate change impacts and what changes are predicted to happen globally?

Global Climate Models (GCMs) provide projections of future climate conditions based on different atmospheric GHG concentrations.

The IPCC (2013) provided the most recent systematic analysis of outputs from a range of GCMs. These models simulate changes based on a set of scenarios. The GCMs simulate many climate aspects, including the temperature of the atmosphere and the oceans, precipitation<sup>4</sup>, winds, clouds, ocean currents and sea-ice extent. The models are extensively tested against historical observations. The standard set of scenarios used in the IPCC report is known as the Representative Concentration Pathways (RCPs), which range from a business as usual emission scenario, to mitigation efforts that are in line with the temperature goals adopted in the 2015 Paris Agreement which seeks to limit global warming to well below 2°C. This Agreement is discussed further below.<sup>5</sup>

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<sup>2</sup> IPCC, 2013.

<sup>3</sup> The cryosphere is those portions of Earth's surface where water is in solid form, including sea ice, lake ice, river ice, snow cover, glaciers, ice caps, ice sheets, and frozen ground (which includes permafrost).

<sup>4</sup> Precipitation means any form of water, such as rain, snow, sleet, or hail, that falls to the earth's surface.

<sup>5</sup> Further information on the RCP's is available in the 2017 EPA report *A Summary of the State of Knowledge on Climate Change Impacts for Ireland*.

The RCPs describe various climate futures, all of which are considered possible depending on how much GHGs are emitted in the years to come. The analysis of future scenarios (i.e. projected global climate change) indicates the following trends:

**Atmosphere (temperature):** global surface temperature change for the end of the 21<sup>st</sup> century *is likely*<sup>6</sup> to exceed 1.5°C relative to the period 1850 to 1900 for all RCP scenarios except RCP 2.6. Warming will continue beyond this period and will continue to exhibit variability and will not be regionally uniform.

**Atmosphere (water cycle):** changes in the global water cycle in response to warming over the 21<sup>st</sup> century will not be uniform. The contrast in precipitation between wet and dry regions and between wet and dry seasons will increase, although there will be regional exceptions. Extreme precipitation events over most of the mid latitude land masses and over wet tropical regions will *very likely* become more intense and more frequent by the end of this century, as global mean surface temperature increases.

**Ocean:** the global oceans will continue to warm during the 21<sup>st</sup> century. Heat will penetrate from the surface to the deep ocean and affect ocean circulation. There has been an increase in ocean acidity of 26% since pre-industrial times, with a 170% increase predicted by 2100 if human CO<sub>2</sub> emissions continue to increase at their current rate (IPCC, 2013).

**Cryosphere:** it is *very likely* that the Arctic sea ice cover will continue to shrink and thin, and that Northern Hemisphere spring snow cover will decrease during the 21<sup>st</sup> century as global mean surface temperatures rises. Global glacier volume will further decrease.

**Sea level:** global mean sea level will continue to rise during the 21<sup>st</sup> century. Under all RCP scenarios, the rate will *very likely* exceed that observed during 1971 to 2010 due to increased ocean warming and increased loss of mass from glaciers and ice sheets.

### Extreme Weather and Climate Events

Climate change not only means changes in the average climate such as temperature but also changes in the frequency and intensity of extreme weather and climate events. Extreme events such as severe flooding, droughts, and heat waves/cold waves can have important socio-economic consequences. Changes in their frequency and intensity are therefore of particular interest to policymakers and stakeholders (Nolan, 2015).

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6 For explanation of likely, very likely etc. in this context see IPCC (2014) Summary for Policymakers. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

Changes in many extreme weather and climate events have been observed since about 1950. Some of these changes have been linked to human influences, including a decrease in cold temperature extremes, an increase in warm temperature extremes, an increase in extreme high sea levels and an increase in the number of heavy precipitation events in a number of regions (IPCC, 2013). The IPCC (2012) concluded that:

- It is virtually certain that increases in the frequency and magnitude of warm daily temperature extremes and decreases in cold extremes will occur through the 21<sup>st</sup> century at the global scale. It is very likely that the length, frequency, and/or intensity of warm spells or heat waves will increase over most land areas.
- It is likely that the frequency of heavy precipitation or the proportion of total rainfall from heavy rainfalls will increase in the 21<sup>st</sup> century over many areas of the globe.
- It is very likely that mean sea level rise will contribute to upward trends in extreme coastal high water levels in the future.
- There is high confidence that changes in heat waves, glacial retreat, and/or permafrost degradation will affect high-mountain phenomena such as slope instabilities, mass movements, and glacial lake outburst floods. There is also high confidence that changes in heavy precipitation will affect landslides in some regions.

Confidence in projecting changes in the direction and magnitude of climate extremes depends on many factors, including the type of extreme, the region and season, the amount and quality of observational data, the level of understanding of the underlying processes, and the reliability of their simulation in models.

***Climate change will amplify existing risks and create new risks for natural and human systems. Risks are unevenly distributed and are generally greater for disadvantaged people and communities in countries at all levels of development. Continued high GHG emissions would lead to mostly negative impacts for biodiversity, ecosystem services and economic development and would amplify risks for livelihoods, food and human security (IPCC, 2013).***

### Tipping points

The precise levels of climate change sufficient to trigger tipping points (thresholds for abrupt and irreversible change) remain uncertain, but the risk associated with crossing multiple tipping points in the earth's systems or in interlinked human and natural systems increases with rising temperature. Severe and widespread impacts, resulting from exceeding tipping point thresholds, could include substantial species extinctions, large risks to global and regional food production, and a combination of high temperatures and humidity, compromising normal human activity (IPCC, 2014).

Assessing the probability of triggering a tipping point requiring a transition is essential for assessing the risks related to climate change. Traditionally, these transitions are estimated as having a low probability of occurrence, but with a great impact on society. Relevant tipping points for global climate change could include:

- accelerated loss of mass of the Greenland and West Antarctic ice sheets;
- significant loss of Arctic sea ice and the Alpine glaciers; and
- collapse of Atlantic Thermohaline Circulation (THC). The probability of collapse of this circulation is estimated to be low, even for high temperatures. However, changes in the intensity of the THC may have significant impact regionally without actually crossing the tipping point for collapse. (Lenton et al, 2007).

Recent significant changes in Antarctica's biggest ice-shelf systems have drawn attention to the impact of a changing climate due primarily to human activity and the implications for sea level rise of some tipping points.

### Uncertainty and Climate Change

Within the above context, a further point to note is that we might not be able to link all extreme weather to climate change. Natural variability in the Earth's atmosphere also plays an important role and this will continue to be important for Ireland and globally. However, increasingly climate change is a compounding factor leading to often subtle, but important changes in the intensity, frequency and impact of extreme events. For example, while the interaction between a storm surge and sea level during storm conditions may not have been an issue in the past, with additional sea level rise this could enable the surge to breach defences.

It is important therefore that climate change risk and vulnerability assessments are informed by the full range of possible climate futures, as predicted by existing climate models. It may be useful to indicate a most likely scenario, but extremes such as worst and best case scenarios should also be considered.

The level of uncertainty associated with climate change projections does not however imply a "wait-and-see" attitude to adaptation. Improvements in our ability to make climate projections are unlikely to ever reach a level that will completely eliminate uncertainties about the future. The general trends observed to date in climate projections are likely to remain the same even as the levels of uncertainty about these projections falls. Uncertainty should strengthen the case for early investment in climate protection and resilience that could help avoid locking in future exposure to climate risks by limiting the range of potential adaptation measures available (McDermott, 2016).

Uncertainty surrounding mitigation efforts is compounded by uncertainty surrounding the future impacts of climate change as well as embedded short-term investment horizons that do not necessarily apply when we are discussing impacts that may not arise for at least several decades. This presents a great challenge at all levels of policy and decision making. In the longer-term, i.e., beyond 2030, one of the key uncertainties relates to the ambition and effectiveness of future international actions to address the drivers of climate change, i.e., to reduce emissions of GHGs. This will eventually determine the full extent of climate change and the level of adaptation that will be required. While many issues remain to be resolved, the emerging literature and practical examples have demonstrated methods for incorporating

uncertain climate change information into local decision making including reducing the sensitivity to uncertainty and providing flexibility within the design and decision making process. Continued variabilities in the Irish climate and the uncertainties associated with them will further challenge Ireland's adaptation efforts.

Uncertainties should not be read as an excuse for inertia in addressing climate change. There is overall agreement on the robustness of trends and projections of key climate variables and associated impacts such as temperature and sea level rise at global and continental scales. Rather than a barrier to action, uncertainty may be treated as a motivation to take a precautionary approach to climate change.

***Rather than a barrier to action, uncertainty may be treated as a motivation to take a precautionary approach to climate change***

### Economic Basis for Adaptation

Adaptation is the only way to deal with unavoidable impacts of climate change and additionally offers an opportunity to adjust economic activity in vulnerable sectors and support sustainable development (Stern, 2007).

Adaptation seeks to minimise cost, enhance the effectiveness of actions taken and maximise the opportunities arising from climate change. Adaptation actions can also contribute towards achieving other policy objectives (co-benefits). There is a large body of scientific literature demonstrating the benefits of early, anticipative or preventative adaptation in investment decision making. The first question that should be asked when justifying adaptive investments is the potential value or benefit of such investments in terms of the avoided losses that would be incurred in their absence. It is also important that the potential benefits identified capture the contribution of the adaptation action towards achieving other policy and development objectives. The international evidence on costs of climate impacts is developing rapidly but with some limitations. However, well-planned, early adaptation has been shown to save lives and money in the medium to longer term (Oreskes et al. 2010; Tanner & Rentschler, 2015).

#### Global costs of climate impacts

Knowing the potential costs of climate impacts is a pre-requisite for developing adaptation strategies. From a purely cost-benefit perspective, the present value of avoided or reduced climate impacts in the future represents the "benefit" of any proposed investments in adaptation. Global estimates suggest mean costs of climate impacts in the region of 1-2% of global GDP for warming of 2.5°C, rising to about 3% of global GDP for 3°C of warming, with the worst off regions losing 10-20% of GDP per year (Tol, 2009). Stern (2007) estimated the cost of unabated climate change at between 5% and 20% of global GDP annually.

However, it is widely accepted that such global level, aggregated, estimates have tended to understate the economic costs of climate change, in part due to important omitted impacts – such as the costs of more extreme weather events, or the indirect economic effects of social or political disruptions due to climate change (Revesz et al., 2014; Stern, 2016).<sup>7</sup> Translating global (or even regional) estimates of the costs of climate impacts to the national level is difficult and would need to consider issues such as where climate change will have most impact, the individual structure of the economy and the relative exposure of economic assets across countries which would be very relevant for a small country like Ireland.

### Socio-economic context

It is also important to take note of the social and economic policy context surrounding adaptation action. Climate change is likely to disproportionately impact on the lowest socio-economic groups in society, these groups are also the worst positioned to adapt to the changing climate. Other socio-economic changes such as urbanisation and increasing population are also likely to pose further challenges to adaptation. Failing to consider climate risks and adaptation is likely to enhance existing vulnerabilities and could potentially give rise to new ones. In enabling a just transition it is therefore important that all adaptation planning takes these considerations into account and factors them into policy making.

### International and EU Policy Context

The global challenge as described above warrants a substantial response from the international community. A substantial body of international and EU climate change policy now exists to guide the development of national policy. These policies frame the objective of transitioning to climate resilience and realising inherent opportunities. It is worth noting that the international policy interventions set out below are mutually reinforcing when it comes to the objective of addressing climate change. In particular, the Paris Agreement, Agenda 2030 Sustainable Development Goals and the Sendai Framework for Disaster Risk Reduction pursue common goals of low carbon, climate resilient sustainable development (Desmond, 2018 in print).

Adaptation is currently high on the global climate change policy agenda. At an international level, the United Nations Framework Convention on Climate Change<sup>8</sup> (UNFCCC) has been at the centre of efforts to address the issue. The UNFCCC refers to adaptation in several of its provisions. For example, Article 4.1(b) provides that All Parties (to the Convention) shall:

***“formulate, implement, publish and regularly update national and, where appropriate, regional programmes containing measures to ... facilitate adequate adaptation to climate change.”***

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7 A recent survey of US economists found that the majority believe costs of climate change are underestimated in standard climate-economy models (P.Howard & Sylvan, 2015).

8 The UNFCCC was adopted in 1992 at the Earth Summit in Rio de Janeiro as the basis for a global response to the problem of climate change.

and Article 4.1(f) provides that All Parties shall:

***“Take climate change considerations into account, to the extent feasible, in their relevant social, economic and environmental policies and actions, and employ appropriate methods, for example impact assessments, formulated and determined nationally, with a view to minimising adverse effects on the economy, on public health and on the quality of the environment, of projects or measures undertaken by them to mitigate or adapt to climate change.”***

The Conference of the Parties (COP)<sup>9</sup> to the UNFCCC has made several decisions with regard to climate change adaptation. The Paris Agreement (COP 21) of 12 December 2015<sup>10</sup> committed 195 countries to the mitigation goal of limiting the increase in global temperature to well below 2°C above pre-industrial levels. The agreement also places significant importance on actions needed, both nationally and globally, to help people adapt to climate change. Successive COPs since then have reaffirmed commitments in this regard.

Article 2.1(b) of the Agreement establishes a long-term adaptation goal as follows:

“This Agreement ... aims to strengthen the global response to the threat of climate change by:  
***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”.***

Article 7 elaborates on this long-term goal by establishing a global 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 global goal explicitly links adaptation to the mitigation goal of limiting global temperature rise to well below 2°C and, paragraph 4 of Article 7, makes it clear that if mitigation activities succeed in limiting the rise in global temperature, less adaptation will be needed to deal with the consequences of climate change. However, current commitments to reduce emissions, even if fully implemented, will lead to an estimated 2.7°C rise in average global temperatures. Global emissions would need to peak soon and then decline rapidly for the Paris Agreement goals to be feasible. Even in this scenario, uncertainty about the sensitivity of the climate to GHGs means there would remain at least a small chance of 4°C or more of warming by 2100.

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9 Established under the UNFCCC to keep the implementation of the Convention and any other legal instruments that it may adopt under regular review.

10 United Nations/Framework Convention on Climate Change (2015) Adoption of the Paris Agreement, 21st Conference of the Parties, Paris: United Nations.

The case of sea level rise (SLR) is particularly illustrative in illustrating the difference between a 1.5°C scenario and a 2°C scenario. In a 1.5°C scenario, the rate of SLR in 2100 would be reduced by about 30% compared to a 2°C scenario (Schleussner et al, 2016). This illustrates how limiting warming to 1.5°C would significantly reduce the risks and impacts of climate change as set out in the Paris Agreement. Therefore, it is prudent to work towards the 1.5°C mitigation goal since the additional climate change impacts that would be avoided are quite significant, requiring further and deeper adaptation actions.

Article 7 also recognises that adaptation is required at the national, subnational, regional and local as well as the international level and that action should follow a country-driven, gender-responsive, participatory and fully transparent approach, taking into consideration vulnerable groups, communities and ecosystems. In accordance with Article 7, each country must formulate and implement national adaptation plans including assessments of climate change impacts and vulnerability and build the resilience of socio-economic and ecological systems, including through economic diversification and sustainable management of natural resources.

### United Nations Sustainable Development Goals

The 2030 Agenda for Sustainable Development, which includes 17 Sustainable Development Goals (SDGs), was agreed by world leaders at the UN General Assembly in September 2015 and is a historic global agreement to eradicate extreme poverty and achieve sustainable development. The Goals are the successor to the Millennium Development Goals (MDGs) but apply both domestically and internationally.

The SDGs cut across a range of pressing environmental challenges of our time and aim to directly combat these, in particular through *SDG 13: Climate Action*. SDG 13 has the following targets relevant to the National Adaptation Framework:

- Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.
- Integrate climate change measures into national policies, strategies and planning.
- Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.

### Sendai Framework for Disaster Risk Reduction 2015-2030<sup>11</sup>

The Sendai Framework is a 15-year, voluntary, non-binding agreement which recognises that Governments have the primary role to reduce disaster risk but that responsibility should be shared with other stakeholders including local government, the private sector and other stakeholders. It aims for the following outcome:

*The substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries.*

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<sup>11</sup> <http://www.unisdr.org/we/coordinate/sendai-framework>

The Sendai Framework is the successor instrument to the Hyogo Framework for Action (HFA) 2005-2015: Building the Resilience of Nations and Communities to Disasters. The Framework has seven global targets and 4 priorities for Action in relation to disaster risk reduction.

At International and European level, there is an emerging acknowledgement of the need to enhance coherence and complementarity between the Paris Agreement, the Sendai Framework for Disaster Risk Reduction as well as the UN Sustainable Development Goals. The Sendai Framework specifically recognises the opportunity to enhance coherence across policies, institutions and goals and seeks to ensure credible links, as appropriate, between these processes.

### **Climate Change Adaptation (CCA) and Disaster Risk Reduction (DRR)**

Climate Change Adaptation (CCA) and Disaster Risk Reduction (DRR) are both relevant to the main goals of the UN 2030 Agenda for Sustainable Development. For its part the Sendai Framework identifies climate change and variability as a driver of disaster risk, along with uncontrolled urbanisation and poor land management and that tackling these is expected to lead to a sizeable reduction of disaster risk. Of equal importance, the Paris Agreement also requires major action to adapt to the adverse impacts of climate change and to enhance climate resilience, thus contributing to sustainable development.

Within this context a recent European Environment Agency (EEA) report<sup>12</sup> noted efforts to reduce disaster risk and at the same time adapt to a changing climate have become a global and European priority. The report covers how climate change adaptation (CCA) and disaster risk reduction (DRR) provide a range of complementary approaches for managing climate risks in order to build resilient societies.

The report further notes how both are cross-cutting and complex development issues with variations, i.e. CCA addresses weather and climate related hazards and focuses on the future by addressing uncertainty and new risks, while DRR focuses on the present by addressing existing risks from all hazards.

Notwithstanding many innovative practices in Europe, the EEA report highlighted a need to foster coherence between DRR and CCA policies, practices and knowledge. Such coherence, the report highlights, can be achieved by ensuring effective coordination and collaboration between the national, provincial and municipal administrations (i.e. multi-level governance).

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12 Climate change adaptation and disaster risk reduction in Europe, EEA report no 15/2017

### European Union

At European Union (EU) level, the European Commission published a White Paper<sup>13</sup> on adapting to climate change in 2009 which was followed by publication of a strategy on adaptation in April 2013.<sup>14</sup> The EU Adaptation Strategy has an overall aim of contributing to a more climate-resilient Europe and focuses on three key objectives:

- 1) Promoting action by member states** – the Commission will encourage all member states to adopt comprehensive adaptation strategies and will provide funding to help them build up their adaptation capacities and take action. It will also support adaptation in cities through Mayors Adapt and the Covenant of Mayors for Climate and Energy.
- 2) ‘Climate proofing’ action at EU level** – by further promoting adaptation in key vulnerable sectors such as agriculture, fisheries and cohesion policy, ensuring that Europe’s infrastructure is made more resilient, and promoting the use of insurance against natural and man-made disasters.
- 3) Better informed decision making** – by addressing gaps in knowledge about adaptation and further developing the European climate adaptation platform (Climate-ADAPT) as the ‘one-stop shop’ for adaptation information in Europe.

Progress on adaptation internationally is monitored and evaluated by instruments such as the UNFCCC National Communications while in member states instruments such as the Mechanism for Monitoring and Reporting and the EU Adaptation Preparedness Scoreboard are used. The 2013 EU Adaptation Strategy is currently under review with a view to assessing how effective the strategy has been in facilitating EU wide progress on adaptation. The review is scheduled to conclude in 2018.

### Adapting for Resilience

Adaptation addresses the current and future risks posed by a changing climate. The aim of adaptation is to reduce vulnerability of our environment, society and economy and increase resilience. Actions that bolster climate resilience are ones that enhance adaptive capacity of social, industrial and environmental infrastructures and mitigate the effects of climate change (Adger, 2005). Effective adaptation brings opportunities through green growth, innovation, jobs and ecosystem enhancement as well as co-benefits in areas such as water and air quality. This is why adaptation is important now to build a climate resilient Ireland.

Adaptation actions range from building institutional and organisational capacity (e.g. increasing awareness, sharing information and targeted training) through policy and finance based options and on to engineering and green solutions. Examples of adaptation measures might include using scarce water resources more efficiently; adapting building or planning codes to future climate conditions and extreme weather events; building new or raising the level of existing flood defences; choosing tree species and forestry practices less vulnerable to storms; and setting aside land corridors to help species migrate. Measures are typically categorised as ‘soft’, ‘green’ and ‘grey’ as follows:

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13 Adapting to climate change: Towards a European framework for action: COM (2009) 147 final, Brussels, 1.4.2009.

14 An EU strategy on adaptation to climate change: COM (2013) 216 final, Brussels, 16.4.2013.

- Soft adaptation involves alteration in behaviour, regulation or system of management, examples include: Extending timeframes of plans further into the future; zoning development away from sensitive areas; and instituting or strengthening building codes in hazard prone areas.
- Green adaptation measures seek to utilise ecological properties to enhance the resilience of human and natural systems to climate change impacts. For example, the re-installment of dune systems to act as buffers against coastal storm damage;
- Grey adaptation measures involve technical or engineering solutions to climate impacts, examples include the construction of sea walls and tidal barrages.

(Source: EEA, 2013. *Adaptation in Europe – Addressing risks and opportunities from climate change in the context of socio-economic developments. Report No 3/2013*)

### Climate Change in Ireland: Now and into the Future

The direct impacts of climate change include increasing temperatures, changes in precipitation regimes, sea level rise, changes in the variability and extremes of storms, flooding, sea surges and flash floods. These will have resulting impacts on our environment, society and economy.

***Some risks associated with climate change are considerable, even at 1°C global mean temperature increase above pre-industrial levels. Many global risks are high to very high for global temperature increases of 4°C or more. For example, an analysis of floods and droughts together in Europe shows that the impact of a +2°C global warming will be most extreme for France, Spain, Portugal, Greece, Albania and Ireland (Roudier et al., 2015).***

Changes in Ireland's climate are in line with global trends. Temperatures have increased by about 0.8°C over the period 1900-2012 – an average of about 0.07°C per decade. The temperature has varied over the period, with colder than normal episodes in the early part of the twentieth century and some cold years in the 1960s and 1970s. Higher temperatures were recorded from the early 1930s to 1960 and from the late 1980s to the present. The overall trend is upwards and consistent with global patterns of change (Dwyer, 2012).

Due to the slow response time of the climate system, changes are projected to continue and increase over the coming decades. Even if GHG emissions came to an end, some changes, such as sea-level rise, are projected to continue up to and beyond the end of this century.

### Climate Change in Ireland: Observed

Observational information and data for over 40 Global Climate Observation System (GCOS) Essential Climate Variables highlight changes and trends in aspects of Irish climate which are relevant to our atmosphere, our seas and our physical landscape. In terms of what has been observed for Ireland in respect of these three key areas, the following is noted<sup>15</sup>:

- Temperatures have increased by about 0.8°C since 1900, an average of 0.07°C per decade.
- The number of annual frost days has decreased whilst the number of warm days has increased.
- Average annual national rainfall has increased by approximately 60mm or 5% in the period 1981 to 2010, compared to the 30-year period 1961 to 1990. However, clear changes in rainfall spatial patterns across the country cannot be determined with a high level of confidence.
- Concentrations of other greenhouse gases including methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) are approximately 140% and 20% respectively above pre-industrial values and concentrations continue to increase.
- Current carbon dioxide (CO<sub>2</sub>) concentrations as measured at Mace Head, Co. Galway are in line with observations from around the globe and are higher than at any time over at least the last 400,000 years.
- Mean annual sea surface temperature, as measured at Malin Head, Co. Donegal, is now more than 1.0°C higher than the long-term average calculated for the period 1961-1990.
- Global surface ocean acidity has increased by over 30% since the Industrial Revolution. Observations in sub-surface and deep offshore waters around Ireland between 1991 and 2010 show significant increases in acidity.
- Historically, sea level has not been measured with the necessary accuracy to determine sea level changes around Ireland. However, measurements from Newlyn, in southwest England, show a sea level rise of 1.7cm per decade since 1916. These measurements are considered to be representative of the situation to the south of Ireland.
- Analysis of long-term river flows from over 40 measurement sites around the country shows a tendency for increasing annual mean flows. Moreover, seasonal analysis indicates that summer mean flows are dominated by increasing trends while there is a tendency also for increases in winter mean flows.
- Observations of the timing of bud-burst for a number of tree species at the phenological gardens<sup>16</sup> indicate that the beginning of the growing season is now occurring more than a week earlier than in the 1970s, leading to an extension of the growing season. Such changes have been linked to a rise in average spring air temperature.

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<sup>15</sup> Dwyer, 2012.

<sup>16</sup> Phenology is the scientific study of the timing of recurring life-cycle events in plants and animals in relation to environmental factors. Phenological Gardens are a network for the observation of plants.



Left: Vartry reservoir during a period of drought in 2000

### Drought and Warmer Summers<sup>17</sup>

Over the period 1900-2014 the hottest summer in Ireland was 1995, which was also the driest summer in that 114 year period. This hot and dry summer was associated with increased mortality (especially among the elderly and infirm). Lower rainfall levels

and water shortages adversely impacted the agricultural sector. Water shortages were also a common occurrence, with record low water levels on the Shannon impacting tourism, while water supplies for major cities like Dublin were put under severe pressure. Using historical weather observations research has shown that experiencing a summer as hot as 1995 has become 50 times more likely over the last century, while the chances of a summer as dry as 1995 occurring have doubled.

Under business as usual greenhouse gas emissions, climate model projections for the end of this century suggest that 1995, the hottest summer in modern Irish history may be seen as an unusually *cool* summer in the future. By the end of this century, summers *as cool as* 1995 may only occur once every 7 years, or so. That translates into summers *at least as hot as* 1995 occurring almost 90 percent of the time. The same climate models suggest that summers as dry as 1995 may become 10 times more frequent by the end of the century. Such changes, in the absence of adaptation, must be of concern given the impacts experienced and vulnerabilities exposed.

Over the period 1850-2015, seven drought rich periods occurred across the island of Ireland; 1854-1860, 1884-1896, 1904-1912, 1921-1923, 1932-1935, 1952-1954 and 1969-1977. Examination of these periods across individual rainfall records reveals substantial variations in drought development, severity and spatial extent across the island. Impacts from severe drought periods, compiled from newspaper reports, include;

- reduced or failed crop yields,
- increased crop and dairy prices,
- human and livestock health issues,
- water restrictions,
- low reservoir levels,
- water supply failures and
- hydro-power reductions.

The results of this analysis show that Ireland is drought prone but recent decades, especially since the 1980s, are unrepresentative of the longer-term drought climatology. Although occasional intense drought events have occurred in this period (e.g. 1995, 2006, 2013) these have been relatively short-lived. This highlights the importance of long-term quality assured weather records. If we were to identify weather extremes and climatic trends in assessing resilience to climate variability by using only the most recent 30-year period, then the risks posed by protracted drought events would be missed – potentially resulting in bad adaptation decisions. The combination of droughts of various duration, evolution and intensity identified as part of the Irish Drought Catalogue, provide a diverse set of conditions under which to stress-test current and planned infrastructure, particularly in the water sector.

<sup>17</sup> This section was adapted from case study material provided by Dr Conor Murphy, Maynooth University. Full citations for the underlying source material are included in the bibliography.

### Climate Change in Ireland: Projected

#### Climate impacts – 2050 and beyond

Regional Climate Modelling (RCM) simulations have been used to assess the impacts of a warming climate on the mid-21<sup>st</sup>-century climate of Ireland (Nolan, 2015). The RCM simulations were run at high spatial resolution, up to 4km, thus allowing a better evaluation of the local effects of climate change. Simulations were run for a reference period 1981-2000 and future period 2041-2060. Differences between the two periods provide a measure of climate change. The following mid-century climate projections were noted for atmosphere, terrestrial and ocean environments.

- **Temperature:** mean annual temperatures will increase by 0.90-1.7°C, with the largest increases seen in the east of the country.
- **Hot days** (defined as top 5% of maximum daily summer temperature) will get warmer by 0.7-2.6°C compared with the baseline period.
- **Cold nights** (defined as bottom 5% of minimum daily winter temperature) will get warmer by 1.1-3.1°C.
- **Frost days** averaged over the whole country, the number of frost days (defined as a day when the minimum temperature is less than 0°C) is projected to decrease by over 50%.
- **Growing season:** the average length of the growing season<sup>18</sup> will increase by over 35 days per year (Nolan, 2015).
- **Precipitation:** results show significant projected decreases in mean annual, spring and summer precipitation amounts by mid-century. The projected decreases are largest for summer, with reductions ranging from 0% to 20%.
- **Heavy rainfall events** will increase in winter and autumn (Nolan, 2015).
- **Wind and extreme events:** the energy content of the wind is projected to decrease during spring, summer and autumn. The projected decreases are largest for summer, with values ranging from 3% to 15% (Nolan, 2015).
- **Storms** affecting Ireland will decrease in frequency, but increase in intensity, with increased risk of damage (Nolan, 2015).
- **Surface water** (rivers and lakes) and runoff: Intensification of the hydrological cycle, leading to both increased incidences of high and low flow periods (Murphy, Harrigan, Hall & Wilby, 2013).
- **Sea level rise:** rise of c.55-60cm to 2100 (based on medium scale climate warming scenarios, viz. (Dunne et al., 2008; Lowe et al., 2009). Changes in mean sea level predicted will be the primary driver in magnifying the impacts of changing storm surge and wave patterns in coastal areas.
- **Regional sea level rise**, allowing for isostatic components<sup>19</sup>, of c.25cm (Dublin/east coast Ireland), c.44cm Sligo/central western coasts, c.40cm south west Ireland by c.2080-2100 (Devoy, 2008).

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18 Within a period of 12 months, the thermal growing season length is officially defined as the number of days between the first occurrence of at least six consecutive days with daily mean temperature > 5°C and the first occurrence of at least six consecutive days with daily mean temperature < 5°C.

19 Isostatic sea level change is the result of an increase or decrease in the height of the land.

### Climate Change: Sectoral Impacts

The above observations confirm that Ireland's climate is changing in terms of sea level rise, increases in average temperature, changes in precipitation patterns, and weather extremes. These changes are projected to continue and increase over the coming decades (Gleeson et al, 2013; Nolan, 2015) and projected changes include: temperature rise, changes in the frequency and intensity of extreme weather events; increased flows to river catchments; ongoing sea level rise; and changes in precipitation patterns and regimes. Observed and projected climate changes and impacts are also outlined in Table 2.

These changes, in turn, will impact on a number of key socio, economic and environmental sectors in different ways which will require appropriate and relevant sectoral responses within the context of this Framework. Examples of such impacts are provided below in Box 1.

#### Box 1 Negative sectoral impacts arising from climate change

**Agriculture:** All aspects of Irish agriculture will be affected by climate change. The main impacts will result from changes in air and soil temperatures, changes in rainfall patterns and extreme events. Key impacts could include water stress for crops, heat stress for animals, plant diseases which are currently rare may occur more frequently and the mobility of machinery on fields may be affected due to increased levels of winter rainfall.

**Forestry:** Changes in climate will significantly affect forestry operations in Ireland and, when planning, foresters must adopt/adapt management practices that ensure the resilience of Irish forestry in a changing climate. Key impacts of warmer temperatures could include changes in the spatial and temporal dynamics of pest species and projected increases in periods of summer drought will cause difficulties in the establishment of forests where roots have not yet fully developed.

**Biodiversity:** Ireland's natural landscape is one of its greatest assets and climate change is expected to have significant impacts and exacerbate existing pressures. Increasing temperatures will impact on the geographical range and phenology (the timing of lifecycle events) of native species. Projected shifts in climate, temperature and precipitation, may result in the increased occurrence of invasive species and competitive pressures for Ireland's native species.

**Coastal areas:** Coastal erosion and flooding currently pose a serious risk to Ireland's coastal areas and this is particularly the case as Ireland's major cities and key pieces of infrastructure are located on the coast. Key impacts include inundation of coastal areas, increase in the intensity of cyclones which will result in more extreme storm activity and an increase in coastal erosion.

**Critical infrastructure:** Water, energy, communications, transport, emergency services are at risk from a range of projected changes including sea level rise, increasing temperatures, changing rainfall patterns and extreme weather events. Ireland's ports will be placed at increased risk due to storm surges. Most of Ireland's power stations, oil refineries and storage facilities are located on the coast and are therefore vulnerable to sea level rise, storm surges and higher waves. Extreme floods will affect dam safety, while extreme winds will damage overhead powerlines.

### Box 1 Negative sectoral impacts arising from climate change – continued

**Marine and fisheries:** Projected changes in sea level, coastal flooding and erosion, and physicochemical changes in the marine environment will have wide-ranging implications for the Marine and Fisheries sector. For example, increased sea surface temperatures will affect the biogeographical ranges of species distribution including major commercial fish stocks. There will likely be a reduction in the range of some northerly species, while southerly species are likely to increase their range northward. Warmer waters support lower levels of dissolved oxygen and provide favourable conditions for the growth of algal blooms.

**Water management:** Climate change will pose significant risks to water management and will exacerbate existing pressures in terms of water supply, quality and flooding. For summer and autumn, projected decreases in surface water flows and increased levels of evapotranspiration will mean a decrease in levels of available water resources and this may lead to problems of water supply.

**Human health and wellbeing:** Increases in extreme events will have significant impacts on health and wellbeing including risk of physical injuries/death, mental health effects from loss and displacement, such as from flooding and waterborne infectious diseases.

Source: Climate Ireland<sup>20</sup> – [www.climateireland.ie](http://www.climateireland.ie)

### Opportunities

Effective adaptation strategies will also involve preparing to capitalise on opportunities (Mendelsohn, 2012). Climate change may present a number of potential economic opportunities for Ireland. In particular, climate change could result in changing comparative advantage, creating opportunities particularly if climate impacts are less severe for Ireland than competing regions.

Such effects might be particularly relevant for tourism and foreign direct investment. In the high-tech sector for example micro-chip manufacturing requires substantial amounts of very pure water; while the location of data centres is influenced by ambient air temperatures, (given their high energy requirements for cooling). Furthermore, intense international competition for talented workers means that the relative attractiveness of a location (i.e. moderate climate) can also have a bearing on the ability to hire specialist skilled workers. For Ireland, relative changes in temperature and rainfall may present more favourable environmental conditions in certain contexts. This could potentially affect sectors such as agriculture, forestry, biodiversity and the marine environment

In the case of the tourism sector, Ireland has also the potential to capitalise on potential increases in visiting tourist numbers who are looking for moderate cooler temperatures. However, from a planning perspective, it will also be important to examine such trends through the increased pressure on our tourism infrastructure. Another potential economic opportunity for Ireland is the adaptation economy. This is discussed further in Chapter 3.

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<sup>20</sup> Climate Ireland was developed by researchers working at MaREI, University College Cork (UCC) and as part of the EPA-funded Climate Information Platform for Ireland (ICIP) project. It aims to deliver climatic and adaptation information that is of direct relevance to climate adaptation planning in Ireland. Material from Climate Ireland was subsequently updated to reflect a number of submissions received during the statutory public consultation process

Most national responses to climate change adaptation will understandably prioritise reducing the risks of the negative impacts of climate change. Discussion of the potential opportunities or benefits of climate change can be a controversial topic. However, given that a certain degree of climate change is already locked into the climate system no matter what mitigation outcomes are achieved, a coherent and efficient adaptation policy response to climate change will also have to consider any potential benefits created by these impacts.<sup>21</sup> Box 2 below references a range of possible opportunities that may arise in a number of sectors in Ireland.

### Box 2 Sectoral opportunities associated with climate change

**Agriculture:** Autumn and spring grass yields may increase due to higher temperatures and increased levels of atmospheric CO<sub>2</sub> and adverse impacts of climate change elsewhere may create new market opportunities for Irish farmers. Fewer cold snaps may result in less frost damage to spring crops.

**Forestry:** Increasing temperatures are expected to increase the length of the growing season and result in increased tree growth. Many species, including Sitka Spruce, are sensitive to frost and central Ireland is particularly prone to late spring frosts. Projected decreases in cold snaps may mean that foresters can plant less hardy species.

**Biodiversity:** The use of green adaptation options can have significant co-benefits in terms of the conservation of important habitats and species. For example, wetlands and functioning coastal habitats can regulate water and provide natural flood defences for coastal and inland areas while also protecting important habitats for plants, birds and animals.

**Coastal areas:** Warming waters may bring additional opportunities for recreation and the tourism sector; they may also bring opportunities for the fisheries sector as new fish species will likely move from the southerly latitudes following warmer waters. For areas subject to coastal erosion, their managed retreat may contribute to ecosystem health and biodiversity.

**Critical infrastructure:** Ireland's location provides a favourable setting for the generation of renewable energy, e.g. wind and wave energy. Less snow and ice in winter would lead to fewer transport disruptions, decreased levels of frost/ice damage and decreased requirements for grit on roads.

**Marine and fisheries:** Climate change may make conditions more favourable for some high value species. For example, species currently present on the south coast of Ireland or in northern France, such as turbot *Psetta maxima* and sea bass *Dicentrarchus labrax* will have increased opportunities to become better established in Ireland. Boarfish and anchovy populations are also set to increase in Irish waters.

**Human health and wellbeing:** Projected increase in temperatures is expected to result in a decrease in levels of cold-related mortality, specifically respiratory and cardio vascular mortality and for those aged over 65 years.

Source: Climate Ireland<sup>22</sup> – [www.climateireland.ie](http://www.climateireland.ie)

21 The Climate Action and Low Carbon Development Act 2015 requires that the Framework consider the strategy for how sectors and local authorities can avail of any positive effects of climate change that may occur.

22 Material from Climate Ireland was subsequently updated to reflect a number of submissions received during the statutory public consultation process.

### Summary

Climate change is happening. It is being observed on all continents and oceans. Projections of future global and regional climate change demonstrate that continued emissions of greenhouse gases will cause further warming and changes in the components of the climate system.

Ireland's climate is changing in line with global trends. Future changes are projected for temperature, precipitation, sea level rise and extreme events. Such changes will impact on all natural and managed systems, water resources, agriculture and food security, human health, and coastal infrastructures and zones.

The character and severity of impacts (on sectors, regions) from climate change and extreme events depends not only on climate-related hazards but also on exposure (people and assets at risk) and vulnerability (susceptibility to harm) of human and natural systems. Each of these components has to be assessed to provide a fuller understanding of specific sectoral and regional risks. On this basis, strategies must be devised to reduce and manage climate change risks through a combination of mitigation and adaptation responses. Ireland's adaptation response to date and this Framework's requirements to develop it further are outlined in the remainder of this document.

Table 2 Summary of observed and projected climate changes and impacts for Ireland

Parameter	Observed	Projected	Example of Biophysical Impacts
 <p><b>Temperature</b></p>	<ul style="list-style-type: none"> <li>Average temperatures have increased by 0.8°C since 1900, an average of 0.07°C per decade.</li> <li>The number of warm days (over 20°C) has increased while the number of cold days (below 0°C) has decreased.</li> </ul>	<ul style="list-style-type: none"> <li>Projections indicate an increase in average temperatures across all seasons (0.9-1.7°C).</li> <li>The number of warm days is expected to increase and heat waves are expected to occur more frequently.</li> </ul>	<ul style="list-style-type: none"> <li>Incidences of cold stress are likely to decrease while incidences of heat stress will increase.</li> <li>The duration of the growing season will increase, occurring earlier and extending farther.</li> </ul>
 <p><b>Precipitation</b></p>	<ul style="list-style-type: none"> <li>Increase in average annual national rainfall of approximately 60mm or 5% in the period 1981-2010, compared to the 30-year period 1961-1990.</li> <li>The largest increases are observed over the west of the country.</li> </ul>	<ul style="list-style-type: none"> <li>Significant reductions are expected in average levels of annual, spring and summer rainfall.</li> <li>Projections indicate a substantial increase in the frequency of heavy precipitation events in Winter and Autumn (approx. 20%).</li> </ul>	<ul style="list-style-type: none"> <li>The increased occurrence of dry spells will result in increased pressure on water supply.</li> <li>An increase in the frequency of extreme precipitation events will result in increased fluvial and pluvial flood risk.</li> </ul>
 <p><b>Wind Speed and Storms</b></p>	<ul style="list-style-type: none"> <li>No long-term change in average wind speed or direction can be determined with confidence.</li> <li>The number and intensity of storms in the North Atlantic has increased by approx. three storms per decade since 1950.</li> </ul>	<ul style="list-style-type: none"> <li>Projections indicate an overall decrease in wind speed and an increase in extreme wind speeds, particularly during winter.</li> <li>The number of very intense storms is projected to increase over the North Atlantic region. Projections suggest that the winter track of these storms may extend further south and over Ireland more often.</li> </ul>	<ul style="list-style-type: none"> <li>Increases in extreme wind speeds may impact on wind turbines and the continuity of power supply.</li> <li>Infrastructure will be at risk due to the increased occurrence of intense storms (e.g. winter 2013/2014).</li> </ul>
 <p><b>Sea Level and Sea Surface Temperature</b></p>	<ul style="list-style-type: none"> <li>Historically, sea level has not been measured with the necessary accuracy to determine sea level changes around Ireland. However, measurements from Newlyn, in southwest England, show a sea level rise of 1.7cm per decade since 1916. These measurements are considered to be representative of the situation to the South of Ireland.</li> <li>Sea surface temperatures have increased by 0.85°C since 1950, with 2007 the warmest year in Irish coastal records.</li> </ul>	<ul style="list-style-type: none"> <li>Sea levels will continue to rise for all coastal areas, by up to 0.8 m by 2100. The south of Ireland will likely feel the impacts of these rises first.</li> <li>Sea surface temperatures are projected to continue warming for the coming decade. For the Irish Sea, projections indicate a warming of 1.9°C by the end of the century.</li> </ul>	<ul style="list-style-type: none"> <li>Significant increase in areas at risk of coastal inundation and erosion.</li> <li>Increased risk to coastal aquifers and water supply.</li> <li>Change in distribution fish species;</li> <li>Implications for fisheries and aquaculture industries.</li> </ul>

## **Chapter 2 Climate Change Adaptation Planning In Ireland**

### **Introduction**

This chapter presents progress to date in Ireland in planning for climate change and developing climate resilience. It begins by discussing the link between climate adaptation and current emergency planning responses to extreme weather events. This is followed by an overview of some of the potential costs of climate change. It describes how a coordinated system of adaptation planning is needed to meet long term climate goals, reduce risks, minimise costs to Ireland and ensure long term climate resilience. It discusses work undertaken to date on adaptation planning at both sectoral and local government level and the resources being put in place to facilitate this work. The role of research and civic society is also discussed. The chapter concludes with a review of overall progress and how this has informed the approach set out in Chapters 3 and 4.

### **Responding to Short Term Challenges while Building Long Term Resilience**

As outlined in Chapter 1 Ireland's climate is changing in line with global trends. Future changes are projected across a range of parameters including temperature, precipitation and sea level rise. The most immediate risks to Ireland which can be influenced by climate change are predominantly those associated with changes in extremes, such as floods, precipitation and storms. Recent years have clearly illustrated the risks posed to Ireland by extreme weather events (such as Storm Ophelia in 2017, Storms Desmond and Frank in late 2015/early 2016 and flash floods in Donegal in August 2017).

We therefore need to consider our response to the more immediate short term impacts of climate change (e.g. emergency planning and how we respond to extreme weather events) while also building long term resilience (climate change adaptation).

While we cannot attribute a single extreme weather event to the impacts of climate change, we can say with a reasonable level of confidence that such impacts will likely increase the frequency and intensity of future extreme weather events. The response to Storm Ophelia in October 2017 provides a useful case study in terms of our preparedness and existing capacity to react to severe weather events. It shows the effectiveness and evolving capacity of existing emergency coordination structures at national level.

As noted in Chapter 1, efforts to reduce disaster risk while adapting to a changing climate has become a priority at EU and international level. Climate Change Adaptation (CCA) and Disaster Risk Reduction (DRR) face similar barriers to implementation, such as incomplete and uncertain knowledge bases, complex relationships between multiple actors and limited resources. It is important that coherence between CCA and DRR policies is enhanced and that potential co-benefits are identified and exploited over time. Both CCA and DRR recognise the concept of "resilience" and this could help to provide common ground upon which more coherent policies and actions might be built. Developing longer term resilience through adaptation planning can play a key role in supporting emergency planning by reducing risks, enhancing our levels of

preparedness for extreme weather events and improving our ability to recover from them at least cost. This will ultimately help minimise the emergency response that is necessary in the future to severe weather events.

### **Coordination of the emergency response to extreme weather events at national and local level**

Building on existing arrangements, the Government Task Force (GTF) on Emergency Planning, chaired by the Minister with responsibility for Defence and the Office of Emergency Planning (OEP) in the Department of Defence worked with key stakeholders (particularly lead Government Departments) to develop a “Strategic Emergency Management (SEM): National Structures and Framework” (July 2017). The Framework includes a list of lead roles and responsibilities at a national-level for 50 emergency incident types. The SEM will underpin the delivery of effective strategic emergency management in Ireland and will be supported by the development of an associated implementation plan and guidance documents.

The procedures for coordination of emergencies, such as convening a National Emergency Coordination Group (NECG) for severe weather and flooding events, at national-level are set out in the “Guidelines for Coordinating a National Level Emergency/Crisis Response” (2011), published by the Office of Emergency Planning. This document is currently being reviewed as part of the SEM implementation plan. The overarching principle and primary purpose of emergency response is to protect life. A revised National Risk Assessment for Ireland (2017) was endorsed by the Government Task Force on Emergency Planning in March 2017 and will be submitted to the European Commission to meet Ireland’s requirements under the EU Civil Protection Mechanism. In line with EU guidance, this National Risk Assessment process gave consideration to the potential impact of climate change.

The Department of Housing, Planning and Local Government is designated as the Lead Government Department for coordinating the response to severe weather emergencies. The Department’s National Directorate for Fire and Emergency Management (NDFEM), headed by the National Director, is mandated by the Secretary General to decide if and when to convene a National Emergency Coordination Group on behalf of the Department. The National Director, or his representatives, are also mandated to chair any NECG convened by the Department.

The purpose of the NECG is to bring “whole-of-Government” support to bear in assisting the local response if required, to manage national level issues and to ensure that information is provided to the public.

The Department receives detailed severe weather warnings from Met Éireann. The Severe Weather Assessment Team within the NDFEM analyses the weather warnings in further consultation with Met Éireann when required and uses this information to make decisions on the appropriate actions to take. This includes convening an NECG, if deemed appropriate. All weather scenarios are examined on a case-by-case basis and all decisions take account of all influencing factors, for example, geographical location covered by the weather warning, time of day when the weather warning is effective, tidal conditions, river levels, the weather patterns preceding the issuing of the weather warning, etc.

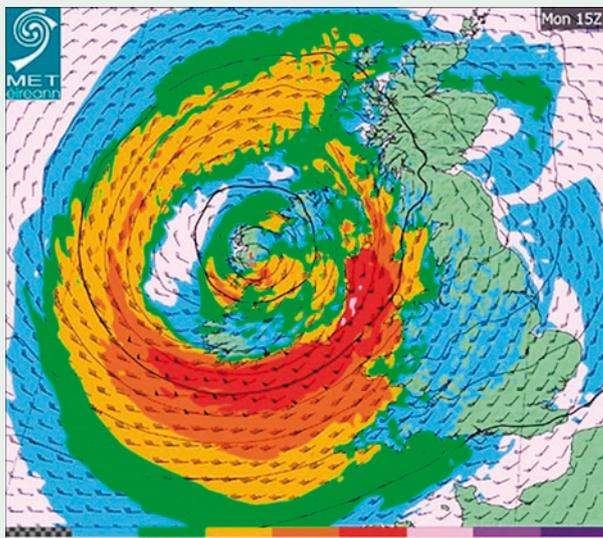
The response to all emergencies is, however, appropriately locally-led in the first instance. Local authorities are designated as the lead agency for coordinating and delivering the response to severe weather emergencies and lead the local response in collaboration with the other Principal Response Agencies – An Garda Síochána and the HSE – in accordance with the mechanisms set out in “A Framework for Major Emergency Management” (2006). Specific guidelines for responding to severe weather events are outlined in “A Guide to Flood Emergencies” (2013) and “A Guide to Severe Weather Events” (2010). Local authorities have severe weather sub-plans in place based on this guidance material.

Met Éireann alerts local authorities directly when severe weather is forecast. These warnings are received by a severe weather assessment team within a local authority. The severe weather assessment team take the appropriate action to scale a response and to ensure that resources are in place to support a response.

In their role as Lead Agency, local authorities carry out a number of functions during the response stage of severe weather and flooding events and deal with recovery issues in conjunction with other responsible agencies. The local authority role includes:

- Coordinating an inter-agency response;
- Continuously monitoring forecasts/alerts/warnings to scale the appropriate response measures;
- Operating flood defences and deploying sand-bag defences;
- Clearing debris and fallen trees;
- Flood rescue and pumping water (fire service); and
- Public communication and safety messaging.

### Storm Ophelia - Case Study



*Image: The Harmonie Weather Prediction Model 9hr forecast showing the position of Storm Ophelia at 1500UTC on 16th October 2017.*

Storm Ophelia was an extra-tropical cyclone when it made landfall in Ireland on Monday 16 October 2017, and the second named storm of the 2017-18 Irish wind-storm season (it was named by the National Hurricane Centre (NHC) in Miami, USA). Of the 2017 Atlantic hurricane season (1 June to 30 November, monitored by the

NHC), it was the tenth hurricane and sixth major-hurricane; it was also the eastern most major Atlantic hurricane on record.

Storm Ophelia was a violent and destructive windstorm. There was extensive disruption to transport with hundreds of roads blocked by fallen trees and obstacles. There were widespread power outages with the worst of the damage occurring in the south and east of the country. Tragically, three people lost their lives as a result of the storm. It also helped fan wildfires on the Iberian Peninsula, and a combination of the dust from these wildfires and Sahara dust turned the sky red for a time across the UK. The highest 10 minute mean wind speed and the highest gust were both recorded at Roches Point, Co. Cork with Violent Storm (62 knots/115 km/h/71 mph) mean winds and gusts of 156 km/h (84 knots/97 mph). The impacts of Storm Ophelia were worsened by the third named storm of the season, Brian, which crossed the centre of Ireland during Saturday 21 October 2017.

The National Directorate for Fire and Emergency Management (NDFEM) Severe Weather Assessment Team met on Friday 13 October to review the situation and the likely track and impact of Storm Ophelia. Updated information received from Met Éireann regarding the trajectory of the storm had identified severe winds, coastal surge and heavy rainfall as being the likely impacts on the country with the potential for this to be a life threatening event with the likelihood of significant destruction in worst affected areas. In light of this, a decision was made to convene a National Emergency Coordination Group (NECG) meeting for Sunday 15 October. All local authorities were advised of this development so as to enable them consider the activation of their local emergency coordination structures in advance of the weather system impacting the country.

Met Éireann upgraded its severe weather warning to RED LEVEL for the entire country. With school bus services now suspended for the entire country, the Department of Education and Skills decided on the afternoon of Sunday 15 October to close all schools and third level colleges for Monday 16 October. Crèches and Montessori facilities were also advised to close. All homeless services in town and cities, hostels and emergency accommodation centres, were instructed to remain open for the duration of Monday.

### Storm Ophelia – Case Study – continued

The NECG met three times on Monday 16 October to assess the level of preparedness and to identify evolving issues in light of the arrival of Storm Ophelia. The objective of these meetings was to bring all Government Departments together to review and disseminate the latest information regarding the storm, review the current national preparedness arrangements and to review public safety messaging as the storm impacted on the country. The NDFEM was in continual contact with local authorities who had activated their Severe Weather Assessment Teams and Local Coordination Centres. The Local Coordination Groups were briefed by the NECG throughout the day. Reports received regarding where the first effects of Storm Ophelia were felt, proved extremely useful in assisting the preparedness of other parts of the country that were yet to be impacted.

The European Union satellite mapping resource (Copernicus) was activated to assist in mapping Storm Ophelia and its impact. Based on information shared at NECG, including the likelihood that many roads in rural areas in particular would be impassable, that power outages would exist in many areas, and that school buildings would have to be inspected for structural damage, the Department of Education and Skills decided that all primary and secondary schools should remain closed on Tuesday 17 October. Crèches and Montessori facilities were also advised to close.

The NECG met twice on Tuesday 17 October to assess issues in the aftermath of Storm Ophelia and to review the progress of clean-up and recovery activities. Over 3,000 local authority staff, across many disciplines including fire services, roads staff, engineers and health and safety officers, were on the ground across the country assisting in the clean-up and recovery efforts. Local authority crews were out overnight and from daylight, clearing roads, ensuring business continuity and access for the public.

At the peak of the storm, the number of homes and businesses without electricity supply was approximately 385,000. All of these premises had electricity restored within 8 days. 250 technicians from the UK and France arrived via mutual aid agreements to assist ESB Networks in carrying out the repair works. The Air Corps assisted ESB Networks by providing helicopters to identify further locations along the network where faults may have arisen. The Defence Forces were also tasked with clearing hard to reach areas where faults had been identified.

A cascading effect of the disruption to electricity supply was the disruption to water supply as many water treatment plants became inoperable. 109,000 Irish Water customers were without supply. 148 wastewater schemes were also affected. In the days following the storm, Irish Water worked in tandem with ESB Networks to prioritise water schemes for restoration. Significant work was also done to identify vulnerable communities and households and to ensure that they were prioritised for the reinstatement of services, while at the same time putting in place a range of contingency measures to assist those that had their water supply interrupted. This collaborative effort meant that virtually all Irish Water customers had their supply restored by the evening of Friday 20 October. While public transport services were suspended on the day of the storm, the following day saw bus and rail travel operating as normal with some local disruptions. Air and ferry travel also operated as normal the following day with some cancellations. Luas service resumption was delayed until the afternoon of 18 October due to wind damage to its control centre at the Red Cow depot.

The NECG met on Wednesday 18 October to review the ongoing clean up and recovery operations. Electricity and water supply were the main issues of concern. The road networks were open again with the exception of a small number of some minor roads due to specific local issues. Health services were impacted during the storm due to the cancellation of appointments on Monday. When services were back to normal, some minor disruption remained due to rescheduling of cancelled appointments. In light of the progress of the recovery and clean up on the ground the NDFEM decided that national level coordination was no longer required and the NECG was stood down. However, the NDFEM continued to monitor the situation.

### Costing Impacts of Extreme Weather Events

The direct damage costs of extreme weather events are regularly quantified using the value of insurance claims associated with these events. For example, over the period 2000-2012, flooding in Ireland cost €749.75 million (in 2015 prices) in insurance claims. However, insured losses from floods generally represent a fraction of total (public and private) asset losses – in Europe, this has been estimated at about 30% (Jongman et al., 2014). If we assume a similar level of insurance penetration in Ireland, this suggests total asset losses (direct damages) from flooding in Ireland in recent years in the order of €192 million per year.

Of the roughly six-fold projected increase in damages from flooding for the EU by 2050, about one-third is accounted for by increased flood risk due to climate change and two-thirds by the effects of anticipated socio-economic change (Jongman et al., 2014). A similar rate of increase in Ireland would see direct damages from flooding of roughly €1.15 billion per year by 2050<sup>23</sup> should appropriate adaptation measures not be introduced.

### Indirect effects of extreme weather events on the economy and society

The risks posed by extreme events can also include potential indirect effects on the economy which are less well understood and less easily quantified, for example;

- transport and other service interruptions
- health and wellbeing effects (including stress/mental health effects)
- business interruptions
- effects on the housing market
- risks to infrastructure
- external factors such as migration and disruption to international markets

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23 Please note: This calculation is purely for illustrative purposes and is not intended as a projection of future flood costs for Ireland.

The costs associated with such indirect effects could be substantial. The indirect effects of some of these impacts were the focus of the EPA funded “Adaptive Responses to Climate Impacts (ARC): Costing climate change impacts and adaptation in Ireland” research project<sup>24</sup>. Climate change disproportionately impacts those in the lowest socio-demographic groups. These groups are also the least well equipped to engage in autonomous adaptation e.g. by moving to a lower flood risk area or purchasing flood insurance. Therefore, it is vital that adaptation planning also considers these distributional impacts.<sup>25</sup>

An analysis of disruptions to the road network in Co. Galway in the aftermath of Storm Desmond in 2015 found that the flooding had a significant impact on commuting costs in affected areas. The total aggregate cost of extra time commuting was estimated at €3.8 million (over a period of 17 working days) – likely a very conservative estimate. Additionally it was found that those already with large commuting costs are burdened with extra costs, and the relative impact (cost of flood disruption as percentage of disposable income) is larger for people on lower incomes. In areas particularly badly affected, the estimated extra cost amounts to 39% of earnings (during the period of disruption).

Higher temperatures and moisture deficits increase the risk of uncontrolled fires. These wildfires have indirect effects such as, delayed afforestation rates (impacting on climate change mitigation goals) and further environmental damage due to their impact on air quality (DAFM, 2017) in another example of indirect effects.

### Sectoral Costs of Climate Change

Information on costs at the sectoral level is being developed over time. The below contains a number of examples currently available:

- The costs for the agricultural sector by 2050, based on an aggregate of costs at EU level have been estimated at between €1-2 billion per year (Flood, 2013). The Agriculture and Forestry Sectoral Adaptation Plan (DAFM, 2017) estimates the cost of the fodder crisis of 2012/13 at €450 million with measures put in place since then helping to avoid a similar crisis and costs in 2015/16.
- “Developing Resilience to Climate Change in the Irish Transport Sector”, transport’s first adaptation plan (DTTAS, 2017) highlights the significant financial costs caused by extreme rainfall and severely cold weather in 2009, estimated to have cost in excess of €225 million for repairs to national, regional and local roads. Severe weather during the later period of January to February 2014 caused further damage to roads and to other transport infrastructure with an associated repair cost of €13.5 million (DTTAS, 2017).
- Local authorities estimated that €53 million would need to be spent to strengthen coastal protection and flood prevention schemes in the affected areas following the winter storms of 2013 (National Directorate for Fire and Emergency Management, 2014).

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<sup>24</sup> <http://erc.epa.ie/droplet/modalFull.php?cid=18136>

<sup>25</sup> Information from UK climate change risk assessment 2017 – national summary England.

### Sectoral Adaptation Planning Approach

Whether addressing the shorter or longer term challenges, to a large extent the stakeholders remain the same. However, when confronting the longer term, we are looking to develop long term resilience which also plays a key part in enhancing our preparedness to deal with the annual challenges that can present with extreme weather events. In terms of planning ahead for resilience and preparing appropriate responses at sectoral level, it is important to note that as set out in the preceding chapter, the potential impacts of climate change on a range of socio-economic groups will vary.

The non-statutory 2012 National Climate Change Adaptation Framework (NCCAF) was the first step in developing a national policy in Ireland to address the anticipated impacts of climate change through a structured programme of action on adaptation across different sectors and levels of government. The NCCAF identified Government Departments responsible for producing adaptation plans for 12 key sectors.

Arising from the NCCAF, the National Adaptation Steering Committee was established in 2014 and meets regularly. Representation includes government sectors, EPA research, CCAC Secretariat, County and City Management Association (CCMA). The aim of the Committee is to provide assistance and guidance to the various sectors (including Local Authorities) in the development of their sectoral/local level adaptation plans. In March 2017, a Committee subgroup on governance issues was formed to consider how adaptation planning can be effectively progressed in sectors where roles and responsibilities are fragmented across government departments, agencies, bodies and local authorities.

Under the 2012 Framework and with the input of the National Adaptation Steering Committee, four sectoral plans covering five sectors have been developed, including:

- Sectoral Adaptation Plan for Flood Risk Management (OPW, 2015).
- Adaptation Planning – Developing Resilience to Climate Change in the Irish Agriculture and Forest Sector (DAFM, 2017)<sup>26</sup>.
- Adaptation Planning – Developing Resilience to Climate Change in the Irish Transport Sector (DTTAS, 2017)<sup>27</sup>.
- Adaptation Plan for the Electricity and Gas Networks Sector (DCCA, 2017).

These plans can be seen as a step towards the statutory requirement to develop sectoral plans in accordance with the requirements of the Climate Action and Low Carbon Development Act 2015 and these plans are discussed further below. A number of the plans also benefited from the availability of climate information, expert opinion and high level guidance made available through the Centre for Marine and Renewable Energy (MaREI) climate change adaptation research group in UCC and funded by DCCA.

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26 Adaptation Planning – Developing Resilience to Climate Change in the Irish Agriculture and Forest Sector available at: <https://www.agriculture.gov.ie/media/migration/ruralenvironment/climatechange/ApprovedAdaptationPlanning040817.pdf>

27 <http://www.dttas.ie/sites/default/files/publications/public-transport/english/developing-resilience-climate-change-irish-transport-sector/developing-resilience-climate-change-irish-transport-sector.pdf>

While the impacts of climate change are more likely to increase sectoral risks, opportunities may also emerge for a number of sectors. For example, increasing temperatures may lead to a significant lengthening of the growing season for the agricultural sector and improve growing conditions for tree species such as oak and ash in the forestry sector.

### Flood Risk Management

The Office of Public Works' flood defence, or flood risk management, sectoral adaptation plan<sup>28</sup> outlines existing flood risk and flood risk management practice in Ireland and summarises existing science on climate change and the current state of knowledge for impacts on flooding and flood risk in Ireland. It defines the policy for adaptation in the flood risk management sector and sets out a series of actions to enhance the understanding of the potential impacts of climate change on flooding and flood risk and to embed adaptation into flood risk management practice. The plan also identifies how changing flood risk should be taken into account in spatial planning and other sectors and sets out what is required for the monitoring, review and evaluation of the plan.

The cyclical implementation of the EU 'Floods' Directive, which has included the National Catchment-based Flood Risk Assessment and Management (CFRAM) in the first cycle, is the principal mechanism for the assessment of the potential impacts of climate change on flood risk, and for planning, through the Flood Risk Management Plans (FRMPs), for the sustainable flood risk management over the long-term in Ireland, including embedding the consideration of climate change in the development of capital flood relief projects. The future scenario flood maps produced under the CFRAM Programme and the Irish Coastal Protection Strategy Study (ICPSS) will facilitate this approach, inform other sectors, and provide a valuable resource for local adaptation planning and sustainable land use management and planning.

In addition, it is important to note the establishment of an Interdepartmental Flood Policy Coordination Group to support the OPW's CFRAM Programme. Through this group, the OPW is coordinating Ireland's whole-of-government approach to flood risk management across three strategic and policy areas including prevention, protection and preparedness. The purpose of the Coordination Group is to help inform the ten-year implementation strategy of the FRMPs and to ensure that policies that can benefit communities and individuals directly are carefully considered. It will be critical that the work of this group also aligns with the ongoing development of climate resilience being carried out by the relevant sectors under the NAF.

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28 <https://opw.ie/en/flood-risk-management/floodriskpolicyfunctions/climatechange/>

### Agriculture and Forestry

The primary objective of the sectoral plan *Adaptation Planning – Developing Resilience to Climate Change in the Irish Agriculture and Forest Sector* (August, 2017) is to outline a joined up approach to adaptation planning within the agriculture and forestry sector.

The objectives of the plan outline a first step for the sectors in terms of adaptation to climate change in Ireland. The objectives are as follows:

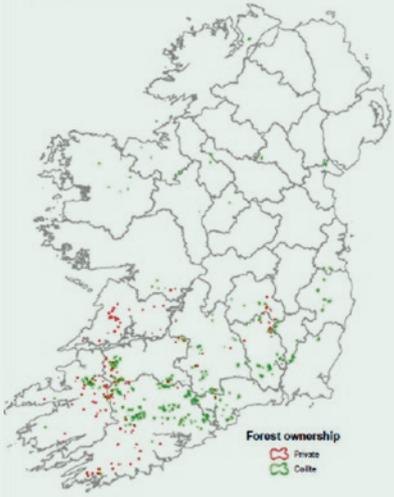
- To analyse the changes that have already occurred to Ireland's climate and the vulnerabilities which are currently in place in the sector.
- To identify the projected changes to Ireland's climate and analyse the potential impacts and vulnerabilities which could occur within the sector.
- Set out adaptation options which would build resilience and reduce the vulnerability of the sector.
- Establish steps to monitor the implementation of these options.

In order to ensure that the approach outlined in the plan is implemented across all areas, it recognises that:

*"All policies, strategies, plans and measures for, or related to, agriculture and forests must be informed of the need to adapt to the potential impacts of climate change."*

### Case Study Forestry – Winter Storms 2013/14

**Forest Storm Damage - Storm Darwin 2014**



**Overview**

The winter of 2013/2014 was wetter than average and storm force winds occurred on 12 separate days between December 2013 and February 2014. This led to a large increase in rainfall on land which was already heavily saturated. The frequency and ferocity of the storms, compounded by waterlogged soils, resulted in extensive windthrow of approximately 8,000 ha (+/- 560ha), with counties Kerry, Limerick, Cork and Clare most affected.

**Response**

Following this period the Windblow Taskforce was established. This Taskforce included representatives from the Irish Forest and Forest Products Association, Irish Timber Growers Association, Coillte, Irish Farmers Association, DAFM and Teagasc.

The estimation of the area, volume and extent of the damage using satellite imagery was undertaken. DAFM recommended the removal of windblown timber and also created a guidance note to assist forest owners in assessing and planning the harvest of this timber. The applications for felling licenses required as a result of storm damage were prioritised by DAFM.

### Transport

The sectoral adaptation plan for the transport sector is a high level plan that seeks to identify vulnerabilities at a national level across the transport system. The plan, which aims to set policy on adaptation strategies for transport, will help to build adaptive capacity within the sector's administrative structures and assist organisations to better understand the implications of climate change for Ireland and how it may impact on transport infrastructure and services at a national, regional and local level.

### Case Study Transport – Widespread Flooding Following Storm Desmond and Storm Frank, December 2015 to January 2016



*Top: Road disintegration in County Cavan, January 2016*

*Bottom: Road damage in Waterford, 2016*

#### Overview

The country was affected by a sequence of major storms during winter of 2015/16, it was the wettest winter in Ireland in a time series from 1850 (McCarthy et al., 2016, Noone et al., 2015) and followed above average rainfall for most places in November. Storm Desmond, early in December, brought record accumulations to parts of the west and northwest which resulted in flooding in the May, Clare and Shannon catchments. Following Storm Frank at the end of the month, further flooding occurred along the south coast and the Blackwater, Suir, Slaney and Shannon catchments.

#### Meteorological Conditions

The jet stream plays a major role in determining weather patterns. During December, an intensified jet stream, oriented southwest to northwest supported the tracking of storms close to Ireland. This resulted in the convergence of warm moist air over Ireland, bringing record rainfall and temperatures. This regime broke down during January and February as the jet stream moved further south, although a further three named storms occurred during January and February.

#### Key Impacts for the Transport Sector:

- As a result of the damage caused to transport infrastructure, €106 million was allocated for repairs: €8 million for rail network, €90 million for regional and local roads and €8 million for national roads.
- Throughout the country, Iarnród Éireann experienced serious incidents. Speed restrictions were imposed and in some places rail lines were closed due to flooding. For instance, the Cobh/Middleton line, the Mallow line and at Gorey and Wexford. There were instances of fallen trees and debris blocking railway tracks and high winds caused problems with automatic level crossings barriers.

### Case Study Transport - continued

- A significant number of national, regional and local roads were closed. National roads included the N25 Cork/Waterford Rd (between Killeagh and Castlemartyr), N65 (between Portumna and Borrisokane) and the N4 (at Shannonside Retail Park). Cavan County Council reported in the region of 50 roads as impassable, many submerged under 1m of water. In east Cork, the County and City Management Association reported that 20 roads were closed, many due to the disintegration of the roads. It was also noted that Bus Éireann had a diversion in Wicklow from the R752 regional road due to road subsidence.
- Notably, there were fewer impacts on the Strategic Motorway Network, potentially reflecting the considerable efforts, since the commencement of the Motorway Maintenance and Renewals Contracts, to undertake preventative maintenance on sections of the network previously negatively affected through flooding.
- Drogheda Port closed to commercial traffic due to sediment accretion within the approach channel: it took five weeks and extensive dredging to restore the port to full operational capacity.



*Left: Floods in Mallow, County Cork, December 2015*

### Energy

The draft Adaptation Plan for Electricity and Gas Networks Sector (Energy) examines the impacts of climate change and weather related events, both past and projected, on the energy networks (gas and electricity). The plan can be viewed as a first step towards reducing vulnerability and building resilience in the sector. Its aim is to stimulate thinking from the public and interested stakeholders on the very important area of climate change adaptation in the energy networks sector. The plan outlines areas of vulnerability now and sets out the steps that can be taken and measures put in place to avoid or minimise future adverse impacts within the sector and also outlines methods to exploit opportunities.

### Adaptation Planning Coordination

The work carried out by the sectors to date, while helping to inform the statutory plan making process required under this Framework, has also identified a number of other benefits such as:

- creating awareness within sectors of the need to adapt;
- building capacity and confidence within sectors,
- engaging stakeholders on adaptation;
- identifying information sources and knowledge gaps (Desmond, 2018, in print).

The work of the sectors under the NCCAF has also identified a number of key barriers to effective adaptation planning. One of these is the fragmentation of roles and responsibilities across government departments, agencies, local authorities and other bodies. In common with other jurisdictions, responsibilities in a number of areas are spread across a number of departments, agencies, bodies and local authorities. This has proven problematic in moving adaptation forward in some important sectors. The National Adaptation Steering Committee and its governance subgroup is one existing way of addressing such challenges but further integration and coordination is required. This is discussed further in Chapter 4.

### Sectoral Adaptation Guidelines

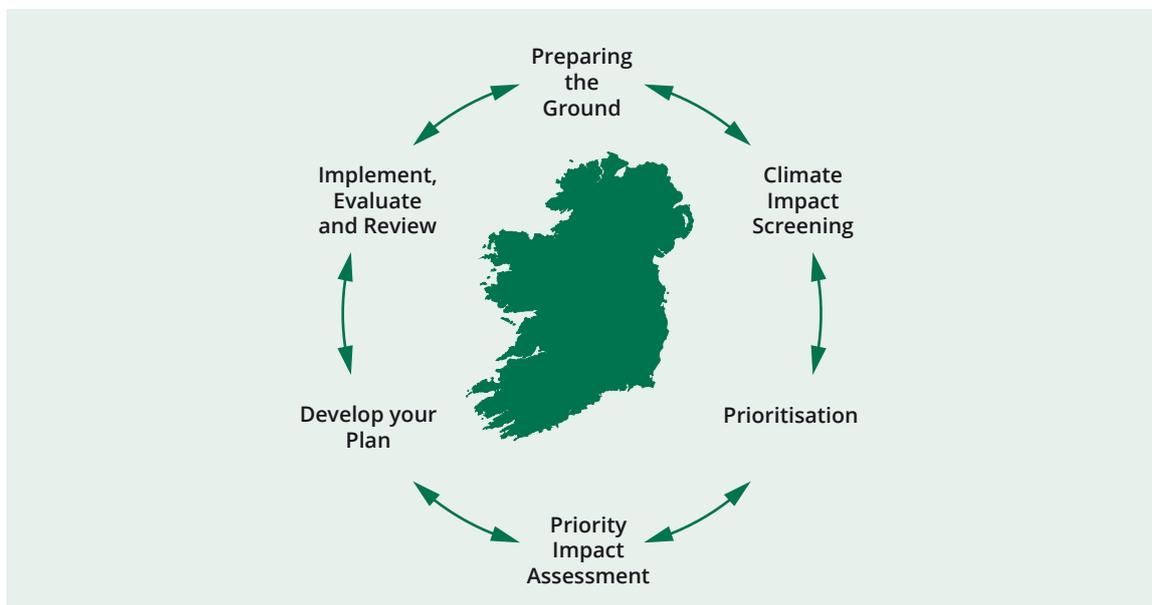
In order to further support key national sectors in planning for climate change adaptation, sectoral adaptation guidelines have been developed as part of the Irish Climate Information Platform, Climate Ireland (ICIP)<sup>29</sup>. The guidelines have been developed by drawing on international best practice (e.g. EEA, 2013; Gray, 2016) and in close consultation with the Department of Transport, Tourism and Sport (DTTAS) and the Department of Agriculture, Food and the Marine (DAFM). The guidelines aim to ensure that a coherent and consistent approach to adaptation planning is adopted at national and local levels and draws on existing sources of climate and adaptation information (e.g. the web-based tool Climate Ireland, [www.climateireland.ie](http://www.climateireland.ie)). It is also hoped that these guidelines will have application beyond the sectors that have been identified to prepare sectoral plans. A summary of the guidelines is provided in the following section.

The guidelines are structured around six steps: 1) Preparing the Ground; 2) Climate Impact Screening; 3) Prioritisation; 4) Priority Impact Assessment; 5) Develop your Plan; 6) Implement, Evaluate and Review. As illustrated in Figure 1, it is important to note that although these steps appear to be sequential, adaptation decision making is an ongoing and iterative process. It may be necessary to move backwards or forwards between steps or to revisit steps as appropriate.

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<sup>29</sup> Funded by the Environmental Protection Agency (EPA) and the Department of Communications, Climate Action and Environment (DCCA).

**Figure 1 Adaptation Planning Process (From Sectoral Guidelines for Planning for Climate Change Adaptation, 2018)**



The emphasis of the guidelines is on a staged and proportionate approach to adaptation planning. Hence the early steps (1 and 2) focus on preparing the ground for an effective adaptation planning process and identify what changes and impacts have the potential to give rise to wider and unacceptable sectoral impacts. Following on from this, Step 3 involves prioritising ongoing and potential future climate impacts in the context of sectoral and policy objectives/targets. Step 4 builds on the scoping stage and examines those changes and impacts considered a sectoral priority. This step involves a more thorough assessment of exposure, sensitivity and adaptive capacity (i.e. vulnerability). Steps 5 and 6 involve identifying a series of goals, objectives and actions thus shifting the focus from potential impacts and vulnerabilities to adaptation.

The stepwise approach of the guidelines aims to adopt a consistent approach to support Ireland's key sectors in planning for climate change adaptation and in the development of their adaptation plans (in accordance with the requirements of the Climate Action and Low Carbon Development Act 2015 and this Framework). This approach is a proportionate and staged way of analysing climate change impacts and the sectoral consequences of these impacts. In addition, and to ensure consistency across all levels of planning, the six steps aim to ensure the vertical and horizontal integration of adaptation objectives, aims and actions arising from developed plans.

### Local Authority Adaptation

Adaptation is also an important consideration for local authorities, businesses and the general public and it is crucial to develop the capability to mainstream climate change adaptation within all areas of existing local authority activity. This will require awareness raising, capacity building and training of those tasked with planning for the inevitable impacts of climate change.

#### Adaptation at local level – progress to date

A number of local authorities have advanced the development of adaptation strategies on foot of the 2012 NCCAF. For example, Clare County Council has integrated climate change actions in their current development plan, with the aim of reducing the carbon output of the county, managing the risk associated with flooding and ensuring that climate change adaptation is a priority during the lifetime of this plan (Desmond, 2018, in print). The four Dublin local authorities have also signalled their intention to prepare a combined mitigation and adaptation action plan in line with general climate strategies that include elements of both mitigation and adaptation; i.e. *A Strategy Towards Climate Change Action Plans for the Dublin Local Authorities*.<sup>30</sup>

The Department of Communications, Climate Action and Environment has been engaging closely with the sector, in collaboration with the EPA, MaREI and UCC to ensure appropriate guidance is provided and capacity is strengthened. *Local Authority Adaptation Strategy Development Guidelines* (Gray, 2016) were published in May 2016.

The research guidelines, which were commissioned by the EPA and developed by UCC, are designed to assist local authorities to develop their own adaptation strategies and to ensure that they will complement adaptation plans to be prepared on a sectoral basis. Local Authority Adaptation strategies prepared under this Framework should be developed using these guidelines.

Follow-up training sessions and regional workshops for relevant staff were held in July and September/October 2016. These were designed to introduce participants to key adaptation principles and provide hands-on experience of adaptation strategy development. The workshops promoted cooperation within the local authority sector while also providing opportunities for local authority staff to share experiences and to identify challenges facing the sector.

Building on the work undertaken, further work on awareness raising, training and capacity building is necessary to equip decision makers with the capability and confidence to analyse and respond to the risks and responsibilities that a changing climate presents. It will be important to create awareness of climate change risks and adaptation responses across all levels of decision making that can then inform decisions at local and community level. Capacity will need to be developed at key levels of decision making. This includes the ability to understand vulnerabilities to current and future climate change and plan appropriate response actions. This could be underpinned by networks of early movers where learning and leadership will be shared amongst peers to drive the adaptation agenda.

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30 [http://www.codema.ie/images/uploads/docs/A\\_Strategy\\_Towards\\_Climate\\_Change\\_Action\\_Plans.pdf](http://www.codema.ie/images/uploads/docs/A_Strategy_Towards_Climate_Change_Action_Plans.pdf)

The regional workshops identified some key barriers to effective implementation of adaptation planning processes. These include:

- Requirement for buy-in at all levels of governance and amongst the general public.
- The need for better coordination between national structures and the local government sector on climate change.
- Adaptation requires political will, viable institutions and effective policy frameworks to ensure coordination amongst individual actions. There is a need to identify and promote adaptation leadership at all levels of governance.
- Planning for adaptation is a complex task and requires appropriate capacity building within local authorities and across all levels of governance.
- Synergies between individual local authorities should be exploited (e.g. through the exchange of data, information, case study material) and at all stages of the adaptation planning process (O'Dwyer et al., 2017).

Local authorities are actively working in consultation with DCCA to develop a regional approach to climate action. The proposed approach harnesses the potential to group certain local authorities based on similar geographical/topographical characteristics and, on the basis of existing synergies, in addressing threats and impacts of severe weather events and ongoing climate change risks. It is therefore based on climate risk assessment with a focus on the predominant risk(s) in each geographical area.

It is envisaged that the regional teams would develop an expertise on the predominant climate risks in their particular regions, becoming Centres of Excellence, and develop regional strategies on that basis. These regional strategies would then inform the Local Authority strategies. The expectation is that there would be shared learning between the regional teams, providing significant benefits from a local, regional and national perspective. These structures would also provide an opportunity for the local government sector to play a key role in coordinating relevant activities related to the National Dialogue on Climate Action, which is discussed below.

### Case Study Local Authorities – Rogerstown Estuary<sup>31 & 32</sup>



This case study details the actions undertaken by Fingal County Council to begin to 'climate proof' Rogerstown Estuary (see left), a key area of public amenity and biodiversity conservation. The project adopted a 'let it flood' approach, the first of its kind in Ireland and is a pioneering study for climate adaptation in estuarine environments.

31 Adapted case study from Power, S, & O'Dwyer, B. (2016) 'Adaptation Inspiration – Scoping Adaptation Case Studies in Ireland', EPA Small Scale Study Report 2016

32 Project page is available at [http://www.fingalbiodiversity.ie/proj\\_rogerstown.html](http://www.fingalbiodiversity.ie/proj_rogerstown.html)

### Case Study Local Authorities – Rogerstown Estuary – continued

#### Climate Adaptation

The project undertaken at Rogerstown is a pioneering example of 'Climate Smart Conservation' in Ireland. The initiative was taken by Fingal County Council in anticipation of the effects that future climate changes would have on the estuary, including rising sea levels, higher tides, and more frequent and intense storm events.

By allocating additional space for floodwater storage on this site, properties upstream are protected from future flooding. Rogerstown presented a unique opportunity to conduct an experiment to investigate the effects of a more natural tidal regime, as there was no risk to people or property as a result of the increased levels of flooding resulting from the removal of the embankment. Long term financial savings have also been secured, as the cost of removing the embankment is significantly less than continual upgrading and maintenance of the embankment structure.

In the long term, this action will restore the natural hydrology of Rogerstown estuary, and will help to protect sites further upstream of the site from the effects of sea level rise, storm surges and higher tides by allocating space for additional floodwater.

#### Process

As part of Fingal's biodiversity strategy, monitoring of biodiversity on the site had been ongoing for a number of years. The information gathered through this monitoring process has provided a baseline of environmental and ecological conditions on the site against which future changes can be measured.

The project, headed by Fingal's biodiversity officer aims to encourage the return of the broad ecosystem dynamics that created the landscape of the area and provide for increased floodwater storage. This was achieved by completely removing the existing embankment, allowing for tidal flooding at the site.

This is an example of a green solution to coastal flooding and coastal climate change impacts. This process allowed for complete inundation of the inner estuary in the event of a high tide or a storm surge and protects areas upstream of the site.

An important aspect of the project is to assess the effects of these changes on the overall biodiversity and ecosystem dynamics of the area. As a result, monitoring continues on an ongoing basis on site, to ascertain the effects of the process on the ecology and environment of the estuary. Since completion of the project, there have been some noted changes in the biodiversity of the area. Meadow Barley, a protected species under the Habitats Directive, have seen their previously high population significantly reduced in the area, although not eliminated. Other bird populations have not been adversely affected by the project and are thriving under conditions in the reserve.

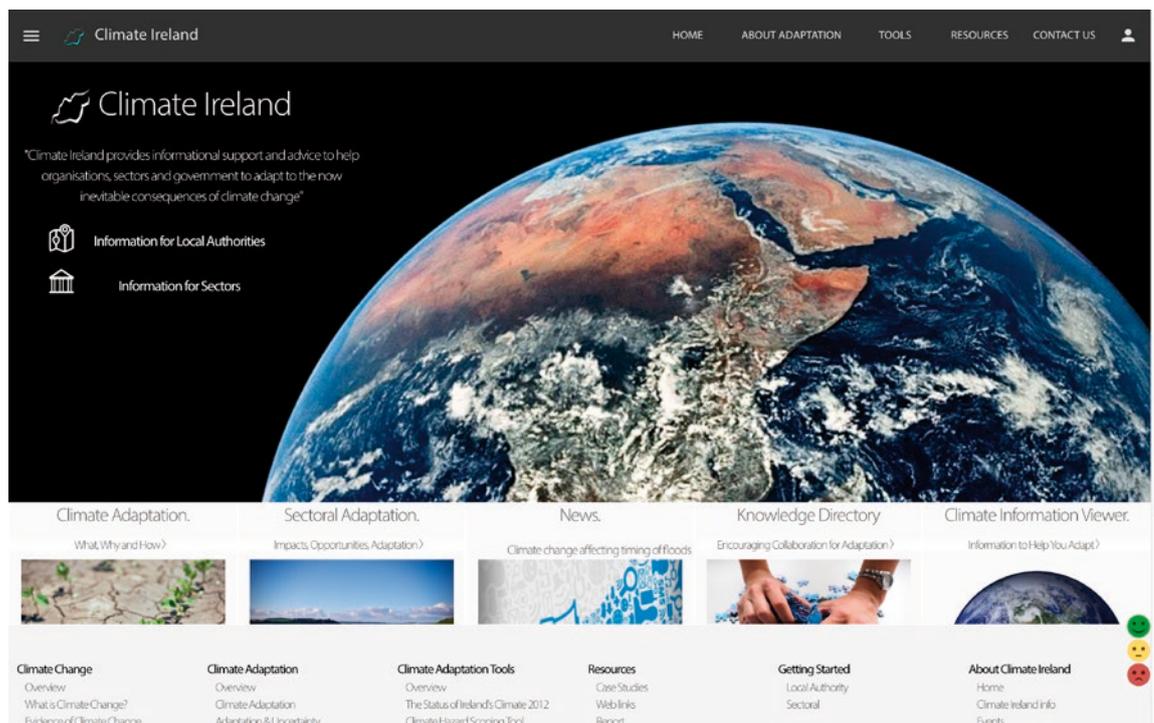
### Climate Ireland

In order to support decision makers in meeting the requirements of the NCCAF and the EU Adaptation Strategy (2013), a centralised information resource, Climate Ireland, has been developed by researchers in UCC through support from the EPA and DCCAE.

Ireland's Climate Information Platform (ICIP), "Climate Ireland" ([www.climateireland.ie](http://www.climateireland.ie)), provides support to decision makers in the development of their adaptation plans. This is achieved through the provision of:

- Tailored information to support awareness and understanding of climate adaptation;
- Essential climate information (observed and projected) to support impact and risk assessment;
- Decision making frameworks and tools to support Local Authority and Sectoral plans.

Figure 2 Climate Ireland Web Resource



### Role of Civil Society

The public consultation carried out in September/October 2017 as part of the preparation of this Framework, generated a total of 28 submissions. This clearly demonstrates a deficit in respect of how society is engaging in the matter of adapting to climate change and developing resilience into the future.

In terms of developing climate resilience, whether in the short or long term, the role of society cannot be underestimated. Everybody has a role to play in climate proofing Ireland and it is critical, in this regard, that mechanisms are in place to ensure civil society can engage on a meaningful level in terms of achieving our goal of climate resilience. Two such processes have been created which should provide the foundation for ensuring that climate discussions take place and that society as a whole can engage on priority climate actions for the future.

### National Dialogue on Climate Action

Under the *Programme for a Partnership Government*, there is a commitment to establish a National Dialogue on Climate Action (NDCA) which is to inform our national objective to transition to a low carbon and climate resilient economy and society. In terms of climate resilience (i.e. adapting to climate change impacts), the publication of this National Adaptation Framework will play a key role in informing the dialogue process and how it addresses the issue of climate change impacts.

The objectives of the National Dialogue on Climate Action are to:

- Create awareness, engagement and motivation to act (locally, regionally and nationally) in relation to the challenges presented by climate change;
- Create structures and information flows to facilitate people gathering to discuss, deliberate and maximise consensus on appropriate responses to these challenges, and to enable and empower appropriate action;
- Establish, on a long-term basis, appropriate networks for people to meet periodically to consider evidence-based inputs on the economic, social, behavioural, environmental and public aspects of climate and energy policy; and
- Provide regular input, through the National Dialogue on Climate Action, into the prioritisation and implementation of climate and energy policy which can be reported and monitored at local, regional and national levels.

The National Dialogue on Climate Action will run initially for a period of two years (2017-2019) with administrative support to be provided by the EPA. Membership of the 15 person advisory group on the National Dialogue was announced in July 2017. This group was established to provide advice in relation to the overall strategy, structure and operation of the National Dialogue.

A key element of the National Dialogue already underway is the Green Schools National Climate Change Action and Awareness Programme which is being run by An Taisce, and which for 2017, includes the development phase for a Climate Change Ambassadors Programme. This programme will look to roll out ambassadors at both school and local community level in terms of engaging the wider community on climate related matters.

### Citizens' Assembly

The *Programme for a Partnership Government* also committed the Government to “the establishment of a Citizens' Assembly, within six months and without participation by politicians, with a mandate to look at a limited number of key issues over an extended time period.”

The Assembly comprises the Chairperson and 99 citizens, randomly selected to be broadly representative of the Irish electorate, established to consider some of the most important issues facing Ireland's future. The Assembly's conclusions on each topic will form the basis of individual reports and recommendations that will be submitted to the Houses of the Oireachtas for further debate by our elected representatives.

- One of the topics identified was ‘*How the State can make Ireland a leader in tackling climate change*’. The Assembly met over two weekends in 2017 to deliberate on the topic. Of particular relevance to this Framework are the following recommendations which emanated from these discussions;
- The State should take a leadership role in addressing climate change through mitigation measures, including, for example, retrofitting public buildings, having low carbon public vehicles, renewable generation on public buildings **and through adaptation measures including, for example, increasing the resilience of public land and infrastructure.**
- The State should undertake a comprehensive assessment of the **vulnerability of all critical infrastructure (including energy, transport, built environment, water and communications) with a view to building resilience to ongoing climate change and extreme weather events.** The outcome of this assessment should be implemented. Recognising the significant costs that the State would bear in the event of failure of critical infrastructure, spending on infrastructure should be prioritised to take account of this.

The Government will study the Assembly's report and recommendations systematically and comprehensively when it receives them and will provide its response to each Assembly recommendation in the Houses of the Oireachtas in due course.

### Climate Change Adaptation Research

Significant progress has been made on advancing the adaptation research agenda in Ireland. It is essential that this work is maintained and enhanced so as to target specific policy areas but also new areas of research informed by international best practice.

Funding for environmental research is the responsibility of the Department of Communications, Climate Action and Environment who have mandated the Environmental Protection Agency (EPA) to manage and allocate this funding under the EPA Research Programme 2014-20. Climate Change is one of the three pillars of the EPA Research Programme 2014-20 funded under a dedicated Climate Change Research Programme (CCRP).

Climate related research is also funded by a number of other state bodies including Teagasc, the Sustainable Energy Authority of Ireland (SEAI) and the Economic and Social Research Institute (ESRI). Met Éireann maintains atmospheric observations networks and carries out analysis, research and modelling activities which also help to inform adaptation. Met Éireann is also involved in funding research and participates in research partnerships with institutions in Ireland and abroad, such as the EC-Earth and ERA4CS consortia.

Research by national research institutions is also funded through Horizon 2020, the EU's Research and Innovation programme 2014 to 2020, and international research programmes. There has also been a growing engagement with pan European research work through the Joint Programming Initiatives (JPIs) and the development of wider international links. For example, the JPI Climate ERA NET for climate services (ERA4CS)<sup>33</sup>, is currently supporting six Irish research projects. Engagement with such initiatives provides unique international collaborative opportunities for Irish researchers.

Marine research is supported through maintaining the marine observation network (including weather buoys, tide gauges, moorings) and involvement in research projects in Ireland and internationally including representation at JPI Oceans<sup>34</sup>.

### Research – Progress to date

In Ireland, climate change research on impacts and adaptation is being advanced under the following headings:

- Observations, monitoring and analysis;
- Modelling of future climate;
- Impacts, risk and vulnerability assessment; and
- Adaptation information and responses.

### Observations, monitoring and analysis

Met Éireann maintains a permanent programme of observations in the atmospheric domain, including an atmospheric chemistry, which will be expanded to incorporate monitoring in line with Integrated Carbon Observation System (ICOS) standards. Additional atmospheric observations are provided from NUI Galway and other institutions. Responsibility for oceanic and terrestrial observations lies with the Marine Institute, Met Éireann, EPA, universities and other institutions.

The Global Climate Observing System (GCOS) specifies 54 Essential Climate Variables (ECVs) that are key for sustainable climate observations. A national GCOS committee has recently been established, led by Met Éireann.

### Modelling of future climate

Climate modelling is a core activity in Met Éireann. Met Éireann has contributed to the scientific development of a new global climate model (EC-Earth) in conjunction with University College Dublin (UCD) and the Irish Centre for High-End Computing (ICHEC). This was used by Nolan (2015) to provide an analysis of the impacts of global climate change on the mid 21<sup>st</sup> century climate of Ireland.

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33 <http://www.jpi-climate.eu/publications>.

34 <http://www.jpi-oceans.eu/>

Met Éireann is continuing work on global ensemble climate simulations using the EC-Earth model for various emission scenarios as well as downscaling the output for the Irish region. The results from this research will contribute to the next IPCC AR6 report and also feed into the different national and EU climate services projects.

Climate adaptation services will also benefit from Met Éireann's participation in the European Research Area for Climate Services (ERA4CS) and associated work on analysis of extreme wind and wave events, climate indicators and climate attribution of extreme events.

### Impacts, risk and vulnerability assessment

In terms of impacts, risk and vulnerability, progress has been made in identifying some of the key impacts and vulnerabilities for Ireland. Further research is, however, needed on the vulnerability of key sectors and the identification of critical thresholds. The following projects should be particularly noted:

- A National Climate Change Vulnerability Scoping study (Coll & Sweeney, 2013) was undertaken to identify high level vulnerabilities for Ireland in a number of key sectors.;
- COCOADAPT (Sweeney et al., 2013) provided recommendations on how key sectors and vulnerable areas could increase their resilience to climate change through adaptation. These include the water, biodiversity, construction and tourism sectors;
- The Coastal Climate Adaptation in Ireland (CLAD) study (Falaleeva et al., 2013) developed a tool kit to support local level climate adaptation in coastal areas;
- OPW, through the CFRAM Programme, has undertaken detailed analysis of the potential impacts of climate change on flood extents and hazards and on the potential consequences of flooding in terms of economic damages and assets at risk for two potential future scenarios. This analysis has been undertaken for 300 communities around the country, including our cities, towns and other communities at potentially significant flood risk, including 90 coastal communities;
- The Urban Adapt<sup>35</sup> project is focussing on the Greater Dublin area and will develop an innovative regional approach that allows for the integrated assessment and management of current and future climate vulnerabilities within the context of existing climate/non-climate pressures and spatial planning practices;
- A National Risk Assessment of Impacts of Climate Change (C-RISK) has commenced.<sup>36</sup> The aim of this EPA – funded project is to establish a national risk and impacts assessment of the effect on Ireland of current and future climate warming patterns in the 21<sup>st</sup> century;
- The EPA-funded Critical Infrastructure Vulnerability to Climate Change (CIViC) study, will assess the vulnerability of elements (water, energy, transport and communications) of Ireland's critical infrastructure to climate change;
- The VAPOR<sup>37</sup> project at UCD is assessing the vulnerability of peatlands to climate change and extremes;

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35 <https://urbadapt.com/about/>

36 <http://www.marei.ie/national-risk-assessment-impacts-climate-change/>

37 [www.ucd.ie/vapor](http://www.ucd.ie/vapor)

- The Ireland/Wales EU programme (i.e. INTERREG) is also very active under its priority 2 in respect of “Adaptation of the Irish Sea and Coastal Communities to Climate Change” and has four projects of relevance currently listed:
  - <http://www.irelandwales.eu/projects/ecostructure>
  - <http://www.irelandwales.eu/projects/bluefish>
  - <http://www.irelandwales.eu/projects/acclimatize>
  - <http://www.irelandwales.eu/projects/cherish>
- JPI Climate ERA4C projects including CoCliME (Co-development of Climate Services for adaptation to a changing Marine Ecosystem) and WatexR (Integration of climate seasonal prediction and ecosystem impact modelling for an efficient adaptation of water resources management to increasing climate extreme events).

### Adaptation information and responses

The centralised information resource, Climate Ireland, was referenced earlier in this chapter in terms of its role in supporting adaptation at sectoral and local level. The future role of Climate Ireland is also addressed in the following chapter.

Under this Framework, climate change science can continue to be developed while new emerging areas can also be supported and progressed. As we move further into the implementation of climate change adaptation, there will be an increased need for interdisciplinary research that will require input from all the sciences. This new direction is necessary to allow us to transition to a climate resilient economy and society.

### Next Phase of Adaptation Planning In Ireland

The *National Adaptive Capacity Assessment* (Desmond and Shine, 2012) provided the first national overview of Ireland’s readiness and ability to adapt to climate impacts. More recently, (Shine, 2016) provided an update on the 2012 *National Adaptive Capacity Assessment*. Significantly, the update reveals that a number of steps have been taken to increase Ireland’s adaptive capacity since 2012, but further work is required. The assessment identified a growing resilience to climate change through institutional strengthening, increased knowledge and awareness of how the planning system operates.

An analysis of Ireland’s preparedness for climate change adaptation was also conducted by the European Commission in 2015. The report assessed preparedness across a number of indicators, corresponding to the steps in the adaptation process. The assessment criteria largely mirror the steps in the adaptation planning cycle, that is, preparing the ground; assessing risks and vulnerability to climate change; identification of adaptation options; implementation of adaptation actions; and monitoring and evaluation of adaptation activities.

Ireland was shown to have made good progress in a number of areas particularly in terms of preparing the ground for adaptation and in assessing risks and vulnerability to climate change. Ireland was noted to have made very good progress in tackling research gaps, good progress in coordinating adaptation policy at national level, good progress in putting in place systems to assess current and projected climate change, impacts and vulnerability as well as showing

some evidence of mainstreaming of adaptation into key land use policies. Insufficient progress was, however, identified in terms of identification of adaptation options and in the monitoring and evaluation of adaptation activities. Ireland was found to have made insufficient progress in terms of stakeholder involvement in the development of adaptation policy, in identifying adaptation options consistent with the results of sectoral risk assessments, in mainstreaming adaptation across key national policy instruments and in developing systems to monitor and report on climate change adaptation, including adaptation related expenditures.

It should be noted, however, that this analysis was carried out in respect of progress up to the end of 2014 and the European Commission is now conducting a new assessment, the results of which will be available in 2018.

Desmond (2018, in print) found that the key components of an enabling environment for climate resilience are in place, however, some barriers remain, which are hampering adaptation action and implementation. The key to overcoming these barriers is identified as being the effective coordination of institutions and processes involved in climate related actions.

This Framework sets out a number of responses to enhance Ireland's climate resilience, building on the sectoral adaptation planning to date and the lessons outlined above.

This includes setting the context for the use of sectoral and local government adaptation planning guidelines and the climate information platform (Climate Ireland), along with considering the role of stakeholders and research. These are discussed further in the following chapter.

## **Chapter 3 A New Framework for Delivering Climate Resilience**

### **Introduction**

Regardless of how successful efforts to mitigate GHG emissions prove to be, the impact of climate change will continue over the coming decades because of the delayed impacts of past and current emissions. There is no choice, therefore, but to take adaptation measures to deal with the unavoidable impacts of climate change and associated economic, environmental and social costs. This is recognised at international, European Union and national level.

Adaptation not only depends on action by all levels of government but also on the active and sustained engagement of all stakeholders, including sectoral interests, the private sector, communities and individuals. Everybody has a role to play in making sure Ireland is taking appropriate adaptation action to achieve a climate resilient future. This is a joint responsibility where “climate proofing” our country is an undertaking for which all of society is responsible and everyone has a role to play.

Most adaptation measures to date in Ireland have been reactive in nature and, given the increased knowledge of climate change impacts, it is now necessary to adopt a planned approach to adaptation so that we are better placed to deal with the short and long term impacts of climate change. This planned approach is the result of a deliberate policy decision, based on the awareness that conditions have changed or are expected to change and an understanding of vulnerabilities and that some form of action is required to reduce risk and/or avail of opportunities. By planning and anticipating climate change risk, it is possible to reduce the cost and maximise the effectiveness of adaptation actions.

### **A Framework Approach**

This chapter sets out the key elements of a new National Adaptation Framework and in doing so covers the following:

- The legislative and policy context for the Framework.
- An overarching vision and definition of climate resilience in Ireland (i.e. a common understanding of a climate resilient Ireland).
- A guiding set of principles for adaptation as described in international research literature.
- The importance of a whole-of-government approach to adaptation.
- The importance of mainstreaming of climate adaptation into all national and local level policy making and decision making processes (i.e. public spending/capital investment and spatial planning processes).
- The requirements for sectoral and local government adaptation planning under this Framework.
- The roles of key stakeholders identified under this Framework.
- The approach to climate change adaptation and emergency planning and management.
- Future research priorities, and
- The reporting and implementation arrangements to ensure delivery.

### Legislative and Policy Context

The National Policy Position on Climate Action and Low Carbon Development (2014) establishes the fundamental national objective of achieving transition to a competitive, low carbon, climate-resilient and environmentally sustainable economy by 2050. Climate change adaptation will play a crucial role in successfully achieving this transition. The Climate Action and Low Carbon Development Act 2015 provides for the preparation of plans covering climate change mitigation and adaptation with the purpose of pursuing the transition to a low carbon, climate resilient and environmentally sustainable economy by 2050 in line with the National Transition Objective. In order to successfully achieve the National Transition Objective, a system of coordinated adaptation planning in Ireland is required so that we are better placed to deal with the future impacts of climate change.

Section 5 of the 2015 Act requires that the Minister for Communications, Climate Action and Environment make and submit to Government for approval a “National Adaptation Framework” not later than 24 months after enactment (i.e. not later than 10 December 2017). The Minister must review the Framework not less than once every five years thereafter.

The Act provides that the Minister must also consult with the Climate Change Advisory Council when developing the NAF and that before submitting a Framework to the Government for approval must also consult with the public and any interested parties inviting submissions on a draft NAF. These consultative processes have taken place.

This Framework makes clear that acting on climate change and ensuring climate resilience is a priority for all levels of Government. This will encourage cooperation between stakeholders as well as allowing stakeholders with particular functions to contribute fully to Ireland’s climate transition.

Rather than seeking to develop additional governance arrangements, this Framework also recognises that existing Government structures are already contributing to climate resilience in a number of ways (e.g. in Emergency Planning and through the National Adaptation Steering Committee). Therefore, it seeks to maximise existing networks and is organised to ensure that responsibilities for adaptation planning and climate resilience respect the principle of subsidiarity and lie at the most appropriate decision making level.

### Role of the Department of Communications, Climate Action and Environment

The Department of Communications, Climate Action and Environment leads and coordinates national adaptation policy and will support the implementation of the National Adaptation Framework at national, sectoral and local government levels working, as appropriate, through the National Adaptation Steering Committee and with due regard to the statutory functions assigned to it under the 2015 Act.

The Department provides high level political (through a senior Cabinet Minister), policy and administrative leadership in relation to adaptation and ensures that all relevant Ministers, administrations and sectors are aware of their adaptation obligations. It also assists and supports the delivery of capacity building and training programmes with the aim of equipping decision makers with the capability and confidence to analyse, plan for and respond to the risks and opportunities that a changing climate presents. In addition, the Department is responsible for complying with Ireland’s reporting obligations at EU level under the Mechanism

for Monitoring and Reporting and the EU Climate Adaptation Scoreboard. As Ireland's representative in respect of the UNFCCC, the Department and its national climate delegation continue to report on global adaptation developments arising on the wider international stage. These reporting mechanisms are discussed further in the "Monitoring and Reporting" section in Chapter 4.

### Defining Climate Resilience

The draft National Adaptation Framework published for public consultation made reference to how important it is to have a clear understanding of what is meant by the term adaptation in terms of providing a consistent approach for all the relevant sectors in addressing the impacts of climate change. The draft Framework also highlighted the need to expand on the definition with particular reference to how adaptation relates to climate resilience.

The Act includes a legal definition for adaptation which correlates well with definitions from the international community (i.e. IPCC, 2014); however, the consultation process and engagement with individual sectors further highlighted the need to expand on the definition and, in particular, how adaptation relates to what we mean by climate resilience. The IPCC definition of resilience refers to the ability of a system and its component parts to anticipate, absorb, accommodate or recover from the effects of a hazardous event in a timely and efficient manner including through ensuring the preservation, restoration or improvement of its essential basic structures and functions.

We can define climate resilience as: the capacity of a socio ecological system to absorb stresses and maintain function in the face of external stresses imposed by climate change and adapt, reorganise and evolve into configurations that improve the sustainability of the system, leaving it better prepared for future climate change impacts (Folke 2006, Nelson et al, 2007).

One definition, provided by Shine (2016) which encapsulates what a climate resilient Ireland might look like states:

*"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 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."<sup>38</sup>*

This definition provides details on the systems of governance and institutional design as well as active planning and monitoring considered key to making Ireland more resilient to the impacts of climate change. The adaptation pathways approach referred to is a method for dealing with uncertainty about future climate scenarios. It is intended to maximise decision makers' flexibility, by offering a wide range of adaptation actions. The approach involves mapping out a series of adaptation actions in a "pathway", decision makers can then shift pathways to increase or decrease the level of planned adaptation actions in response to new scientific information or in response to key thresholds being breached.

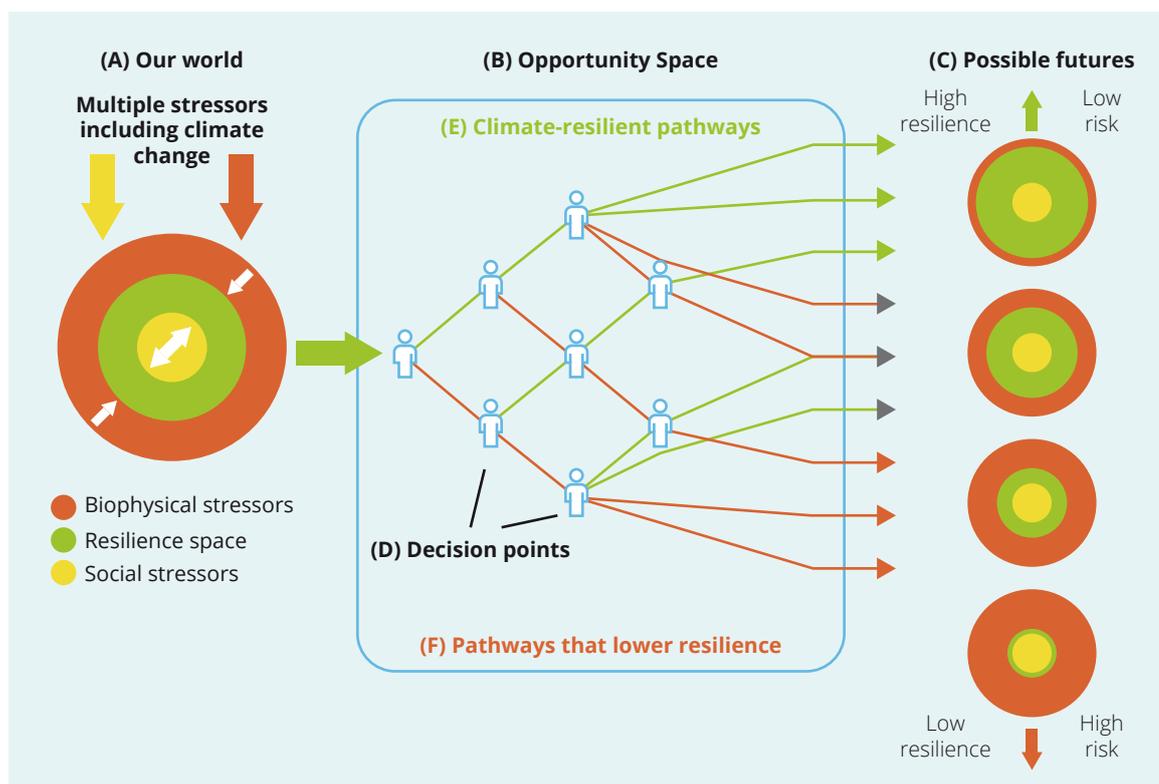
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38 Shine, T. (2016). EPA Small Scale Study 2016-CCRP-SS.12. EPA.

Desmond (2018, in print) refers to climate resilience in terms of the outcomes of evolutionary processes of managing change in order to reduce disruptions and enhance opportunities. Here the pathways approach is examined with respect to actions, strategies and choices that reduce climate change impacts while assuring that risk management and adaptation can be implemented and sustained.

The pathways approach is illustrated in Figure 3 below (IPCC, 2014) and sets out where our world is threatened by multiple stressors that affect resilience – climate change, climate variability, land-use change, degradation of ecosystems, poverty and inequality, and cultural factors. An opportunity space is highlighted where decision points are reached that take us along either climate resilient pathways or pathways that lower resilience. Decisions made will influence whether we reach a highly resilient, low risk future or a future where we have low resilience and high risk.

**Figure 3 Climate Resilient Pathways (IPCC, 2014)<sup>39</sup>**



The National Adaptation Steering Committee’s Governance subgroup has considered how the sectors represented on the group define resilience and this process identified a number of common themes – namely the importance of reducing vulnerability, recovery and availing of opportunities. Taking all of these themes into account, an overarching definition of resilience for the purposes of this Framework and for the sectors to consider in the development of sectoral adaptation plans and local government strategies is as follows:

39 IPCC, 2014. Figure SPM.9

***Climate resilience is the capacity of a system, whether physical, social or ecological, to absorb and respond to climate change and by implementing effective adaptation planning and sustainable development (including governance and institutional design) to reduce the negative climate impacts while also taking advantage of any positive outcomes. This will allow the system to either return to its previous state or to adapt to a new state as quickly as possible.***

### Guiding Principles for Adaptation

Recognising that the process of adapting to climate change is iterative, it will be important to consider a set of guiding principles<sup>40</sup> which would inform adaptation planning at sectoral, regional, local and individual levels. The following principles summarise the main success factors for adaptation contained within international research and should help to inform the approach to be taken in preparing sectoral adaptation plans under this Framework;

**Ownership:** A clear commitment at senior levels within relevant organisations to pursuing adaptation from the outset. In the longer term, sufficient personnel and financial resources for adaptation must be made available.

**Vulnerability based assessment:** Each sector and region will begin their adaptation planning with a clear understanding of sensitivities and vulnerabilities to current and future climate change.

**Openness and knowledge transfer:** Sharing best practises in adaptation, improving data collection of adaptation relevant information as well as the communication of this information are all essential for adaptation processes. Scientific information must be presented in a way that is understandable, consistent and meets the requirements of the specific target audience.

**Foster cooperation:** A working partnership with relevant and affected stakeholders throughout the entire adaptation process is an important prerequisite for successful adaptation. The objectives and the areas of responsibility of the participants must be clearly determined and communicated.

**Account for uncertainty:** Uncertainties are an inherent part of all projections of climate change and its impacts. They will never be fully eliminated but adaptation measures will be required nonetheless. A precautionary approach to adaptation should be adopted. Appropriately, accounting for uncertainty can improve adaptation decisions by making them more robust in the face of uncertainties.

**Climate Scenarios:** When prioritising climate change impacts at regional and local levels, both past weather events and scenarios of possible future climatic and socio-economic changes should be analysed. In order to understand the uncertainty in the potential impacts of climate change, a range of scenarios should always be drawn upon for the estimation of climate trends.

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40 Derived from Prutsch et al (2010)

**Identify a wide range of adaptation options:** A comprehensive range of adaptation options should be considered at the outset (green, grey and soft<sup>41</sup>). The available options should be described in as much detail as is reasonably possible in terms of their objectives and direct and indirect effects.

**Prioritise adaptation actions:** It will not be practical to undertake all adaptation options identified. Implementation of adaptation actions must be prioritised according to relevant criteria such as efficiency, cost-effectiveness, risk and urgency and ensuring a just transition. The local authority and sectoral adaptation guidelines discuss how to both prioritise climate risks at the appropriate scales and, following this, how identified adaptation options should be prioritised for implementation.

**Monitoring progress:** It will be necessary to establish appropriate monitoring mechanisms and indicators so as to ensure the effectiveness of sector specific adaptation responses. Such mechanisms will also ensure efficient use of resources while allowing flexibility to how plans are implemented.

### Mainstreaming Adaptation to achieve Climate Resilience

Based upon experience gained during the implementation phase of the non-statutory 2012 NCCAF, Government Departments can best prepare workable sectoral plans in an area that is statutorily under its remit, where the Department has long standing relationships with the key agencies and stakeholders working in that sector and control over budgets and resources in that sector.

The effective integration of adaptation into decision making (mainstreaming) requires strong coordination of adaptation from centres of power at national level. The Government, for its part, is committed to providing clear leadership in promoting the policy objective of climate change adaptation and supporting a coherent approach to dealing with the challenges ahead. In August 2017, the Government published the *National Risk Assessment 2017 – Overview of Strategic Risks* which recognised that climate change poses a strategic risk to Ireland and that strategies must be devised to reduce and manage climate change risks, through a combination of mitigation and adaptation responses. In this regard, it is important to note that the Government agreed the following at a special meeting of Cabinet in July 2017:

- that Climate Change is one of the most important long-term challenges facing Ireland and that the Government is committed to the transformation required to achieve a low carbon and climate resilient future;
- that a National Climate Change Adaptation Framework, to deal with the impacts of climate change on Ireland, will be published by the end of the year;
- that the forthcoming Budget and 10 Year National Investment Plan will be informed by the need for climate action; and
- that there will be intensive engagement with citizens and awareness raising through the National Dialogue on Climate Action.

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41 Described in Chapter 1

The need for coherence and coordination is obvious and clearly reflects the need for a whole-of-Government approach to adaptation. In addition to the preparation of individual sectoral plans, it will be important for this approach to facilitate the following;

1. Integrate climate adaptation within all relevant national policy and legislation (e.g. National Planning Framework, estimates and budgetary process, National Investment Plan) and Department and Agency decision making.
2. Increasing awareness of the necessity for climate adaptation and building adaptive capacity where required.
3. Encouraging the implementation of climate adaptation measures.
4. Developing and exploiting the knowledge base.
5. Addressing prioritised urgent and future climate risks.
6. Monitoring the progress and effectiveness of adaptation at national level.

'Climate proofing' Ireland is a collective responsibility for which every member of Irish society is responsible. Government can provide an enabling environment for independent adaptation actions by private actors in terms of ensuring the necessary information and incentives are available to respond appropriately, but a proactive role for Government is also justified. An example of this would include ensuring that plans underpinning our economic development take account of current, medium as well as long term climate risks.

### Capital Investment and Evaluation of Public Expenditure

The ongoing development of Ireland's *Capital Investment Plan (2018-2027)* recognises the challenges posed by climate change as requiring a whole-of-government approach. It also identifies that the National Transition Objective will need to fundamentally shape investment choices and spatial settlement and that the development and improvement of Ireland's public capital infrastructure is one of the primary levers available to Government to mainstream climate action goals across Government Departments. The Government's Capital Investment Programme is also seen as the cornerstone for the implementation of *Ireland 2040-National Planning Framework (NPF)*.

A key objective of the *Capital Investment Plan* will be to illuminate the role of public capital investment in helping to achieve national climate action goals. Such actions include those aimed at increasing climate resilience and adapting to climate change. The plan specifically identifies flood defences, making key infrastructure (energy, water) resilient and adapting agriculture to new climatic conditions as key actions in adapting to climate change. Other priority actions identified in the sectoral adaptation plans to be prepared under this Framework will also require capital allocations in the future.

The *Capital Investment Plan* also references significant investments in Met Éireann's network which is important for informing both our short and long term responses to climate change while *Innovation 2020* is also highlighted in terms of its now expanded role for climate action.

Within the context described above, it will be important that sectors identified under the NAF make preparations in advance of Budget 2019 in terms of financing, as well as recommendations for longer-term funding strategies to enable domestic investment in adaptation measures as an essential element of Ireland's climate resilient transition. Funding strategies should consider all relevant EU funding programmes (Structural and Investment funds, LIFE, Horizon 2020 etc.).

### **Evaluation of Public Expenditure**

Government choices in relation to expenditure are informed by rigorous analysis in relation to the proposed costs and benefits of such expenditure. Public bodies rely on the Public Spending Code, published by the Department of Public Expenditure and Reform (DPER), for guidance on how to approach such analysis, by appraising a proposed programme before expenditure is committed as well as the ongoing management, control, review and evaluation of expenditure projects and programmes that are underway or completed. To assist public bodies, the Public Spending Code also includes detailed guidelines on appraisal methodologies including Cost Benefit Analysis (CBA) and Multi Criteria Analysis (MCA).

It is essential that public expenditure choices are informed by an assessment of the economic and financial impacts as early as possible at the appraisal stage. This means being able to capture the broadest possible range of potential costs as well as the range of benefits that might also accrue.

The review of the Public Spending Code, which has now commenced, will involve economic and evaluation resources within the relevant Government Departments determining if the existing appraisal framework provides the best available advice on measuring and reporting on the costs and benefits, including their distributional impacts, associated with climate change measures. Departments should also engage with DPER to consider specific sectoral guidance, as well as to ensure that the Public Spending Code evolves to meet appraisal requirements for public service programmes and projects.

### **National Planning Framework (NPF)**

The planning process provides an established means through which climate change adaptation objectives can be integrated and implemented at local level. Planning legislation already requires different levels of the planning process to address climate change.

The National Planning Framework represents a key opportunity in ensuring that the climate implications of our spatial choices are fully considered and addressed from the top of the planning hierarchy. The climate projections which are informing such implications must be core considerations within all plans and strategies developed within this hierarchy. The draft National Planning Framework includes an objective to support national targets for emissions reduction and objectives for climate change mitigation and adaptation by ensuring that climate change considerations are further integrated into the planning system and that they continue to be taken into account as a matter of course in planning-related decision making processes.

The implementation of the National Planning Framework must ensure that the planning system responds successfully to the challenges of climate change and specifically those associated with how Ireland transitions successfully to a climate resilient economy by 2050. The most effective strategy is to integrate climate change considerations into statutory plans and guidelines, policy statements, programmes and projects at all levels of government. Established planning processes offer further potential to incorporate such considerations into the hierarchy of spatial plans. Complementary guidance material prepared under the NPF, which is capable of providing the strategic context over the long term, will be essential in ensuring effective progress on adaptation.

### **Built Environment and Spatial Planning**

It is clear that climate change considerations need to be taken into account as a matter of course in planning-related decision making processes and that the deepening of adaptation considerations in the planning and building standards processes is considered the most appropriate way of increasing the resilience of the built environment.

Effective planning reduces vulnerability to the negative effects of climate change by integrating climate considerations into decision making in order to avoid inappropriate forms of development in vulnerable areas and promoting compact development in less vulnerable areas.

Other considerations include likely heat-island effects<sup>42</sup> and the spatial implications of water stress.<sup>43</sup> Land use policies may also facilitate the conversion or maintenance of land at risk of flooding to less vulnerable uses (e.g. parks, gardens and open spaces for natural habitats, etc.). As part of their overall increased active land management role, local authorities should consider policies to acquire flood prone lands for suitable, less vulnerable land uses. The continued promotion of appropriate green infrastructure is also a key aspect of the planning system and the 2013 Local Area Plans guidelines, for example, note the contribution that a green infrastructure approach can make to climate change mitigation and adaptation. The effect of development on the capacity of biodiversity to adapt to climate change also should be considered in planning-related decision making. Flood resilience and increased access to wildlife and green space can be a 'no-regret' benefit<sup>44</sup> of effective adaptation and these potential synergies should be considered when assessing adaptation options.

There is a risk of damage to buildings and structures from severe weather events, in particular high winds and intense rainfall. In terms of location, layout and design, development permitted today should accommodate predicted future climate change impacts without requiring major redesign and redevelopment in the future which could be costly and inefficient. This approach will require facilitating innovative building design, new materials and standards (to accommodate hotter summers while withstanding changes in precipitation patterns and more intense storms for example). Changes in facilities management practices are also likely to be required. When assessing applications or preparing conditions for permitted development, planning authorities

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42 The temperatures of cities are almost always warmer than in rural areas and this has implications for future design, heating and cooling decisions for example.

43 When the demand for water in a location exceeds the available amount during a certain period.

44 Options which would provide immediate economic and environmental benefits and continue to be worthwhile regardless of future climate. They would be justified under all plausible future scenarios, including without climate change.

should therefore be cognisant of the requirements of adaptation. This applies to new buildings but also to the climate proofing of older ones. Consideration must also be given to how the upkeep of national building standards can support or impede climate adaptation measures while ensuring that standards developed by the National Standards Authority of Ireland (NSAI) (which are the main sources of reference when amending the Technical Guidance Documents to the Building Regulations) are based on appropriate meteorological data to take account of future climate changes.

The *Local Authority Adaptation Strategy Development Guidelines* (2016) recommend that a strategy, once approved, should be used by a local authority to assess the adaptation fitness of its spatial plans and the other plans and policies under its remit. The guidelines reiterate that the work undertaken to develop a local adaptation strategy should inform development plans and other statutory plans of the local authority. Such considerations should inform future revisions to the Development Plan and Development Management guidelines for planning authorities thus ensuring climate change adaptation considerations are mainstreamed into the process.

Managing, and adapting to, the effects of climate change on the historic built environment, in particular the archaeological and architectural heritage, is also essential. This will likely require close cooperation amongst the owners and custodians of heritage sites in addition to other key stakeholders. Historic buildings have already experienced and survived the effects of climatic change, in many cases over several centuries, leaving a building stock of proven resilience. However, the increasing occurrence of extreme weather events mean that all structures, including historic ones, need to be kept in a good state of repair to resist damage from a variety of threats. The built heritage is particularly vulnerable to maladaptation (i.e. actions taken now that will actually increase long term vulnerability) and the availability of the correct skills and materials to maintain, repair and adapt historic structures and sites will be critically important.

### **Environmental Impact Assessment (EIA), Strategic Environmental Assessment (SEA) and Appropriate Assessment (AA)**

Assessments such as Strategic Environmental Assessment (SEA) of plans and programmes, Environmental Impact Assessments (EIA) of projects and Appropriate Assessment (AA) also require the integration of climate change considerations. This is important in terms of mainstreaming such considerations in strategic plans and programmes but also in respect of project specifics at a particular location.

The EPA's 2015 guidance note on *Integrating Climate Change into Strategic Environmental Assessment in Ireland* notes that SEA "is now coming to be recognised as perhaps the most flexible and capable instrument of climate policy integration available internationally and nationally".

The revised EU EIA Directive 2014/52/EU which is project focused and which is being transposed into Irish law, requires more explicit recognition of climate change effects in the preparation of Environmental Impact Assessment Reports. This will help again with the mainstreaming process but will also ensure that specific locational issues are addressed appropriately. The need to update guidance on incorporating adaptation considerations in SEA and EIA following transposition of the 2014 EIA Directive will also need to be assessed in due course to ensure mainstreaming of climate change is effective.

### Emergency Planning

There is a growing recognition at EU/international level of the need for greater integration of emergency planning (particularly disaster risk reduction) and climate change adaptation. As also indicated earlier, this has already begun in Ireland. Under this Framework, it is foreseen that these relationships will continue to strengthen over time.

In Ireland, the benefits of longer term planned responses (i.e. climate change adaptation planning) to how we respond to in the short term to extreme weather (i.e. emergency management) need to be further developed. It is important to ensure that coordination and coherence are maintained and enhanced as we move forward in planning for resilience whether for tomorrow or for 2050 and beyond. Further connectivity and coherence between the two areas can improve the efficiency of data collection and build up a more complete picture of progress and priorities at national level.

Effective climate adaptation can minimise risks and costs and also protect lives and property by building resilience into existing systems. This can ultimately help minimise the emergency response that is necessary in response to severe weather events. Work undertaken in the area of flood risk management to date is a good illustration of this principle. Flood risk prevention strategies often make use of assessments of long-term changes in flood intensity and frequency based on climate projections. This can build long term resilience into flood defences to cope with conditions that may arise in the future.

It is also crucial that any developments in the area of emergency management undertaken in line with this Framework recognise existing structures and the policies underpinning them at national level. This Framework therefore seeks to ensure coherence between how the impacts of climate change will influence our combined responses to both adaptation planning and national emergency planning for extreme weather events. Such an approach will also help to align with the key responsibilities outlined under the Strategic Emergency Management National Structures and Framework and the associated guidance documents.

### Sectoral Adaptation Planning

A critical undertaking for relevant Government Departments is to take a leadership role in implementing the Framework by mandating and supporting adaptation planning and implementation of actions within their Departments and Agencies in line with the requirements of the 2015 Act and the NAF. Under the Framework, Government Departments (or Agencies, where appropriate) with responsibility for priority sectors will prepare adaptation plans in line with the Act. All Departments however, even those not specifically required to prepare a plan under this Framework, must lead by example and prepare for the impacts of climate change by determining how to integrate climate adaptation into relevant policies and measures under their remit, including procurement. Departments should also cooperate in other adaptation-relevant areas that may not come under their direct remit but that may, nonetheless, require their input and advice. This is particularly relevant in areas such as flood risk management, critical infrastructure, marine and coastal issues and emergency planning, where statutory responsibilities lie across a number of Government Departments and where existing structures can facilitate such cooperation (e.g. Interdepartmental Marine Coordination Group,

Interdepartmental Flood Policy Coordination Group, Government Task Force on Emergency Planning). Departments must engage with key players in their respective sectors; championing adaptation policies and encouraging the private sector and civil society to partake in the collective adaptation effort.

Agencies and other State bodies should also engage proactively with their parent Department to inform them of adaptation measures undertaken and to identify areas where further action may be necessary and contribute to information sharing and capacity building.

Government Departments (or Agencies, where appropriate) with responsibility for the sectors set out in Table 3 will prepare adaptation plans in line with the requirements of Sections 5 and 6 of the Climate Action and Low Carbon Development Act 2015 and in line with the Framework and the “Sectoral Guidelines for Planning for Climate Change Adaptation”. In doing so, the sectors are considering their own vision for a climate resilient future which of course will have a sector specific focus. This is essential in terms of understanding the key risks that face each sector; however, the Framework aims to present an overarching view of how each sector can contribute to a climate resilient Ireland in line with national, European and international policy. Therefore, each sectoral plan must be approved by Government in line with the 2015 Climate Act.

The process for preparation of these draft sectoral plans should allow for input from all relevant stakeholders, particularly those bodies who will be expected to play a key part in implementing the plans. In preparing these sectoral plans, due account will also need to be taken of the requirements of the EU Strategic Environmental Assessment and Habitats Directives.

Substantial preparatory work has been completed that has succeeded in building the knowledge base for adaptation and in increasing awareness of the need to adapt to climate change. Work has also been completed in a number of sectors under the NCCAF (2012) that will provide a strong foundation for statutory sectoral adaptation plans.

In this regard, sectors have begun the process of identifying potential adaptation actions which may have a particular impact on other stakeholders or who might have a role in their delivery with a view to exploring the opportunities for early engagement. This should help to ensure that a coherent and coordinated approach is brought to bear on the respective plan making processes. Priorities identified to date show that issues common to a number of sectors include the possible disruption of sector specific supply chains and insurance issues, along with the need for up to date information, research and capacity building, and effective monitoring, surveillance and early warning systems.

A number of sectors share objectives to mainstream adaptation requirements via sectoral policies, strategies, plans and measures; however, it is not yet clear how these objectives will be achieved. Sectoral adaptation plans will need to build on these commitments and include specific and measurable policies rather than just general ones that simply state an intention to minimise negative impacts and maximise opportunities.

Sectors will also need to have an ongoing consideration of how any negative consequences of actions impacting on other sectors are eliminated, reduced or mitigated and how the climate resilience of their sector may be impacted on positively or detrimentally, by actions in many other sectors. This will be enhanced through the themed approach set out below.

### A Themed Approach

Vulnerability data which is becoming available for Ireland<sup>45</sup> has shown that certain sectors are likely to face similar adaptation challenges and opportunities. This presents opportunities for enhanced cooperation and coordination in developing climate adaptation responses, building on the experience of the 2012 NCCAF.

Table 3 below lists the key sectors concerned in developing sectoral adaptation plans including the Departments who have the lead responsibility in bringing this work forward. In an effort to promote enhanced cooperation and coordination, Table 3 also highlights how sectors could be grouped under four key thematic areas. This approach also reflects trends at EU level towards a more thematic approach to climate adaptation which may be expanded upon in future NAFs. The four thematic areas identified are as follows:

- 1. Natural and Cultural Capital<sup>46</sup>**
- 2. Critical Infrastructure**
- 3. Water Resource and Flood Risk Management**
- 4. Public Health**

The themed approach highlights the potential to work cross departmentally in terms of identifying synergies and efficiencies that can be achieved in bringing forward coherence between respective adaptation policies and measures. Within this context, it is worth noting that Ministers responsible for plans in each sector are also required to consult with other Ministers preparing plans in the same theme and with the Minister of Communications, Climate Action and Environment, Minister for Public Expenditure and Reform and Minister for Finance and any other Minister as directed by Government in accordance with the 2015 Act.

The themes outlined below are themselves cross cutting in nature while the sectors will also identify inter-dependencies across other sectors and therefore engagement across themes and Departments is encouraged. In some sectors it is recognised that the lead department will be required to closely collaborate with many other Departments and Agencies given the diverse range of responsibilities and issues. This will be facilitated through the National Adaptation Steering Committee and other existing structures as appropriate.

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45 E.g. *A Summary of the State of Knowledge on Climate Change* (Desmond et al., 2017) and information presented in Chapters 2 and 3.

46 Defined by the Irish Forum on Natural Capital as stocks of physical and biological resources including air, water, minerals, soils, fossil fuels and all living things.

**Table 3 Sectors and Lead Departments**

<b>Theme</b>	<b>Sector Level</b>	<b>Lead Department for Sectoral Adaptation Plans</b>
<b>Natural and Cultural Capital</b>	Seafood	Department of Agriculture, Food and the Marine
	Agriculture	
	Forestry	
	Biodiversity	Department of Culture, Heritage and the Gaeltacht
	Built and Archaeological Heritage	
<b>Critical Infrastructure</b>	Transport infrastructure	Department of Transport, Tourism and Sport
	Electricity and Gas Networks	Department of Communications, Climate Action and Environment
	Communications networks	
<b>Water Resource and Flood Risk Management</b>	Flood Risk Management	Office of Public Works
	Water Quality	Department of Housing, Planning and Local Government
	Water Services Infrastructure	
<b>Public Health</b>	Health	Department of Health

### **Sectoral Plans**

Departments should attempt to focus within their sectoral plans on actions that can be undertaken within the next five years while identifying options that may be required in the medium to long term. In doing so, sectors should consider a prioritisation exercise based on what they determine are the most urgent or pressing risks for areas under their remit. Particular focus should be given to the following:

- Mainstreaming adaptation into their key sectoral plans and policies.
- Identifying and understanding the key vulnerabilities, risks and opportunities facing their sectors. This should include major cross cutting risks.
- Ensuring that plans related to emergencies assigned to a sectoral department as Lead Government department under the Strategic Emergency Management National Structures and Framework are climate proofed.
- Identifying and collecting information on the costs and benefits of adaptation within their sectors.

- Building capacity within their sectors to cope with climate change.
- Identifying and addressing key research gaps within their sectors.
- Improving coordination with the local government sector.
- Developing appropriate monitoring and verification systems within their sectors.
- Transboundary impacts and synergies.

As a minimum, these plans will present evidence of a clear understanding and description of the risks presented by climate change to the sector, their vulnerability to such risks and actions both to address the risks and ensure the climate resilience of the sectors. Government departments may also direct bodies under their aegis to draw up adaptation plans for specific areas of responsibility, where warranted.

In drawing up these sectoral plans, three basic steps must be reflected, namely:

- a clear understanding of the consequences of a changing climate for each sector;
- actions to equip decision makers with skills and tools; and
- the integration of adaptation into policy and administration at sectoral level in Ireland.

The existing Climate Ireland resource (Ireland's Climate Information Platform – ICIP)<sup>47</sup> which is being developed to an operational level will continue to be a key source of assistance underpinning these three steps and in particular with respect to its Sectoral Adaptation Tool application. This is based on the **“Sectoral Guidelines for Planning for Climate Change Adaptation”** which are structured around a 6 step planning cycle, these are: 1) Preparing the Ground; 2) Climate Impact Screening; 3) Prioritisation; 4) Priority Impact Assessment; 5) Develop your Plan; 6) Implement, Evaluate and Review.

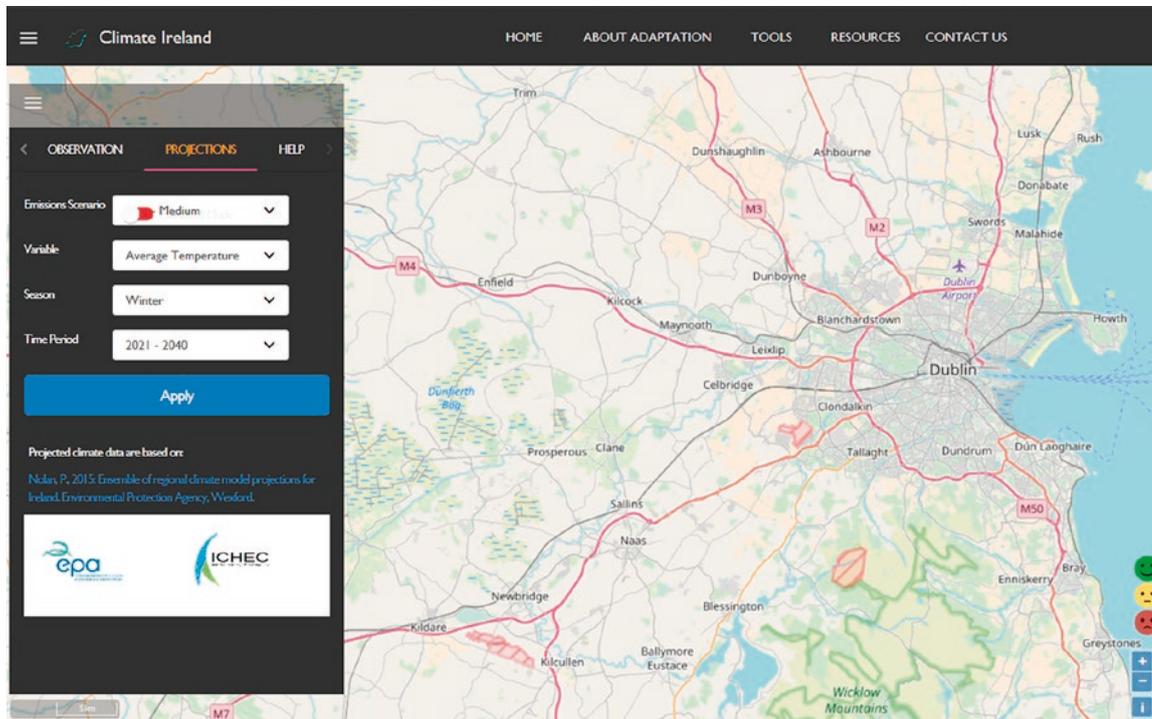
The development of Climate Ireland under the EPA research programme represents a very good example of how a research project can provide a hugely valuable resource in practical terms for the provision of critical climate information so as to support decision making frameworks at local regional and sectoral levels. The availability of accurate, consistent and authoritative data, information and analysis specific to Ireland is crucial to successful adaptation planning. In this regard, Climate Ireland represents a unique system by providing decision makers with a one stop repository of Ireland specific information, data and knowledge to support planning for the impacts and consequences of climate change.

To date Climate Ireland has provided expert support to a number of Government Departments and local government in the development of non-statutory sectoral adaptation plans and strategies. This work was also critical in the development of sectoral adaptation guidelines which have provided an important input into the ongoing development of the NAF. It is critically important that Climate Ireland be now placed on a permanent operational basis so as to continue to inform the relevant sectors but also in terms of providing a valuable resource to civil society.

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47 “Climate Ireland” ([www.climateireland.ie](http://www.climateireland.ie))

**Figure 4** Climate Ireland Map Viewer



The process of climate adaptation evolves over time in response to ongoing assessments of impacts and vulnerabilities. Adaptation planning is therefore an iterative process, where plans and actions can be modified and changed as new information and research becomes available. Accordingly, it is envisaged that sectoral plans will be reviewed and updated at least every 5 years in line with the 2015 Act; however, given the dynamic and iterative nature of adaptation planning it is envisaged that measures or actions could be continuously reviewed and updated to reflect what new information might become available within the planning cycle.

### Local and Regional Adaptation

The local government sector plays a pivotal role in planning for, and responding to, emergency situations. Given their close relationship with the community, local authorities can react faster and more effectively to local climate events than other government agencies. This has been demonstrated in their response to extreme weather events in Ireland over recent years. They have essential local knowledge of the natural and manmade environment and have a critical role to play in managing climate risks and vulnerabilities and identifying adaptation actions. They also deliver key services to the public either directly or on in partnership with other Government Departments such as housing, planning, sanitation and maintenance of local roads, parks and waterways.

In line with legislation, this Framework sets out the national strategy for the application of adaptation measures by a local authority in its administrative area in order to reduce the vulnerability of the State to the negative effects of climate change and avail of any benefits that may occur. In addition, Section 15 of the 2015 Act provides that a 'relevant body' (the definition of which includes a local authority) must have regard to the most recently approved NMP and NAF in the performance of its duties.

While the structure of local government facilitates independent adaptation planning and action on the part of individual local authorities, it is clear that many authorities face challenges similar to their neighbouring areas. In such instances, and as already referenced in Chapter 2, local authorities are now proposing to adopt a joint or regional governance approach to adaptation planning, where there are opportunities to share knowledge, experience and resources or to avail of economies of scale.

It will be important that this proposed approach is given the support it requires in terms of ensuring that appropriate arrangements are put in place as soon as is practical so as to provide for effective delivery of climate resilience at the regional/local scale.

While a regional structure does not remove the requirement for each local authority to advance the adaptation strategy process, it does provide the opportunity to establish centres of expertise that will be available to local authorities in the region, ensure consistency within the various local authority plans and deal with cross-boundary issues within and across the regions. They will equally provide input/advice into sectoral adaptation plans and in particular, they will be in a position to advise on local implications of sectoral actions. Ultimately, national policy will aim to ensure that the appropriate tools and guidance are provided to the local authority sector to enable them to plan effectively for the impacts of climate change and to ensure that climate change adaptation is a key issue that is considered by each local authority in the formulation of their own plans and programmes.

Work to date by sectors has identified local authorities as a key stakeholder responsible for implementing adaptation actions in their area. In the flood risk management sector, for example, they are a key stakeholder in the preparation of flood emergency response plans, while they are also likely key stakeholders in the control of invasive species and management of fluvial flooding on road surfaces in the Biodiversity and Transport sectors respectively. This is due to their close relationship with the local community, proximity to events and their familiarity with local conditions. Therefore it is vital that local authorities and their role be considered as part of the development of sectoral adaptation plans to ensure coordination and efficiency with actions delegated to the local level when appropriate.

Each local authority should make and adopt local adaptation strategies based on the regional governance approach to adaptation planning which will be established under the Framework. The development of strategies must be undertaken in accordance with the *Local Authority Adaptation Strategy Development Guidelines*, this Framework and the requirements of the Climate Action and Low Carbon Development Act 2015. In preparing local adaptation strategies, authorities should consider bringing any proposed strategy, be it regional or local authority based, before elected members at city, county or city and county level, as appropriate.

### **Covenant of Mayors**

After the adoption, in 2008, of the 2020 EU Climate and Energy Package, the European Commission launched the Covenant of Mayors to endorse and support the efforts deployed by local authorities in the implementation of sustainable energy policies. The Covenant of Mayors was a unique bottom-up movement that succeeded in mobilising a great number of local and regional authorities to develop action plans and direct investments towards climate change mitigation measures.

Building on the success of the Covenant of Mayors, the Mayors Adapt initiative was launched in 2014, relying on the same governance model, inviting cities to make political commitments and take action to anticipate and prepare for the unavoidable impacts of climate change. In 2015, the initiatives merged under the new integrated Covenant of Mayors for Climate and Energy, adopting the EU 2030 objectives and an integrated approach to climate change mitigation and adaptation.

To date seven Irish local authorities have committed to adaptation commitments under Mayors Adapt or the Covenant of Mayors for Climate and Energy. These initiatives present further opportunities to align both adaptation and mitigation, enhance local adaptation strategies and build local awareness and support for such actions.

### **Enhancing the Enabling Environment for Effective Resilience**

The section above describes the context for how the sectors, including local government will fulfil their obligations in preparing adaptation plans and strategies to contribute to the overall target of achieving climate resilience at National level. The importance of existing resources such as Climate Ireland and Sectoral and Local Government Guidelines is also explained. It is also critical however that the wider environment, in which sectors and local government operate, works to facilitate or enable the National Transition Objective of a climate resilient economy and society by 2050.

### **Role of Climate Change Advisory Council**

The integration of a facility for the provision of independent expert advice into the adaptation governance framework and policy process is important. The Climate Change Advisory Council (CCAC) was established by Ministerial Order on 18 January 2016 under Section 8 of the Climate Action and Low Carbon Development Act 2015. The Council, which is independent in the performance of its functions, provides advice and recommendations to, inter alia, the Minister for Communications, Climate Action and Environment in relation to the preparation of the NAF; the making by a relevant Minister of a sectoral adaptation plan; and the approval by the Government of a NAF. In addition, the Council has a number of reporting obligations, including with regard to 'Annual' and 'Periodic Reviews' of progress towards meeting the National Transition Objective. The Climate Change Advisory Council's published its first periodic report in July 2017 which makes specific recommendations in respect of the development of the National Adaptation Framework. It also established an Adaptation Committee in 2016 to focus specifically on adaptation related matters.

It is essential, in terms of underpinning a whole-of-government approach to adaptation/resilience that the Council continue to liaise with the key sectors concerned so as to assess and monitor progress in achieving our transition objective for climate resilience.

### Role of Met Éireann

Met Éireann's vision is to make Ireland weather and climate prepared through helping Irish society to be ready for and responsive to weather-related challenges. Met Éireann supports climate adaptation through its observation, forecasting and climate research activities. Met Éireann maintains and will continue to develop a sustainable program of atmospheric observations, and it will play a lead role in the coordination of the network of the Global Climate Observing System (GCOS) Essential Climate Variables. It will continue to maintain and expand the national climate archive of observations and make the data available through an open data portal. As climate change progresses, Ireland's future weather is likely to become even more challenging, with an increased frequency and severity of extreme events. Met Éireann will support citizens, public agencies and sectoral interests in decision making by provision of high quality local forecast information. Met Éireann will engage with the OPW and relevant stakeholders in the establishment of the National Flood Forecasting and Warning Service (NFFWS). The range of Climate Services will be increased through an expanded climate research programme, including analysis and reanalysis of the current and past climate, continued climate modelling through the EC-Earth consortium and collaborative research project such as those in the European Research Area for Climate Services (ERA4CS) to provide user specific value-added climate information at a local scale.

Copernicus Climate Change Service is a European Union Programme that responds to environmental and societal challenges associated with human-induced climate change. The service will give access to information for monitoring and predicting climate change and will help to support adaptation and mitigation. It benefits from a sustained network of in situ and satellite-based observations, re-analysis of the Earth's climate and modelling scenarios based on a variety of climate projections. The Programme is coordinated and managed by the European Commission. It is implemented in partnership with the member states, the European Space Agency (ESA), the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), the European Centre for Medium-Range Weather Forecasts (ECMWF), EU Agencies and Mercator Océan.

Copernicus Climate Change service (Copernicus C3S) is tasked to provide information to increase the knowledge base to support adaptation and mitigation policies. It will in particular contribute to the provision of Essential Climate Variables (ECVs), climate analyses, projections and indicators at temporal and spatial scales relevant to adaptation and mitigation strategies. Met Éireann, as Ireland's representative for two of the Copernicus' implementation bodies (EUMETSAT and ECMWF) and with expertise in the areas on satellite Earth Observation and in situ (non-space) data, has a pivotal role in improving coordination, communication and policy linkage with the Copernicus programme.

### Role of the Private Sector

In 2010, Forfás published a report titled *Adaptation to Climate Change: Issues for Business* which stated that a changing climate brings risks and costs, concluding that an early adaptation measures can reduce the costs of climate change for businesses and the economy and that once properly prepared, that adaptation may also provide opportunities for businesses in Ireland.

The Forfás report noted specific responses to deal with adaptation including:

- Adapting and applying business planning tools to help business adaptation.
- that both new and existing professionals have developed the skills necessary to respond to climate change.
- Creating, gathering and sharing sector-specific information on adaptation by sector organisations.
- Assessing current business supports to understand their potential to support adaptation.
- Continuing to ensure enterprise development agencies continue to incorporate climate change adaptation research and considerations in their work.

In addition to the above it can also be anticipated that the private sector will continue to invest in research and development and contribute to research priorities to continue to support adaptation activities while also identifying and investing in emerging opportunities.

The Government acknowledges the importance of complementary private sector action to address the impacts of climate change. Each Minister and Agency, where appropriate, should seek to engage with private sector representatives for their respective sector/area in shaping and developing their adaptation plans. The private sector must themselves consider climate impacts in their long term strategic planning and investment decisions and identify vulnerabilities to climate change risks across their supply chains and assess climate risks to their assets and activities adaptation considerations should form part of an organisation's normal risk management assessment processes. Potential business areas which climate change may impact:

- **Markets:** climate change could change demand for goods and services.
- **Logistics:** climate change could increase vulnerability of supply chains, utilities (in particular water and energy), transport arrangements and communications.
- **Premises:** climate change (such as more frequent flooding events, storms, coastal erosion, etc.) could impact on location, materials, building design, construction, maintenance and facilities management.
- **Finance:** climate change could have implications for investments, insurance costs and stakeholder reputation.
- **Production:** climate change could result in changes in employee productivity and work place comfort and safety and create risks to production processes  
These impacts may be experienced more by those sectors that are expected to be most exposed to the impacts of climate change. These sectors include:
  - Sectors currently affected by weather events (e.g. food and drink, construction);
  - Sectors making long-term investment decisions (e.g. utilities, pharmaceuticals);

- Sectors heavily reliant on transport/infrastructure in (global) supply and demand chains (e.g. ICT/pharmaceuticals);
- Sectors that are global in nature and are particularly exposed to adaptation internationally (e.g. financial services); and
- Sectors that need a lot of high quality water such as pharmaceuticals, ICT (wafer manufacturing), food and drink.

The 2017 UK Climate Change Risk Assessment report highlighted the role of government in “enabling, facilitating and supporting private sector adaptation through policies, regulation and other supportive measures such as information sharing and raising awareness” and this should also be a key consideration under the Framework here in Ireland.

In terms of insurance, the private sector has significant experience in quantifying, pricing, reducing risk and managing weather-related risks across the relevant sectors. In partnership with Government, it can therefore play an important role in collecting and disseminating data on weather and catastrophe risk, financing risk assessments, and supporting the design and provision of insurance schemes. Surminski (2017) argues that insurers have a crucial role to play in climate change adaptation but that greater collaboration is required.

This may be addressed by better information sharing between insurers, agencies such as the OPW and local authorities facilitating improved risk modelling and the charging of premiums which more accurately reflect a household's risk level, for example.

Information platforms such as Climate Ireland can help address both of these issues by providing insurers with more accurate information on households risk level e.g. through flood mapping while also supporting households in taking actions to lower their risk level.

A potential economic opportunity for Ireland is the adaptation economy. This is related to the concept of climate services and involves the transfer of specific adaptation knowledge and developing a comparative advantage and expertise in adaptation to particular forms of climate hazard e.g. flooding. Climate Services<sup>48</sup> are the sharing of climate knowledge to researchers and decision makers in policy and business. This includes knowledge for understanding the climate, climate change and its impacts, as well as guidance in the use of climate knowledge.

### Role of Civil Society

The process of making Ireland climate resilient must be open, transparent, and inclusive. Interested organisations and stakeholders, at sectoral, local, regional and national levels, must be given early and adequate opportunity to input to the process of preparing the Framework, sectoral plans and local strategies.

One of the key objectives of the Framework is to raise awareness and encourage action around climate change adaptation. The publication of this document for public consultation will represent a hugely significant step forward for this objective however it is imperative that civil society also has a voice in determining the future of Ireland's climate resilience.

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48 <http://www.jpi-climate.eu/ERA4CS>

The National Dialogue on Climate Action running initially for two years (2017-2019) and the recommendations of the Citizens' Assembly on 'How the State can make Ireland a leader in tackling climate change' will have a key role in considering future public awareness, engagement and motivation to act in relation to the challenges and opportunities presented by climate change and specifically with respect to how we plan ahead for adaptation/resilience. We need to consider innovative forms of communication (i.e. through the Dialogue process and Climate Ireland) so as to inform but also to ensure society remains engaged on the long road ahead in making Ireland climate resilient by 2050.

It is important to note that the majority of adaptation actions will be taken by individuals, households and businesses, as they adjust independently to their circumstances due to experiences or perceptions about climate risk. This can include putting in place short-term changes to farming practices such as changing crop planting dates, or implementing temporary flood protection measures for individual houses and businesses. Uncoordinated adaptation actions may result in missed efficiency gains and independent adaptation action in one sector may also have unintended adverse impacts for other sectors which could potentially increase, rather than reduce, overall vulnerability to climate change impacts. Research indicates many people believe they live further away from potential climate hazards (e.g. flood risk areas) than is actually the case and individuals with low risk perceptions are less likely to undertake preventive actions that will reduce their risk level (O'Neill et al., 2016). This suggests a role for Government in ensuring these independent actions are more informed.

Therefore a primary role for government will be providing an enabling environment to ensure these individuals and businesses have the necessary information and appropriate incentives to respond appropriately (Collier et al., 2008). This is to be achieved through increased information provision (through Climate Ireland for example) and awareness raising (through initiatives such as the National Dialogue on Climate Action), including encouraging individuals and businesses to assess the impact of past weather events as a means of self-assessing resilience for events which may happen in the future. Also, each sector and local authority preparing adaptation plans and strategies under this Framework should consider how individual adaptation actions may contribute to or reduce the vulnerabilities in their sector and in doing so can ensure they play a key role in mobilising the public as a result of their interaction with citizens and communities through the discharge of their various statutory functions.

The position of local government, as the level of government closest to the citizen, puts it in an effective position to provide local leadership. In addition to their influencing role through, for example, statutory community networking (e.g. Public Participation Networks, Local Community Development Committees), support of community groups, Local Enterprise Offices and environmental awareness programmes, the National Dialogue on Climate Action provides an ideal forum for local authorities to play a key role in advancing informed discussions across all areas of the national climate agenda.

### Role of International Development

It is also important that Ireland plays its part at a global level in respect of discharging its obligations on matters relating to how we contribute to climate resilience in the developing world.

Ireland's policy for International Development, One World, One Future and Ireland's Foreign Policy, Global Island prioritise action against climate change for the poorest people in developing countries, in particular the least developed countries.

The majority of this work falls within the remit of the Department of Foreign Affairs and Trade, through Irish Aid. Their international programmes recognise the importance of community based adaptation to climate change programming, reflected in the Climate Change and Development Learning Platform ([www.climatelearningplatform.org](http://www.climatelearningplatform.org)), developed in collaboration with the International Institute for Environment and Development (IIED), which supports Irish Aid Key Partner Countries and organisations in integrating climate change and climate risk management into development programmes and planning. The intention would be to continue this level of collaboration and where feasible to develop further initiatives which could facilitate exchange on adaptation best practice thus generating lessons that could be of potential value (and directly comparable) to the Irish experience.

Adaptation is seen as a key priority by developing countries, and Ireland has a strong record of recognising and supporting this need. Ireland's international financial support for climate change action heavily prioritises adaptation programmes. Generally, over 90% of Irish climate finance in recent years has supported adaptation goals in developing countries, largely in sub-Saharan Africa. Ireland contributes to the Least Developed Countries – Expert Group and the Least Developed Countries Fund, for the design of National Adaptation Plans in these countries. Ireland has been an active partner in supporting climate diplomacy at EU and UN levels, and has supported the prioritisation of adaptation and the climate change needs of Developing Country Parties. In the period to 2020 Ireland will continue to support partners to integrate climate change into development programmes and to prepare and implement adaptation plans.

In addition, it is important to note that in November 2017 Government agreed to Ireland becoming a member of the NDC (Nationally Determined Contributions) Partnership, which was formally announced by Minister Denis Naughten at COP23 in Bonn. The NDC, which is currently housed within the World Resources Institute and is a partner of Irish Aid's, is looking to provide a mechanism for quick-drawdown, demand based input to both national mitigation and adaptation plans. The intention is that the learning process would enable Ireland to provide technical support to developing countries while also allowing Ireland to access peer support on the planning and implementation of adaptation actions elsewhere.

### Role of Research

Innovation 2020, published in 2015 is Ireland's five year strategy on research and development, science and technology. Innovation 2020 sets out the roadmap for continuing progress towards the goal of making Ireland a Global Innovation Leader, driving a strong sustainable economy and a better society. It notes the societal benefits of climate change research and innovation and seeks to promote innovation in relation to the environment, including climate change. As part of Innovation 2020 it was agreed that a refresh of Research Prioritisation would be undertaken in 2018. Given the increased urgency of climate change and sustainability challenges, alongside the increased opportunities for enterprise within this wider context, climate action research and innovation is likely to become further prioritised.

Climate research and modelling programmes should support climate adaptation by delivering climate services at a local level across all sectors of the economy, including emergency management. The research carried out to date has been hugely instrumental in developing the current knowledge base on impacts, risks and vulnerabilities to climate change with a view to informing climate change adaptation decision making. Current ongoing work will add significantly to this in terms of national climate change risk assessment and integrated assessment and management of current and future climate vulnerabilities within the context of spatial planning practices and critical infrastructure.

The Environmental Protection Agency (EPA) will continue, through the EPA research programme, in building the evidence base for climate action to inform policy and decision making at national, regional and local levels; in filling knowledge gaps that act as barriers to climate adaptation; and in providing tools to help sectors and organisations to understand and adapt to climate change. The EPA will also disseminate the results of its research projects to relevant Government and other bodies in order to build adaptive capacity within those organisations to take action on climate change adaptation. The Agency will also play a key role in facilitating the National Dialogue on Climate Action and specifically, in terms of the Framework, to ensure that climate adaptation/resilience is captured appropriately in this process.

Technical support for the development and management of key operational elements in the national climate and energy policy process is provided by the Technical Research and Modelling Group (TRAM). TRAM was established by Government decision in 2015 and supports the ongoing development and implementation of the National Mitigation Plan and will support the development and implementation of adaptation actions under this Framework.

### Future Research Priorities

As we move further into the implementation of climate change adaptation there will be an increased need for interdisciplinary research that will require input from all the sciences. This new direction is necessary to allow us to transition to a climate resilient economy and society. Potential areas for future research have been discussed with the relevant sectors concerned to enhance Ireland's climate resilience and may include the following:

#### 1. Observations, monitoring and analysis

The continued systematic observation of key climate parameters and data analysis is central to research in this area. Every effort must be made to ensure the sustainability, and evolution, of the observation systems while providing ongoing support of data analysis and delivery. It is likely that an update research programme of work on *Status of Ireland's Climate* (Dwyer, 2013) will begin work in early 2018. Consideration must be given to how the network is sustained and built upon and the integration of evolving future requirements.

#### 2. Modelling of future climate change

**Projections/modelling:** at a general level, Ireland needs a programme of continuous updating of regional climate model outputs to maintain a state of the art understanding of future climate change at resolutions and timelines appropriate to national, regional and local decision making.

#### 3. Impacts, risk and vulnerability assessment

**Climate vulnerability:** further research to analyse more fully the vulnerability of each sector, the built environment etc. and identify critical thresholds-this type of work needs to account for spatial, sectoral, social and ecological vulnerabilities, perhaps within a common cross-disciplinary framework.

**Impacts and risk assessment:** alongside the ongoing National Risk Assessment of Impacts of Climate Change (C-RISK) and Critical Infrastructure Vulnerability to Climate Change (CIViC) projects, there is a requirement for an integrated approach to this which would allow us to understand cross sectoral impacts, cumulative impacts etc. and the integrated assessment and management of current and future vulnerabilities within the context of spatial planning practices and critical infrastructure, for example. How this is updated to consider new methodologies, scientific advances and climate change is a key consideration.

**Climate change impacts analysis:** further analysis of impacts temporally, spatially and under different emission scenarios, further detail on implications for Ireland of global impacts e.g. large scale singular events, food security, climate migration, further analysis of secondary impacts (knock on effects) and interplay between impacts at sectoral level.

**Socio-economic scenarios:** assessment of scenarios of future development pathways. This would be important for future planning and decision making. This could initially build on IPCC scenarios in conjunction with emissions scenarios.

**Achieving Resilience in the Marine/Coastal Environment:** requirement to address knowledge gaps in relation to climate impacts within the marine/coastal environment, including the sectors concerned and the impacts of both existing and emerging marine legislative frameworks.

**Issues for Enterprise:** The physical effects of climate change will be a key influence on important business decisions such as investment location. Further analysis of the implications from an enterprise perspective of climate change and adaptation/resilience for the private sector should be considered.

#### 4. Adaptation information and responses

**Develop a coordinated and coherent approach to climate resilience:** including how it might be achieved at sectoral, local and community levels and addressing fragmentation and duplication across governance levels. This would also require a 'narrative' piece around climate resilience and positive 'win-win' messages.

**Finance and costing of climate impacts and future adaptation needs:** this might include a full cross-sectoral costing of current impacts and future adaptation costs of climate change, including an assessment of a 'business as usual' approach in comparison to a proactive adaptive approach (win-win) and also accounting for the insurance element of this.

**Indicators:** supporting the development of appropriate national, sectoral and local level climate change indicators is proposed in the NAF. This could meet international/EU reporting requirements, track progress on indicators of adaptation action, and aid awareness raising.

**Adaptation decision making-information** is needed on decision making frameworks, such as Adaptation Pathways, robust decision making, etc. to meet short, medium and long term resilience goals.

**Behaviours and attitudes:** further understanding of how stakeholders understand the transition to a low carbon, climate resilient future post Paris Agreement.

**Adaptation option and selection:** need an understanding of the benefits and challenges of grey, green, soft adaptation options. Need to understand how these options can also double up as mitigation options and thus function as 'win-win' policy options.

**Develop methods to improve landscape permeability to facilitate the movement of biodiversity in a changing climate:** This research would consider the concepts of green infrastructure, multifunctional, permeable, heterogeneous landscapes and propose climate adaptation zones to facilitate the movement of biodiversity in a changing climate. Any proposed zones would have to take into account the National Planning Framework, Local Plans and the network of protected areas.

**Policy integration:** levels of policy integration, coherence between policy objectives such as the National Policy Position and between mitigation, adaptation and sustainable development, building capacity among the planning and policymaking community and the continued development and use of climate services (learning and building on projects currently being supported).

The EPA, in light of its statutory role, has established a National Climate Research Coordination Group bringing together various actors to coordinate climate environmental research in Ireland. Within this context it will be important to collate relevant research to the climate change adaptation agenda so as to ensure coherence in terms of prioritising future research. It will also be important to identify how best to bring this research forward (i.e. under the EPA research programme, TRAM etc.).

# Chapter 4 Implementation and Governance

## Implementation and Accountability

The Government will, within three months of laying this approved NAF before both Houses of the Oireachtas, request Ministers identified within this Framework prepare the sectoral plans that are assigned to them in accordance with their obligations under the Climate Action and Low Carbon Development Act 2015 and this Framework. These plans will specify the adaptation policy measures the Minister in question proposes to adopt. The plans will be submitted to the Government for approval within a specified period. The NAF and the sectoral plans produced under it will form part of an iterative process and will be revised at a minimum every five years to reflect developments in scientific knowledge and to facilitate the modification and escalation of adaptation actions as necessary. Table 3 highlights the relevant sectors and lead Departments for preparing sectoral adaptation plans under this Framework.

The National Adaptation Framework will be implemented in a coordinated and integrated way, providing coherence, avoiding duplication and maximising resources. Monitoring implementation and progress will be key aspects of this. Successful implementation of this NAF requires governance structures that will enhance oversight and coordination and be informed by relevant, up to date research and analytical input. Implementation of the National Adaptation Framework will require strong governance and accountability, including oversight by the Oireachtas, independent advice from the Climate Change Advisory Council and coordination across Government and other actors.

The 2017 periodic review report of the CCAC<sup>49</sup> identifies a need for clarity on governance and ownership of implementation actions arising from this National Adaptation Framework. Ireland's adaptation response requires an integrated and coordinated approach in order to minimise implementation gaps. Strong policy and planning coordination among Government Departments, agencies, local authorities and other actors will be crucial in the delivery of successful and cost effective adaptation measures.

Sectoral coordination has been taking place under the auspices of the National Adaptation Steering Committee which is chaired by the Department of Communications, Climate Action and Environment. The role of the Steering Committee is to provide advice and guidance to the relevant sectors in respect of the development of sectoral adaptation plans required in accordance with Section 6 of the 2015 Act. The composition of the Committee includes the majority of sectors originally mandated under the NCCAF (2012) to undertake sectoral adaptation plans, together with expert support, as necessary. The local government sector is represented by the County and City Management Association (CCMA) and the regional assemblies.

Under Section 15 of the Act, a relevant body shall, in the performance of its functions, have regard to the most recently approved National Adaptation Framework and approved sectoral adaptation plans and may be required to report on progress in meeting the terms of the Framework and sectoral plans.

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49 <http://www.climatecouncil.ie/councilpublications/periodicreviewandreport/>

### National Adaptation Steering Committee

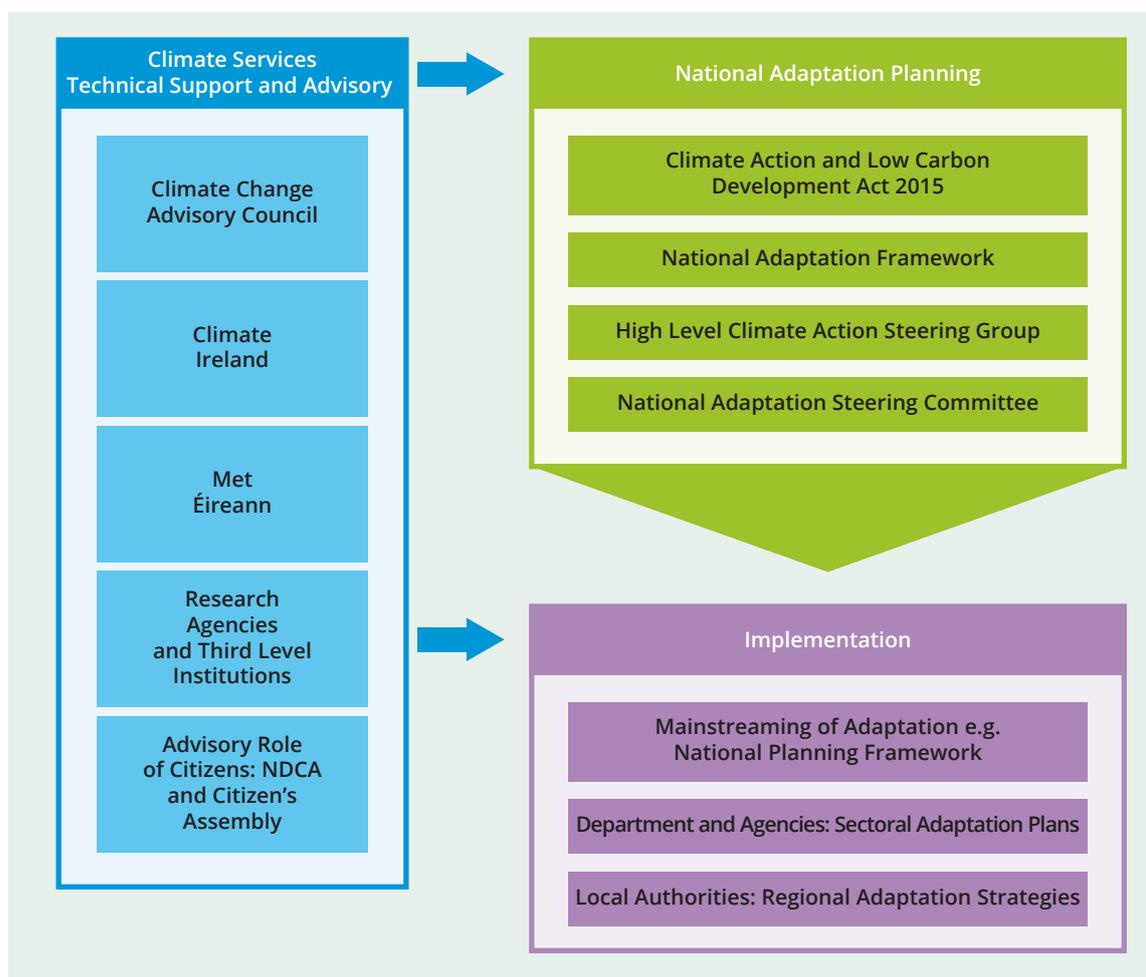
The National Adaptation Steering Committee will be reviewed and restructured to ensure that a coordinated, comprehensive and coherent approach to implementing actions under the NAF is adopted by sectors – including government departments and agencies – and local government. The **Adaptation Steering Committee** will continue to be chaired by the Department of Communications, Climate Action and Environment. Its membership will include representatives of those preparing plans under the Framework, the Departments of Finance and Public Expenditure and Reform, representatives of local government and the regional climate offices, spatial planning experts, the EPA and Climate Ireland. The Committee will meet every two to three months.

Departments preparing sectoral plans under this Framework will be required to consult with other sectors through the Steering Committee process during the development of their plans. This will ensure adequate cooperation on cross cutting issues such as prioritisation and the use of consistent and common information on matters such as climate risks, climate change data and analysis for policy development.

The Steering Committee will report to the **high level climate action steering group** which is being established under the National Mitigation Plan and will be chaired by the Minister. This high level group will address the full climate action agenda including both mitigation and adaptation. In terms of adaptation, the group will;

- monitor progress by sectors and agencies in delivering on climate change adaptation actions for which they are responsible;
- ensure that a coordinated and coherent approach is adopted and maintained towards achieving a climate resilient Ireland.

Figure 5 National Adaptation Governance Structure



## Monitoring and Reporting

Monitoring and reporting, review and accountability are central to adaptation governance. At UN level, the review and reporting arrangements include:

- meetings of Conference of the Parties;
- submission of periodic adaptation communications under the Paris Agreement;
- review of climate plans including commitments on adaptation, every five years; and
- submission of national reports – “National Communications” – on implementation.

At EU level, arrangements include:

- reporting to the Commission every four years on national adaptation planning and strategies to facilitate adaptation to climate change in accordance with the Mechanism for Monitoring and Reporting; and
- reporting under the adaptation preparedness scoreboard, measuring member states’ level of readiness for climate change impacts and adaptation.

At national level and in addition to the oversight arrangements set out above, oversight and reporting will be undertaken through a number of statutory mechanisms including:

- review by the Minister for Communications, Climate Action and Environment of a Government approved National Adaptation Framework not less than once in every five period (Section 5 of the 2015 Act);
- submission of an annual report by the Climate Change Advisory Council to the Minister for Communications, Climate Action and Environment containing findings and recommendations in furthering transition to a low carbon, climate resilient and environmentally sustainable economy (Section 12 of the 2015 Act);
- submission of a periodic review report by the Climate Change Advisory Council (at its own instigation or that of the Minister) to the Minister for Communications, Climate Action and Environment (Section 13 of the 2015 Act);
- the presentation of an annual transition statement to each House of the Oireachtas by the Minister for Communications, Climate Action and Environment with regard to a number of mitigation and adaptation related matters including adaptation policy measures adopted in the preceding year to enable the achievement of the National Transition Objective (Section 14 of the 2015 Act);
- the presentation of annual sectoral adaptation statements to each House of the Oireachtas by the relevant Minister and as considered appropriate by the Minister for Communications, Climate Action and Environment (Section 14 of the 2015 Act).

A priority for Ireland will be to take forward a project to develop a range of adaptation indicators which will enable Ireland to monitor progress in preparing for the long term effects of climate change. The use of adaptation indicators will also be an important tool for assessing progress on adaptation. They can be used to:

- prioritise areas for action;
- highlight where policy changes are needed;
- prevent action which increases vulnerability;
- integrate adaptation into existing decision making; and
- enable actions which supports the transition to a climate resilient, low carbon and environmentally sustainable society and economy.

The governance framework outlined above describes an open, accountable and transparent process requiring a whole-of-government approach in order to engage successfully in a planned adaptation process involving:

- public participation in the drafting of the NAF;
- the presentation of the approved National Adaptation Framework before the Oireachtas;
- the justification in a democratic forum of actions or inactions of those participants contributing to the process; and
- oversight and review and evaluation of adaptation policy performance and activities.

## Key Actions under the Framework

Action	Proposal	Timeline	Stakeholders
1	Government to request Ministers to submit sectoral adaptation plans within a specified period.	Within three months of laying before Oireachtas	Government, DCCAE, Relevant Departments
2	Sectoral Ministers to prepare and submit a sectoral adaptation plan to the Government for approval.	Within the period specified by Government	Government, DCCAE, National Adaptation Steering Committee, Relevant Departments
3	Formally establish a revised Sectoral Adaptation Steering Committee reporting to the Government High Level "Climate Action" Steering Group chaired by the Minister established under the National Mitigation Plan.	2018	DCCAE, Relevant Departments
4	Formalise status of <i>Local Authority Adaptation Strategy Development Guidelines</i> to be used in the preparation of Adaptation Strategies at regional or local level.	2018	Local Government, DCCAE
5	Each local authority should make and adopt local adaptation strategies based on the regional governance approach to adaptation planning which will be established under the Framework.	Ongoing	Local Government, DCCAE, Relevant Departments
6	Formalise Status of <i>Sectoral Guidelines for Planning for Climate Change Adaptation</i> at sectoral plan level.	2018	Local Government, DCCAE, Relevant Departments
7	Put in place arrangements to ensure Climate Ireland – Ireland's Climate Information Platform is developed to its full potential as a long term operational support for climate action in Ireland.	2018/2019	Local Government, DCCAE, Relevant Departments, EPA, Met Éireann, OPW, Marine Institute

Action	Proposal	Timeline	Stakeholders
8	Advance proposals to establish regional climate action offices to coordinate Local Authority response to climate change in parallel with Action 9 of the National Mitigation Plan.	2018	Local Government, DCCAIE, Relevant Departments
9	Implement programme of awareness raising to address climate adaptation and resilience through local and regional level partnership with National Dialogue on Climate Action (NDCA) including promoting better societal response in the context of the increased risk of extreme weather events in a changed climate.	Ongoing	Local Government, DCCAIE, Relevant Departments, EPA, Met Éireann, OPW, Marine Institute
10	Integration of climate adaptation within all relevant national policy and legislation (budgetary process, Capital Investment Planning etc.).	Ongoing	Local Government, DCCAIE, Relevant Departments
11	Ensure climate proofing considerations are fully integrated into arrangements and reforms arising from the new <i>Ireland 2040 – National Planning Framework</i> including Guidelines, updated guidance on adaptation proofing of SEA and EIA and also in revisions of building standards.	Ongoing	Local Government, DCCAIE/DHPLG, Relevant Departments, EPA, National Standards Authority of Ireland, Met Éireann
12	Framework to be updated at a minimum of every 5 years and Sectoral Plans as requested by Government.	Minimum of every 5 years	Government, DCCAIE, Relevant Departments

### Supporting Objectives in Implementing the Framework

The implementation of the Framework will be supported by the following objectives:

- Examine potential legislative changes to the Climate Action and Low Carbon Development Act 2015 so as to enhance implementation – e.g. underpinning the making and adopting of a local or regional adaptation strategy and providing for the making and adoption of a local or regional adaptation strategy as a reserved function.

- The Climate Change Advisory Council's consideration of adaptation/resilience as part of Annual Reviews and Periodic Reviews and increased liaison between sectors, local government, and Advisory Council's Adaptation subcommittee in terms of progressing the adaptation/resilience agenda.
- Ongoing development of Ireland's first dedicated national climate change risk assessment and assessing the vulnerability of critical infrastructure to climate change.
- The development of appropriate national, sectoral and local level climate change adaptation indicators.
- Met Éireann research through targeted actions such as (i) localised climate simulations (ii) identification of extreme weather events and of their nature and (iii) quantification of simulations' uncertainty, and also measures to improve the effectiveness and resilience of monitoring and forecasting of extreme weather events.
- Ensure that national adaptation research priorities support adaptation planning at sectoral and local level through ongoing reporting by the National Climate Research Coordination Group.
- Ensure continued alignment with emergency planning for extreme weather events including where plans related to emergencies assigned to a sectoral department as Lead Government department under the "Strategic Emergency Management National Structures and Framework" are climate proofed.
- Effective collaboration through the sectoral adaptation planning process in terms of ensuring inter-dependencies can be addressed across sectors on a range of responsibilities (e.g. seafood, health, biodiversity).
- Further analysis of the implications from an enterprise perspective of climate change and adaptation/resilience for the private sector should be considered with a view to building on the work carried out to inform the 2010 Forfás Report "Adaptation to Climate Change: Issues for Business".
- Ireland will continue to support partners in the developing world and to collaborate where possible in developing new partnerships so as to contribute to the goal of achieving global climate resilience in line with our national and international obligations.
- National reporting through the presentation of annual sectoral adaptation statements and annual transition statements to the Oireachtas by relevant Ministers to enable the achievement of the National Transition Objective.
- Continue to avail of opportunities to collaborate with other jurisdictions to tackle common challenges on adaptation and resilience and to consider transboundary impacts and synergies when they arise.
- International reporting obligations including periodic communications under the Paris Agreement and National Communications to UN; reporting to the European Commission on national adaptation planning under the Mechanism for Monitoring and the preparedness scoreboard on EU member states' level of readiness for climate change impacts and adaptation.

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## Appendix 2 Glossary

**Adaptation:** a change in natural or human systems in response to the impacts of climate change. These changes moderate harm or exploit beneficial opportunities and can be in response to actual or expected impacts.

**Adaptive capacity:** describes the ability of a sector to design or implement effective adaptation measures, using information on possible future climate change and extreme weather to moderate potential damage, take advantage of opportunities or to cope with the consequences.

**Baseline:** a baseline is a state against which a change is measured. For example, a 'current baseline' is made up of observable, present-day conditions.

**Capacity:** the combination of all the strengths and resources available within a community, society or organisation which can reduce the level of risk, or the effects of a disaster. It can also be described as capability.

**Capacity building:** in the context of climate change, capacity building describes developing the right skills and capabilities to help countries adapt to climate change. This also includes helping them to mitigate their greenhouse gas emissions.

**Climate:** the climate can be described simply as the 'average weather', typically looked at over a period of 30 years. It can include temperature, rainfall, snow cover, or any other weather characteristic.

**Climate change:** refers to a change in the state of the climate, which can be identified by changes in average climate characteristics which persist for an extended period, typically decades or longer.

**Climate change scenario:** is a plausible description of the change in climate by a certain time in the future. These scenarios are developed using models of the Earth's climate. Climate models are based upon scientific understanding of the way that the land, ocean and atmosphere interact and their responses to factors that can influence climate in the future, such as greenhouse gas emissions.

**Climate proofing:** is concerned with protecting development investments and outcomes from the impacts of climate change. It reduces the vulnerability of projects by: Analysing the risks that climate change poses and taking steps to counteract them.

**Confidence:** in a scientific context, confidence describes the extent to which the findings of an assessment are considered valid, based on the type, amount, quality, and consistency of evidence.

**Ecosystem Services:** the benefits to society from resources and processes provided by ecosystems can be described as *ecosystem services*. These can include pollination and disease control, providing food and fuel, regulating the flow of water through land to both prevent flooding and filter clean drinking water and the aesthetic and amenity value of the countryside.

**Extreme weather:** includes unusual, severe or unseasonal weather or weather at the extremes of the range of weather observed in the past.

**Greenhouse gases:** a number of gases whose presence in the atmosphere traps energy radiated by the Earth; this is called the greenhouse effect. These gases can be produced through natural or human processes. Carbon dioxide is the most important greenhouse gas. Other greenhouse gases are methane, fluorinated gases, ozone and nitrous oxide. See also Section 1 of the Climate Action and Low Carbon Development Act 2015 for a legal definition.

**Hazard:** a situation or event which could cause harm. A hazard does not necessarily cause harm.

**Impact:** in the context of climate change, an effect of climate change (e.g. flooding, rails buckling, etc.).

**Likelihood:** the chance of an event or outcome occurring, usually expressed as a probability.

**Mitigation:** describes action to reduce the likelihood of an event occurring or reduce the impact if it does occur. This can include reducing the causes of climate change (e.g. emissions of greenhouse gases) as well as reducing future risks associated with climate change.

**Model:** is a representation of how a system works and can be used to understand how the system will respond to inputs and other changes.

**Natural Adaptive Capacity:** describes the ability of a species or natural system to adjust to climate change and extreme weather to moderate potential damage, to take advantage of opportunities or to cope with the consequences.

**No regret (adaptation) options:** could be activities which would provide immediate economic and environmental benefits and continue to be worthwhile regardless of future climate. They would be justified under all plausible future scenarios, including without climate change.

**Planned adaptation:** the result of a deliberate policy decision and most likely includes action that is required to return to, maintain, or achieve, a desired state.

**Probability:** is used to describe the chance or relative frequency of particular types of event occurring. It can also include sequences or combinations of such events.

**Projection:** any plausible description of the future and the pathway that leads to it. A specific interpretation of a 'climate projection,' refers to an estimate of future climate developed using models of the Earth's climate. Projections are not predictions. Projections include assumptions, for example, on future socio-economic and technological developments, which might or might not happen. They therefore come with some uncertainties.

**Radiative forcing:** the difference between sunlight absorbed by the Earth and energy radiated back to space.

**Resilience:** describes the ability of a social or ecological system to absorb disturbances while retaining the same basic ways of functioning, and a capacity to adapt to stress and change.

**Risk:** combines the chance that an event will occur with how large its impact could be, in social, economic or environmental terms. For example: the costs of damage, number of people affected or areas of land affected by a specific climate effect.

**Risk Assessment:** is an analysis of risks and their impacts to provide information for decision making. Often, risk assessment will consider a particular impacted party, like a building or population. The process usually includes identifying hazards which could have an impact; and assessing the likelihoods and severities of impacts.

**Risk Management:** putting in place plans to avoid unacceptable consequences of risks.

**Scenario:** is a plausible description of a possible future state of the world. These use specific assumptions on how aspects of the world might change e.g. economies, social trends, changes in technology, environmental changes, etc., based upon the best understanding available.

**Sensitivity:** the degree to which a system is affected, either adversely or beneficially, by climate variability or change.

**Severe weather:** refers to any dangerous meteorological phenomena with the potential to cause damage, serious social disruption or loss of life.

## Appendix 3 Acronyms

<b>COP</b>	Conference of the Parties
<b>DCCA</b>	Department of Communications, Climate Action and Environment
<b>DAFM</b>	Department of Agriculture, Food and the Marine
<b>DTTAS</b>	Department of Transport, Tourism and Sport
<b>EEA</b>	European Environment Agency
<b>EPA</b>	Environmental Protection Agency
<b>GCM</b>	Global Climate Models
<b>GHG</b>	Greenhouse Gases
<b>ICIP</b>	Climate Information Platform for Ireland
<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>MaREI</b>	Centre for Marine and Renewable Energy
<b>NAF</b>	National Adaptation Framework
<b>NCCAF</b>	National Climate Change Adaptation Framework
<b>NGO</b>	Non-governmental Organisation
<b>NMP</b>	National Mitigation Plan
<b>RCP</b>	Representative Concentration Pathways
<b>SLR</b>	Sea Level Rise
<b>UNFCCC</b>	United Nations Framework Convention on Climate Change

## Appendix 4 SEA/AA Pre-Screening Document

### National Climate Change Adaptation Framework

*Screening for the purpose of determining whether a Strategic Environmental Assessment or Appropriate Assessment are required*

Department of Communications, Climate Action and Environment

July 2016

#### Introduction and purpose of document

1. In accordance with Section 5 of the Climate Action and Low Carbon Development Act 2015 (the “2015 Act”), the Minister for Communications, Climate Action and Environment is required to make and submit to Government for approval, not later than December 2017, a national climate change adaptation framework (“national adaptation framework”). The purpose of the national adaptation framework, together with the national mitigation plan which is being prepared as a separate but complementary element of climate action under the 2015 Act, is to enable the State to pursue and achieve transition to a low-carbon, climate resilient and environmentally sustainable economy by the end of 2050.
2. The purpose of this document is to carry out a screening exercise to determine, in respect of the proposed national adaptation framework, if
  - an environmental assessment is required to be carried out in accordance with the European Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment (“SEA Directive”) as transposed by the European Communities (Environmental Assessment of Certain Plans and Programmes) Regulations 2004 (S.I. 435 of 2004), as amended; or
  - an appropriate assessment is required to be carried out in accordance with the Habitats Directive (Directive 92/43/EEC) as transposed by the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 447 of 2011).

#### Background

3. The Paris Agreement (12 December 2015) commits 196 countries to the mitigation goal of limiting the increase in global temperature to well below 2°C above pre-industrial levels. The agreement also includes a long-term adaptation goal which refers to enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change in a manner that does not threaten food production. Ensuring an adequate adaptation response in the context of the temperature goal explicitly links adaptation to the mitigation target. The policy response to climate change is, therefore, two-fold:
  1. **mitigation** of emissions of the greenhouse gases (GHGs) that are driving climate change; and
  2. **adaptation** to the negative impacts of climate change and availing of any benefits that may arise.

### National Mitigation Plan

4. To address the mitigation challenge, Ireland will pursue and aim to meet its national, EU and international GHG mitigation commitments through the adoption of a series of five-yearly statutory national mitigation plans. In accordance with Section 4 of the 2015 Act, the Minister for Communications, Climate Action and Environment must submit a National Mitigation Plan (NMP) to Government for approval by June 2017. The primary objective of the NMP is to track implementation of measures already underway and identify additional actions in the longer term to reduce GHG emissions and progress the transition agenda to 2050; a draft NMP is due to be published for consultation by end 2016.

### National Adaptation Framework

5. While climate policy has been, and must continue to be, focussed on limiting GHG emissions in accordance with our national, EU and international obligations, taking steps to adjust human and natural systems in response to existing or expected climate change so as to prevent or moderate environmental damage or to take advantage of any opportunities that may arise, is also an urgent policy priority. Accordingly, under Section 5 of the 2015 Act, the Minister must submit to Government for approval not later than December 2017, a national adaptation framework. The framework will set out the national strategy for the application of adaptation measures in different sectors and by local authorities in their administrative areas. The 2015 Act also provides that relevant Ministers will be required to develop sectoral adaptation plans which will specify the adaptation policy measures the Minister in question proposes to adopt.
6. The national adaptation framework will build on the work already carried out under the existing non-statutory National Climate Change Adaptation Framework (NCCAF)<sup>50</sup> and ensure that climate adaptation in Ireland is brought forward in line with EU and international best practice. The publication of the NCCAF in 2012 was the first step for Ireland in developing a comprehensive national policy position within which adaptation measures to address the impacts of climate change could be taken.<sup>51</sup> This non-statutory but Government approved framework required the development and implementation of sectoral adaptation plans and local authority adaptation strategies which, together, would form part of the national response to the impacts of climate change. The NCCAF has succeeded in building the evidence base and in filling many of the knowledge and research gaps; it has also increased awareness and capacity within the sectors to help them to address climate change adaptation. This ongoing work will form an important input to the development of the new statutory national adaptation framework (the subject of these screenings) and will further inform the subsequent development of statutory sectoral adaptation plans, in accordance with Section 6 of the 2015 Act.

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50 DECLG, 2012. *National Climate Change Adaptation Framework: Building Resilience to Climate Change*. Department of the Environment, Community and Local Government, Dublin, Ireland.

51 Implementation work under the existing framework is being coordinated by the Department of the Environment, Community and Local Government through a National Adaptation Steering Committee. The committee is chaired by the Department and includes membership from the relevant sectors as well as EPA, Department of Public Expenditure and Reform, with the local government sector represented through the County and City Management Association and the regional assemblies.

### Strategic Environmental Assessment

7. The objectives of the SEA Directive are set out in Article 1 as follows:

*“The objective of this Directive is to provide for a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans and programmes with a view to promoting sustainable development, by ensuring that, in accordance with this Directive, an environmental assessment is carried out of certain plans and programmes which are likely to have significant effects on the environment.”*

8. The European Communities (Environmental Assessment of Certain Plans and Programmes) Regulations 2004 (S.I. 435 of 2004), as amended, which transposed the SEA Directive, require certain plans and programmes to be subject to an environmental assessment. Any such assessment is designed to allow environmental considerations to be integrated in the preparation and adoption of these plans and programmes.

### Requirement to carry out SEA – pre-screening check using decision-tree

9. A pre-screening check is necessary to determine if the proposed national adaptation framework is considered to be a plan/programme under the provisions of Article 9(1) of S.I. 435 of 2004,<sup>52</sup> as amended, which provides that an environmental assessment is mandatory for all plans and programmes:

(a) which are prepared in respect of a number of specified sectors,

**and**

(b) which set the framework for future development consent of projects listed in Annexes I and II to Environmental Impact Assessment Directive (85/337/EEC),

**or**

(c) where it has been determined under Directive 92/43/EEC (Habitats Directive) that an assessment is required.

10. A pre-screening check, using the decision tree set out in Figure 2 of the EPA report *Development of Strategic Environmental Assessment (SEA) Methodologies for Plans and Programmes in Ireland*<sup>53</sup> has been applied to the proposed national adaptation framework. The decision tree is based on a series of administrative questions that allow for the “screening out” or “screening in” of proposed plans and programmes. A copy of this decision tree is set out in the Appendix. An examination of the national adaptation framework, availing of the decision tree tool, has pointed to a **recommendation that an SEA is not required**; analysis in support of this conclusion is set out in the following paragraphs.

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52 “9. (1) Subject to sub-article (2), an environmental assessment shall be carried out for all plans and programmes which are prepared for agriculture, forestry, fisheries, energy, industry, transport, waste management, water management, telecommunications and tourism, and which set the framework for future development consent of projects listed in Annexes I and II to the Environmental Impact Assessment Directive, or which are not directly connected with or necessary to the management of a European site but, either individually or in combination with other plans, are likely to have a significant effect on any such site.”

53 EPA, 2003. *Development of Strategic Environmental Assessment (SEA) Methodologies for Plans and Programmes in Ireland – Synthesis Report*. Environmental Protection Agency.

### Pre-screening analysis

11. The condition at 9(a) above that the national adaptation framework must be a plan or programme prepared for agriculture, forestry, fisheries, energy, industry, transport, waste management, water management, telecommunications, tourism and town and country planning or land use has not been met. The policy in relation to climate adaptation, first set out in the NCCAF (2012) and subsequently restated in the National Policy Position on Climate Change (2014)<sup>54</sup>, describes an integrated policy framework within which adaptation measures are taken across different sectors and levels of government, via lower level plans and strategies, to manage and reduce Ireland's vulnerability to the negative impacts of climate change. The statutory national adaptation framework, when finalised, will maintain and renew this approach and will provide a clear statutory and government approved mandate for line departments, agencies and local authorities to prepare sectoral adaptation plans and local authority adaptation strategies.
12. As the impacts of climate change vary spatially, adaptation requires locally specific responses, which address not only climate impacts but also integrate coherently with the local fabric of social, economic and ecological systems. As a result, high-level adaptation policy is typically developed by central government but local differences in social and cultural norms, physical environment, land use and economics make adaptation decision making principally the concern of regional and local scale administrators, businesses and the general public. The framework will, therefore, set out a national strategy in terms of setting out a general policy direction for how best to consider and apply adaptation measures in different sectors and by local authorities in their administrative areas; it will not identify specific locations or propose adaptation measures or projects in relation to sectors. Respecting the principle of subsidiarity, detailed adaptation measures will be developed across sectors, including the local government sector, in accordance with the national adaptation framework, and will be subject to SEA, as appropriate.
13. In considering the second condition at 9(b) above, the Department has used the interpretation of the term "*...framework for developmental consent*" as set out in the EPA report "*Development of Strategic Environmental Assessment (SEA) Methodologies for Plans and Programmes in Ireland*". This interpretation states that:
 

*"A framework for future development consent can be interpreted to mean measures that identify circumstances under which development will be encouraged or allowed or brings forward programmes that identify certain types of development to be pursued in a particular sector e.g. wind energy within an Energy Plan/Programme."*
14. The Department does not consider that the "*framework for future development consent*" condition is met on the basis that the national adaptation framework will not identify and pursue specific areas for development nor will it set a framework for future development consent of projects that fall within the categories set out in Annexes I and II to the EIA Directive.

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<sup>54</sup> DECLG, 2014. *Climate Action and Low Carbon Development, National Policy Position Ireland*.

### Appropriate Assessment and the Habitats Directive (Directive 92/43/EEC)<sup>55</sup>

15. In relation to 9(c) above, Natura 2000 is an EU-wide network of nature protection areas established under the Habitats Directive. The aim of the network is to assure the long-term survival of Europe's most valuable and threatened species and habitats. Appropriate assessment examines nature conservation impacts of any plan or project on the Natura 2000 network of sites. Article 6(3) of the Habitats Directive states that:

*“Any plan or project not directly connected to or necessary to the management of the site but likely to have significant effect thereon, either individually or in combination with other plans and projects, shall be subjected to an appropriate assessment of its implications for the site in view of the sites conservation objectives.”*

### Screening for Appropriate Assessment

16. The first test in an appropriate assessment is to determine whether an assessment is required and for this purpose the review of the policy context for and content of the proposed national adaptation framework, set out in the preceding paragraphs is relevant also with regard to appropriate assessment. As indicated above, the purpose of the framework is to set out a policy framework to be pursued in relation to climate change adaptation; it will not identify specific locations, be they Natura 2000 sites or otherwise, nor will it propose adaptation measures or projects in respect of those sites. Adaptation approaches and identification of locations or sites will be detailed via lower level adaptation plans and strategies which may undergo appropriate assessment, as appropriate.

### Conclusions

17. The pre-screening process set out above has indicated that the administrative provisions of Articles 9(1) and 9(3) of the European Communities (Environmental Assessment of Certain Plans and Programmes) Regulations, as amended have not been fulfilled and an SEA would not, therefore, be required for the national adaptation framework. Similarly, an appropriate assessment of the framework in accordance with the Habitats Directive (Directive 92/43/EEC) as transposed by the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 447 of 2011), is also assessed as not being required.

### Next steps

18. It is now proposed to proceed with the development work on the drafting of the framework.

### Contact point for comments in relation to this document

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<sup>55</sup> Transposed by European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 447 of 2011).





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