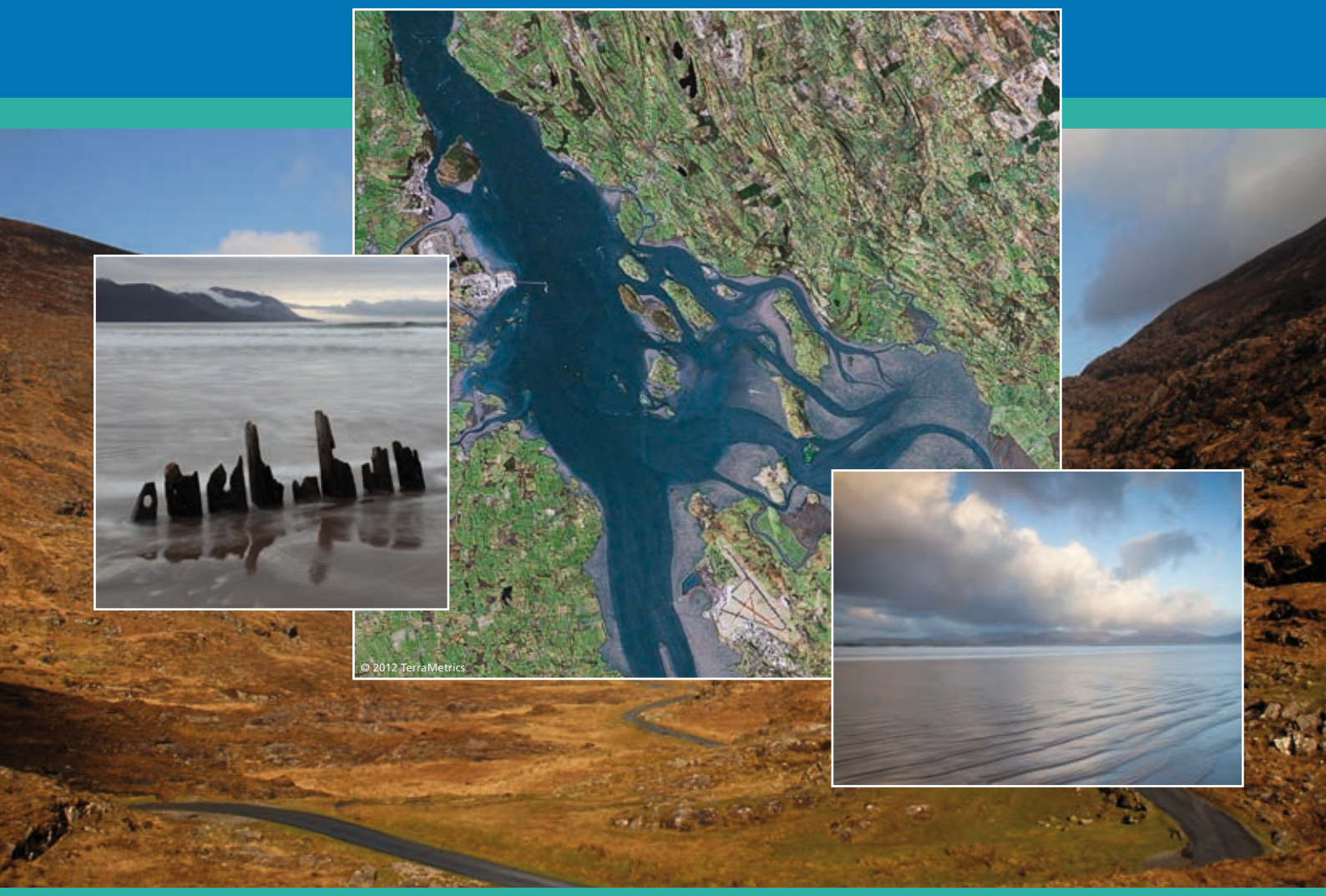
# Integrating Climate Change into Strategic Environmental Assessment in Ireland

## A Guidance Note




epa
Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

# Environmental Protection Agency

The Environmental Protection Agency (EPA) is a statutory body responsible for protecting the environment in Ireland. We regulate and police activities that might otherwise cause pollution. We ensure there is solid information on environmental trends so that necessary actions are taken. Our priorities are protecting the Irish environment and ensuring that development is sustainable.

The EPA is an independent public body established in July 1993 under the Environmental Protection Agency Act, 1992. Its sponsor in Government is the Department of the Environment, Community and Local Government.

## OUR RESPONSIBILITIES

### LICENSING

We license the following to ensure that their emissions do not endanger human health or harm the environment:

- waste facilities (e.g., landfills, incinerators, waste transfer stations);
- large scale industrial activities (e.g., pharmaceutical manufacturing, cement manufacturing, power plants);
- intensive agriculture;
- the contained use and controlled release of Genetically Modified Organisms (GMOs);
- large petrol storage facilities;
- waste water discharges.

### NATIONAL ENVIRONMENTAL ENFORCEMENT

- Conducting over 2,000 audits and inspections of EPA licensed facilities every year.
- Overseeing local authorities' environmental protection responsibilities in the areas of – air, noise, waste, waste-water and water quality.
- Working with local authorities and the Gardaí to stamp out illegal waste activity by co-ordinating a national enforcement network, targeting offenders, conducting investigations and overseeing remediation.
- Prosecuting those who flout environmental law and damage the environment as a result of their actions.

### MONITORING, ANALYSING AND REPORTING ON THE ENVIRONMENT

- Monitoring air quality and the quality of rivers, lakes, tidal waters and ground waters; measuring water levels and river flows.
- Independent reporting to inform decision making by national and local government.

### REGULATING IRELAND'S GREENHOUSE GAS EMISSIONS

- Quantifying Ireland's emissions of greenhouse gases in the context of our Kyoto commitments.
- Implementing the Emissions Trading Directive, involving over 100 companies who are major generators of carbon dioxide in Ireland.

### ENVIRONMENTAL RESEARCH AND DEVELOPMENT

- Co-ordinating research on environmental issues (including air and water quality, climate change, biodiversity, environmental technologies).

### STRATEGIC ENVIRONMENTAL ASSESSMENT

- Assessing the impact of plans and programmes on the Irish environment (such as waste management and development plans).

### ENVIRONMENTAL PLANNING, EDUCATION AND GUIDANCE

- Providing guidance to the public and to industry on various environmental topics (including licence applications, waste prevention and environmental regulations).
- Generating greater environmental awareness (through environmental television programmes and primary and secondary schools' resource packs).

### PROACTIVE WASTE MANAGEMENT

- Promoting waste prevention and minimisation projects through the co-ordination of the National Waste Prevention Programme, including input into the implementation of Producer Responsibility Initiatives.
- Enforcing Regulations such as Waste Electrical and Electronic Equipment (WEEE) and Restriction of Hazardous Substances (RoHS) and substances that deplete the ozone layer.
- Developing a National Hazardous Waste Management Plan to prevent and manage hazardous waste.

### MANAGEMENT AND STRUCTURE OF THE EPA

The organisation is managed by a full time Board, consisting of a Director General and four Directors.

The work of the EPA is carried out across four offices:

- Office of Climate, Licensing and Resource Use
- Office of Environmental Enforcement
- Office of Environmental Assessment
- Office of Communications and Corporate Services

The EPA is assisted by an Advisory Committee of twelve members who meet several times a year to discuss issues of concern and offer advice to the Board.

SEA and Climate Change

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## A Guidance Note

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## Disclaimer



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# Contents

# Executive Summary

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## 1 Introduction

Environmental decision-making, planning and investment needs to respond to the challenges posed by climate change. One of the key responses is to integrate (or mainstream) climate change into all levels of decision making including policies, plans and programmes and strategies (PPPS). The European Commission (EC) describes mainstreaming as the functional integration of climate change mitigation and adaptation policy priorities into everyday planning and management. Strategic Environmental Assessment (SEA) is now coming to be recognised as perhaps the most flexible and capable instrument of climate policy integration available internationally and nationally. It provides a coherent framework for assessing and managing a broad range of environmental risks which contribute to the integration of climate change considerations into PPPS. The integration of climate change adaptation into strategic planning through the application of the SEA Directive (2001/42/EC) should lead to better informed, evidence-based PPPS that are more sustainable in the context of a changing climate.

This document is a good practice guidance note on how to practically incorporate climate change into PPPS, falling under the remit of the SEA Directive. It is aimed at plan-making authorities and SEA practitioners who, in implementing the requirements of the SEA Directive, need to consider that PPPS may be directly or indirectly affected by climate change, or may affect climate change directly or indirectly. This document should also be useful to anyone involved in preparing or reviewing SEAs. It presents information on the causes and consequences of climate change; how they can be described, evaluated and incorporated into the SEA; and where appropriate information can be found.

In Ireland, both spatial and non-spatial PPPS have been undertaken by plan-making Authorities at different levels in the planning hierarchy, ranging from detailed small-scale local area plans to broad-based national-level strategies. It is envisaged that this guidance will provide useful insights into how climate change should be considered and taken into account in the preparation of the SEA and the draft PPPS.

This document has been prepared by the EPA SEA Section in collaboration with the EPA Climate Change Research Programme (CCRP). It was informed by a literature review of existing good international practices, external review, and reconfiguration of existing guidance on climate change adaptation in a format that should be usable by SEA practitioners.

# Introduction

# 1. Introduction

**Chapter 1 Summary**

*Summary of Key Findings for Ireland's Climate*
*Climate Mitigation & Adaptation Definitions*
*Climate Change and SEA Overview*

The Intergovernmental Panel on Climate Change (IPCC) has reiterated that "warming of the climate system is unequivocal" (IPCC 2013). Anthropogenic greenhouse gas (GHG) emissions have already triggered substantial and long-lived change, bringing about atmospheric carbon dioxide concentrations that are "unprecedented in at least the last 800,000 years".

Climate policy must move to limit carbon emissions as a matter of urgency if the globally agreed target of limiting warming to a relatively "safe" 2°C by the end of the century is to remain a possibility. However, even if this challenge is met, the climate will continue to change for the foreseeable future; sea levels will rise, heat waves, droughts, extreme precipitation events, storms and floods will all likely increase in their frequency and intensity. With these factors in mind, taking steps to foster the adaptation of human and natural systems to a changing climate is now essential.

One of the key mechanisms available to sectoral and local planners in adapting human and natural systems to climate change is Strategic Environmental Assessment (SEA). This guidance note will thus seek to outline how both climate change mitigation and adaptation can be successfully incorporated into the practice of SEA in Ireland.

The findings of the IPPC Fifth Assessment Report (IPCC, 2013) are summarised in Table 1.1.

*Table 1.1 – Short Summary of IPCC Fifth Assessment Report Findings (IPCC, 2013)*

| Climate aspect | Summary of findings |
|---|---|
| **Observed Changes in the Climate System** | Warming in climate system is unequivocal. |
| **Atmosphere** | Each of the past three decades has been successively warmer at the Earth's surface than any preceding decade since 1850. |
| **Oceans** | "Virtually certain" that upper ocean (0–700 m) has warmed from 1971 to 2010. |
| **Sea Level** | Rate of sea level rise since mid-19th century higher than mean rate during the previous two millennia (high confidence). Over period 1901–2010, global mean sea level rose by 0.19 (0.17–0.21) m. Global sea level rise of between 0.26 m and 0.82 m is likely, depending on the effectiveness of global efforts to reduce emissions. |

| Climate aspect | Summary of findings |
|---|---|
| **Carbon and Other Biogeochemical Cycles** | Atmospheric concentrations of $CO_2$, methane and nitrous oxide have increased to levels unprecedented in 800,000+ years. $CO_2$ concentrations have increased by 40% since pre-industrial times, primarily from fossil fuel emissions and secondarily from net land use change. Oceans have absorbed about 30% of the emitted anthropogenic $CO_2$, causing ocean acidification. |
| **Water Cycle** | Contrast between wet and dry regions and between wet and dry seasons expected to increase (with regional exceptions possible). Oceans will continue to warm during 21st century. Heat will penetrate from the surface to deep ocean and affect circulation. |
| **Detection and Attribution of Climate Change** | It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century. |

In other recent updates, the Working Group II contribution to the Fifth Assessment Report (AR5) – *Climate Change 2014: Impacts, Adaptation and Vulnerability* (IPCC-WG2, 2014) – includes information on observed climate change inputs and vulnerability adaptation. It also considers future risks and opportunities for adaptation and guidance in relation to managing future risks and building climate resilience. The Working Group III contribution to AR5 – *Climate Change 2014: Mitigation of Climate Change* (IPCC-WG3, 2014) – assesses approaches to climate change mitigation, mitigation pathways and measures in the context of promoting sustainable development.

Environmental decision-making, planning and investment need to respond to the challenges posed by climate change. One of the key responses is to integrate (or mainstream) climate change into all levels of decision-making including policies, plans and programmes and strategies (PPPS). The European Commission (EC) describes mainstreaming as the functional integration of climate change mitigation and adaptation policy priorities into everyday planning and management. The mechanisms for doing so have recently been the focus of considerable research effort and policy focus across Member States. SEA is coming to be recognised as perhaps the most flexible and capable instrument of climate policy integration available internationally and nationally (Desmond and Shine, 2012). It provides a coherent framework for assessing and managing a broad range of environmental risks which contribute to the integration of climate change considerations into PPPS. The integration of climate change adaptation into strategic planning through the application of the SEA Directive (2001/42/EC) should lead to better informed, evidence-based PPPS that are more sustainable in the context of a changing climate (DAC/OECD, 2010).

This document is a good practice guide on how to practically incorporate climate change into PPPS, falling under the remit of the SEA Directive. It is aimed at Plan-Making Authorities and SEA Practitioners who, in implementing the requirements of the SEA Directive, need to consider that PPPS may be directly or indirectly affected by climate change, or may affect climate change directly or indirectly. This document should also be useful to anyone involved in preparing or reviewing SEAs. It presents information on the causes and consequences of climate change; how they can be described,

evaluated and incorporated into the SEA; and where appropriate information can be found. In Ireland, both spatial and non-spatial PPPS have been undertaken by Plan-Making Authorities at different levels in the planning hierarchy, ranging from detailed small-scale local area plans through to broad-based national-level strategies. It is envisaged that this guidance will provide useful insights into how climate change should be considered and taken into account in the preparation of the SEA and the draft PPPS.

This document has been prepared by the EPA SEA Unit in collaboration with the EPA Climate Change Research Programme (CCRP). It was informed by a literature review of good international practices, stakeholder engagement and reconfiguration of existing guidance on climate change adaptation in a format that should be usable by SEA practitioners. It incorporates a report carried out by the UK Environment Agency (2011), *Strategic Environmental Assessment and Climate Change: Guidance for Practitioners*; and the recent *European Commission (2013) Guidance on Integrating Climate Change and Biodiversity into Strategic Environmental Assessment*. It has also been peer reviewed externally by an international SEA expert.

## 1.1 Strategic Environmental Assessment

The SEA Directive requires plan-makers to identify and evaluate their PPPS's potential for likely significant impacts on a number of environmental topics including "climatic factors". Twelve sectors fall under the scope of the SEA Directive (Article 3) – *agriculture, forestry, fisheries, energy, industry, transport, waste management, water management, telecommunications, tourism, town and country planning and land use*. Where appropriate, measures are required to be established to minimise and respond to the significant current and future impacts identified.

In Ireland, the SEA Directive is transposed by *European Communities (Environmental Assessment of Certain Plans and Programmes) Regulations 2004* (S.I. No. 435 of 2004 as amended by S.I. No. 200 of 2011) for non-land use plans, and by *Planning and Development (Strategic Environmental Assessment) Regulations 2004* (S.I. No. 436 of 2004 as amended by S.I. No. 201 of 2011) for land use plans.

## 1.2 Climate change

### Observed climate change

The signals of climate change are already evident in Ireland and are expected to continue to increase in the coming decades and up to at least the end of the century. These include changes in key meteorological parameters such as average temperature, rainfall intensity and patterns, as well as increased frequency of extreme events such as flooding and storm surges, the latter exacerbated by rising sea levels. These changes will in turn lead to risks and opportunities in all sections of our environment, society and economy.

Table 1.2 summarises changes in Ireland's climate over time. In general, there has been a trend towards milder winters, higher overall temperatures, drier summers, changes in the frequency of extremes of weather (e.g. cold snaps, heat waves and stormy conditions). Reduced summer precipitation in the mid to latter part of the 21st century, in combination with increased evapotranspiration rates, is likely to result in marked increases in soil moisture deficits and drought stress in Ireland. Significant changes in the severity and frequency of flood events are also likely as winter rainfall increases throughout the century. The greatest increases are suggested for the North West; while little change is expected to occur on the east coast and in the eastern part of the Central Plain, though further work in these areas is required to corroborate this. Sea level rise will likely lead to coastal and low lying areas being affected by more flooding than at present, particularly where storm surges coincide with high tides and extreme rainfall events.

*Table 1.2: Key Findings for the Status of Ireland's Climate (Dwyer, 2013)*

| Climatic aspect | Summary of findings |
|---|---|
| **Atmosphere** | Mean annual surface air temperature has increased by approximately 0.8°C over the period 1900 to 2010. Future projections indicate an increase of 1–3°C compared to 1961–2000 average.<br>Annual decrease in no. of frost days and annual increase in warm days.<br>Average rainfall (nationally) increased by c. 60 mm (5%) in period 1981–2010. Projections are for wetter winters and drier summers. For spatial variations, results are more uncertain and indicate wetter winters in the west and drier summers in the east.<br>$CO_2$ concentrations globally are currently higher than at any time in the past 400,000 years.<br>Concentrations of methane and nitrous oxide are c. 140% and 20% respectively above pre-industrial values and are continually increasing. |
| **Oceans** | Mean annual sea surface temperatures are more than 1°C higher than long-term average for period 1961–1990. There has been a rise of 0.6°C/decade since 1994: this is unprecedented in the 150 year observational record, with greatest warming in the Irish Sea.<br>Sea level in SW England (Ireland analogue) shows a rise of 1.7 cm per decade since 1916. Satellite observations indicate a rise of 4–6 cm/decade since the early 1990s.<br>Surface ocean acidity has increased by over 30% since the industrial revolution. Subsurface and deep offshore waters around coast between 1991 and 2010 showed increased acidity. |
| **Terrestrial** | Major land-use change from grassland/peatland to forestry, leading to amount of carbon stored/sequestered in forests increased by 40%.<br>Ireland's soil carbon stock decreased by 27 million tonnes between 1990 and 2000 due to changes in management of peatlands and to lesser extent changes in patterns of agricultural land use and urban development.<br>Extension of growing season observed, particularly in the southwest.<br>Tendency for increasing annual mean river flows, particularly summer mean flows. Only some stations, those with the longest records, show increases in winter mean flows. |

## 1.3 Observed and projected climate change

New global climate model simulations carried out in Ireland by Gleeson et al., (2013) provide an update on the expected changes in the Earth's climate over the 21st century. Data from this new model and other global models have been downscaled over Ireland to update the projections of future Irish climate.

Depending on the global GHG emission scenarios used, the projected changes in the Irish climate and related impacts include:

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

### Mitigation and adaptation

Climate change mitigation and adaptation are now considered equally valid policy responses to climate change.

**Mitigation measures** are actions that reduce the impact humans have on the climate system by reducing/managing our emissions of greenhouse gases[1] or providing/enhancing carbon sinks[2]. Examples include moving to more sustainable forms of transport, increasing energy efficiency by improving building insulation, using energy generated from renewable sources, and increasing forest cover.

**Adaptation measures** are actions taken to diminish the vulnerability and increase the resilience of a given system or group of systems to existing or anticipated climate change impacts.

> Adaptation responses can take the form of: 'grey' engineered measures to reduce climate hazards, such as the construction of flood defences; 'green' ecosystem-based adaption measures, such as the restoration of dune systems and wetlands to buffer against sea level rise; and 'soft' adaptations which aim to alter the behaviour of the public through policy or economic instruments, such as offering discounted insurance on homes that retrofit flood defences.

1 The most abundant greenhouse gases in Earth's atmosphere are water vapour ($H_2O$), carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), ozone ($O_3$), and chlorofluorocarbons (CFCs). They are called greenhouse gases because they absorb infrared radiation produced by the sun warming the earth's surface, trapping the heat in the atmosphere.

2 A carbon sink accumulates carbon-containing compounds. Carbon sinks include soils, trees and oceans.

Adaptation measures are essential in order to address the impacts of climate change in PPPS, given that many of the impacts of climate change are unavoidable in the short to medium term, regardless of how successful climate mitigation measures are in reducing future emissions.

When proposing particular mitigation/adaptation measures, it is important to assess the likely environmental effects of the measures themselves. For example, building flood defences may alleviate flood potential but may impact negatively on protected habitats and species.

Our response to climate change needs to include both adaptation and mitigation objectives and consideration of their interactions. Mitigation and adaptation measures can and should, wherever possible, be coherently integrated within the PPPS. For instance, increased temperatures will influence the way buildings are designed, but installing air conditioning will add to greenhouse gas emissions. Strategic national/regional plans (which tend to cover a long timeframe of 12 years or more) should include commitments for setting climate change targets and objectives while lower level plans, with shorter timeframes, should strive to achieve these targets through the inclusion of specific commitments and implementable actions. In keeping with this approach, guidelines are currently being produced under the EPA's climate change research programme to assist local authorities through the process of developing long-term adaptation strategies, accounting for climate change impacts to mid-century and beyond. These strategies can then be implemented via immediate instruments of planning and policy such as Local Area Plans (LAPs) and County Development Plans (CDPs).

## 1.4 Climate change in SEA

The SEA Directive provides plan-makers with a statutory framework to integrate climate-related policies/objectives into plans and programmes. The environmental report is required to describe the PPPS's impacts on *"biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage including architectural and archaeological heritage, landscape and the interrelationships between the above factors"*.

Annex I of the SEA Directive requires that the environmental report should describe *"the measures envisaged to prevent, reduce and as fully as possible offset any significant adverse effects on the environment of implementing the plan or programme"*, as well as *"an outline for the reasons for selecting alternatives dealt with"*. In the context of climate, the identification of mitigation and adaptation measures should utilise alternative development scenarios and coherently account for climate change impacts and responses to them.

A number of characteristics of climate change influence the way in which they need to be considered in SEA:

- Long-term and cumulative nature of effects
- Complexity of cause-effect relationships
- Uncertainty

### Long-term and cumulative nature of effects

Annex I of the SEA Directive requires the environmental report to describe the likely significant effects of implementation of the PPPS, including cumulative and synergistic effects.[3] Plan-makers are required to consider and assess the effects of other on-going PPPSs as well as their own. Guidance on Cumulative Effects Assessment in SEA will be forthcoming from the EPA during 2015, and will provide guidance on the assessment of cumulative effects in the context of SEA.

The SEA Directive also requires the environmental report to describe long-term as well as short- and medium-term impacts. The monitoring of SEA-related/Strategic Environmental Protection Objectives should allow for an assessment of the likelihood of potential significant environmental effects over the lifetime of a particular PPPS and beyond. For many PPPSs, an SEA will already have been carried out: this should allow a review of the changes to the environment since the adoption of the previous PPPS. Plan-makers should assess and reflect these changes in their subsequent review of the new or updated plan.

### Complexity of cause-effect relationships

Annex I of the SEA Directive requires the environmental report to describe the PPPS's impacts on *"biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage including architectural and archaeological heritage, landscape and the interrelationships between the above factors"*. The interrelationships between aspects such as flood risk, land use, water quality, and biodiversity may have significant implications for certain PPPS elements such as infrastructural planning and design or land use zoning, and should thus be assessed. The determination of a preferred alternative development scenario should take account of the interrelationships between environmental aspects and also the effects between other PPPSs.

**3** Synergistic effects are where the interaction between factors or substances leads to an effect greater than the sum of the individual effects. An example is where the thawing of permafrost due to global warming releases methane, further increasing the concentration of greenhouse gases in the atmosphere.

## Uncertainty

The SEA Directive requires that any difficulties found during preparation of an SEA, *"such as technical deficiencies or lack of know-how encountered in compiling the required information"*, should be described. As with any area of future planning, many of the uncertainties surrounding the timing and distribution of the impacts of climate change are difficult to predict, and should be accounted for within the environmental report. For instance, alternative scenarios of global carbon emissions and modelled responses of the climate system to their atmospheric concentration will predict different degrees of change in climatic variables such as precipitation and temperature. Selecting a single projection value against which to assess the impacts of climate change on a PPPS is unlikely to be feasible or desirable. Instead, a range of plausible future climate change projections and climate impacts should inform the SEA, with a clear description of the projections employed and their limitations. Employing a range of projections in this manner should not be taken to imply that the future deviation of climatic conditions from those experienced today is somehow less likely than a business-as-usual scenario. Modelling and projection work to date indicates that a hugely significant change is underway. While some of the parameters determining the precise trajectory of that change are subject to scientific uncertainty, there is very little uncertainty with respect to the future climate differing significantly from that of today.

## Hierarchy of PPPS in integrating climatic factors

This section provides information on the level at which PPPS can effectively take account of both climate change mitigation and climate adaptation measures. The table below, taken from *Considerations of Climatic Factors with Strategic Environmental Assessment* (Scottish Government, 2010), shows some typical influences on climatic factors from land use development plans. It also provides a useful approach/methodology in the assessment of climate change impacts on spatial planning using a hierarchy of PPPS. Many similar tables on typical influences on climatic factors from transport plans, energy & resource plans and other types of plans are also provided in the above guidance and rather than replicate these tables in full, you are encouraged to review and adapt these resources in the preparation of specific PPPS to suit your own specific plan type.

*Table 1.3 Considerations of Climatic Factors with Strategic Environmental Assessment (amended from Scottish Government, 2010)*

| Plan type | Climate change mitigation | | | | | Climate adaptation | | | |
|---|---|---|---|---|---|---|---|---|---|
| Development Plans (Strategic Development Plans (SDPs), Local Development Plans (LDPs) and Supplementary Guidance (SG) as indicated | **Reduce all GHG emissions** | **Reduce impact of transport through reduction in the need to travel and modal shift** | **Reduce energy use, increasing energy efficiency and enabling renewable energy generation** | **Reduce resource use (e.g. reducing waste to landfill)** | **Reduce carbon loss from soils** | **Resilience to changed frequency and intensity of precipitation, flood risk and flooding** | **Resilience to changes in patterns of high winds and storminess** | **Resilience to changes in patterns of droughts and heat waves** | **Resilience to changes in patterns of erosion and landslides** |
| | Make efficient use of existing infrastructure to reduce the need for additional facilities with associated emissions from pumping/ treatment (SDP/ LDP) | Promote development patterns that reduce need to travel (SDP/LDP) | Provide spatial framework for renewables development in appropriate locations (LDP/ SG) | Provide spatial framework for new waste facilities such as recycling, composting and thermal treatment (SDP/ LDP) | Protect high-carbon soils from loss/sealing through new development (LDP) | Avoid building in flood risk areas (LDP) | Ensure development takes account of drainage and sewerage infrastructure capacity in light of any possible increase in storm events (LDP) | Avoid development patterns that fragment habitat corridors for the movement of species and seek to enhance where possible (SDP/LDP) | Avoid development in areas at risk from erosion including coastal erosion (SDP/ LDP) |
| | Promote high energy efficiency standards (LDP) | Promote mixed use development (LDP) | Support provision of micro-renewables on buildings or in developments (LDP/SG) | Help to reduce waste in development of new buildings and encourage the re-use of construction waste (LDP/SG) | Restrict commercial peat extraction (LDP/ SG) | Increase resilience to floods through use of SuDS (LDP/SG) | Avoid development in coastal areas at risk of current and future flooding (SDP/ LDP) | Encourage design for environmental performance – reduce need for cooling and help to address urban heat island effect (LDP/SG) | Protect and expand native woodland cover (SDP/LDP/SG) |
| | Use solar gain through layout and design (LDP/ SG) | Allocate sites close to existing public transport routes (LDP) | Encourage Combined Heat and Power (SDP/ LDP/SG) | | | Ensure that any new essential infrastructure and service development are not at flood risk (LDP/SG) | | Encourage the greater use of green roofs, protect and expand green space and tree cover (SG) | |
| | Small housing at higher density (LDP/SG) | Prioritise the re-use of brownfield land (SDP/LDP) | | | | Permeable surfaces and green space in new development (LDP/SG) | | Consider future water needs and availability when planning new development (SDP/LDP) | |
| | Tree planting and protection (LDP/SG) | Support car-free developments (LDP) | | | | | | Encourage use of rainwater and grey water (LDP) | |

# SEA Process and Climate Change (mitigation and adaptation)

# 2. SEA Process and Climate Change (mitigation and adaptation)

**Chapter 2 Summary**

*Tables for use in consideration of climate change in Screening, Scoping, Alternatives Assessment, Environmental Report, Consultation & Monitoring phases*

Table 2.1 shows a broad overview of the key stages of the SEA Directive requirements and how climate change should be taken into account. Further information on each of the key stages is provided in the other tables in this chapter.

*Table 2.1 – High-level Summary of SEA Stages and Climate Change Considerations*

| | |
|---|---|
| **Screening** | ■ Establish context/objectives of the PPPS<br>■ Assess the potential for likely significant effects of climatic factors on the PPPS to determine how climate-resilient the PPPS is<br>■ Consider energy/emissions/infrastructure etc. demands associated with PPPS<br>■ Assess compatibility with higher level PPPS climate change commitments and consider appropriate mitigation/adaptation measures<br>■ Early consultation<br>■ Determination of potential for likely significant adverse effects |
| **Scoping** | ■ Establish environmental (climatic) baseline<br>■ Develop climate change Environmental Protection Objective(s)<br>■ Identify environmental vulnerabilities which may be affected significantly by climate change<br>■ Consider adaptation and mitigation options to achieve the aims/goals of the PPPS<br>■ Early scoping consultation |
| **SEA Alternatives** | ■ Consider 'reasonable' SEA alternatives to meet PPPS objectives, while maximising climate resilience where possible<br>■ Select alternatives which avoid or minimise environmental impacts<br>■ Assess energy demands of alternatives, land use zoning options in spatial plans, transportation/commuting etc |
| **SEA Environmental Report** | ■ Assess the impacts of the PPPS as a whole for likely significant effects, including cumulative effects of climate change on environmental vulnerabilities<br>■ Establish and recommend appropriate climate change mitigation/ adaptation measures and fully integrate SEA recommendations into PPPS<br>■ Provide sufficient time for consultation on Draft PPPS and SEA |
| **Monitoring** | ■ Develop a monitoring programme for the environmental baseline data. Review updated baseline information available throughout the lifetime of the PPPS at appropriate intervals to determine how effectively the PPPS is responding to climate change |
| **SEA Statement** | ■ Summarise in the SEA Statement how climatic factors have been integrated into the PPPS |

Tables 2.2–2.7 set out the main stages in the SEA process where climate change considerations can be addressed/assessed and usefully integrated. The format used in this Chapter follows the steps involved in the SEA process. Chapter 3 – Climate Change Baseline should be used in conjunction with these tables, where relevant and appropriate.

*Table 2.2 – Consideration of Climate Change in SEA Screening Stage (modified from EA, 2011)*

| SEA Process | How climate change could be considered in the process |
|---|---|
| **Stage A:** Screening – establishing the context and objectives of the assessment. Determining whether likelihood for potential significant environmental effects may necessitate full SEA. | ■ Consider whether the PPPS is likely to have a significant effect on climatic factors during its lifespan and legacy, factoring in uncertainties, and determine whether measures may be appropriately incorporated to mitigate any negative consequences regarding GHG emissions or carbon sinks caused by the PPPS.<br>■ Assess climate change aspects against SEA environmental criteria (Annex I (f) of the Directive) and in accordance with Annex II.<br>■ Consider energy demands associated with Plan implementation, associated greenhouse gas emissions, greenfield/soil loss, etc.<br>■ Consider the impacts of current and future climate change on the PPPS, and adaptation measures that it may need to include based on the vulnerability and adaptive capacity of both the system and the PPPS itself.<br>■ Ensure that Plan objectives are compatible with wider SEA objectives, or refer to higher level PPPSs which set out objectives that influence the particular PPPS.<br>■ Make a determination on whether full SEA is required. |

*Table 2.3 – Consideration of Climate Change in SEA Scoping Stage (modified from EA, 2011)*

| SEA Process | How climate change could be considered in the process |
|---|---|
| **Stage B:** Scoping – establishing the baseline and deciding on the scope<br>■ Identifying other relevant plans, programmes and environmental protection objectives.<br>■ Collecting baseline information<br>■ Identifying environmental problems.<br>■ Developing SEA objectives.<br>■ Consulting on the scope of the SEA. | ■ Describe the current and likely future climate change baseline based on relevant observations/projections, keeping in mind that multiple scenarios/projections may be appropriate (see Chapter 3 for Environmental Baseline).<br>■ GIS can be used to overlay maps showing different environmental vulnerabilities. This may highlight areas where a number of vulnerabilities/sensitivities exist and that may have greater potential for significant cumulative effects, and that therefore should be afforded significant protection in implementing a particular Plan. The EPA's GISEA Consultation Manual will be available in Q3 2014.<br>■ Describe the "likely evolution of the environment" without implementation of the PPPS. The cumulative climate change effects are particularly important with regard to the evolving baseline.<br>■ Identify the key likely significant impacts and opportunities created by climate change.<br>■ Identify other relevant PPPSs that have climate change impacts, or contain climate change mitigation and adaptation measures that could affect the options being considered.<br>■ Develop climate change objectives and indicators for mitigation, adaptation, and where relevant links between them. The objectives and indicators should take account of the uncertainty of future climate change.<br>■ Ensure early consultation with SEA and other stakeholders on climate change issues to build/incorporate climate change into the assessment from the outset. |

*Table 2.4 – Consideration of Climate Change in Development of Alternatives (modified from EA, 2011)*

| SEA Process | How climate change could be considered in the process |
|---|---|
| **Stage C:** Developing and refining reasonable/realistic alternative scenarios and assessing effects.<br>■ Testing the PPPS objectives against the SEA objectives.<br>■ Developing strategic alternatives.<br>■ Predicting the effects of the PPPS including pragmatic alternatives.<br>■ Avoiding and minimising adverse impacts. | ■ Suggest PPPS alternatives to deal with key climate change related problems: both mitigation and adaptation.<br>■ Develop alternatives that are based on a "win-win" or "low-regret" approach (see Chapter 7).<br>■ Assess the effects of PPPS alternatives on the climate change objectives and indicators.<br>■ Consider whether there is potential for cumulative effects of allowing multiple developments in a specific area, taking account of existing environmental sensitivities (capacity of environment to absorb development).<br>■ Avoid "point in time" predictions: consider trends and environmental conditions with and without the proposed PPPS (and its alternatives).<br>■ Begin to integrate climate change mitigation and adaptation measures into the PPPS. |

*Table 2.5 – Consideration of Climate Change at SEA Environmental Report Stage (modified from EA, 2011)*

| SEA Process | How climate change could be considered in the process |
|---|---|
| **Stage D:** Preparing the Environmental Report.<br>■ Writing the draft Environmental Report, including the results of the assessment. | ■ The Environmental Report and Draft PPPS should clearly explain how climate change issues have been identified and managed, including how uncertainty has been factored into the decision-making process.<br>■ Climate Change Mitigation and Monitoring related aspects of SEA preparation are covered in detail in Chapter 7. |

*Table 2.6 – Consideration of Climate Change in SEA Consultations (modified from EA, 2011)*

| SEA Process | How climate change could be considered in the process |
|---|---|
| **Stage E:** Consulting on the draft PPPS or programme and the Environmental Report.<br>■ Consulting the public and Consultation Bodies on the draft PPPS and the Environmental Report.<br>■ Assessing significant changes.<br>■ Making informed decisions and providing information. | ■ Carry out early consultation with authorities responsible for climate change management and others who can provide advice on good practices (see Stage A).<br>■ Fully integrate climate change mitigation and adaptation measures into the final PPPS. |

*Table 2.7 – Consideration of Climate Change in SEA/PPPS Monitoring (modified from EA, 2011)*

| SEA Process | How climate change could be considered in the process |
|---|---|
| **Stage F:** Monitoring the significant effects of implementing the PPPS.<br>■ Developing aims and methods for monitoring. | ■ Monitor climate change and effectiveness of mitigation measures in reducing greenhouse gas emissions. The effectiveness of adaptation measures is likely to be difficult to monitor, but can be monitored where such measures are implemented.<br>■ Consider the latest climate change science and prediction and how these could relate to the significant effects of implementing the PPPS.<br>■ Be prepared to respond to any adverse impacts identified. |

*Table 2.8 – Consideration of Climate Change in SEA Statement Preparation*

| SEA Process | How climate change could be considered in the process |
|---|---|
| **Stage G:** SEA Statement Preparation | ■ Describe how climate resilience has been brought into the PPPS. The key commitments in relation to climate adaptation and climate mitigation should be described within the SEA Statement. |

# Climate Change Baseline

# 3. Climate Change Baseline

**Chapter 3 Summary**

*Summary of climate change related baseline described*

The publication *Ireland's Environment 2012 – An Assessment* (EPA, 2012) provides a high-level summary on status of greenhouse gases and climate change in an Irish context. It describes the key drivers and pressures and responses to climate change that may occur, providing an outlook of greenhouse gas projections to 2020, and also identifies future challenges to be addressed.

Tables 3.1 through to Table 3.4 below describe more recent information on the observed and projected environmental changes due climate change on a national scale (while Appendix B provides links to baseline data about climate change). These form the 'business as usual' scenarios. The "confidence"[4] and "projected changes" columns serve as a guide in assessing how climate change should be taken into account in the preparation of PPPS.

*Table 3.1 – Observed and Projected Changes in Temperature and Precipitation – Adapted from Desmond et al. (2009) and Gleeson et al. (2013)*

| Climate variable | Observed changes | Scientific confidence | Projected changes | Scientific confidence in projection |
|---|---|---|---|---|
| **Air temperature** | Mean annual surface air temperature has increased by approximately 0.8°C over the period 1900 to 2010 | High | Average temperatures will rise by about 1.5°C (RCP4.5 scenario) by mid-century and up to 3°C by 2100 compared to the 1961–1990 average. | Medium (depends on scenario), medium for extremes. |
| | All seasons are warmer but more so in winter. | High | Strongest signals in winter and summer. Continued night-time heating. | Medium |

4 Scientific confidence is confidence in changes observed to date. Confidence projection refers to confidence in projected changes into the future.

| Climate variable | Observed changes | Scientific confidence | Projected changes | Scientific confidence in projection |
|---|---|---|---|---|
| **Heat waves** | Only one station recorded a significant increase in the heat wave duration index. | High | Increased frequency of heat waves. | Medium |
| **Cold snaps/ frost days/ nights** | Less frost; trend of decreasing frost nights and decrease in duration. 14% to 88% decrease in number (median of 30–40%). | High | Decreased frequency. | Medium |
| **Precipitation** | A 5% increase in the period 1981–2010 relative to 1961–1990. In general larger increases recorded in the western half of the country. Seasonally, small increase across all seasons although spatial distribution and intensive vary. | Medium (low confidence for local details and very low confidence for extremes). | Wetter winters in the west. Drier summers in the south east.<br>Spatially, however, there remains a high level of disagreement.<br>Frequency of heavy precipitation events during winter shows increases of up to 20%.<br>Changes in precipitation are likely to have significant impacts on river catchment hydrology. | Medium |
| | Fewer snow days. | High | Less snow throughout. | Medium/High |
| | Drier summers. | Medium (2007 and 2008 were anomalous but did not reverse trend). | Drier summer: 5–25% less rainfall in 2021–2060 compared to 1961–2000. | Low |
| **Extreme events** | There is evidence of an increase in the frequency of days with heavy rain (10 mm or more) over the period 1981–2010 relative to the period 1961–1990. | | Increase in the frequency of heavy rainfall, particularly in winter. | |

*Table 3.2 – Observed and Projected Changes in Phenology, Hydrology, Soil Temperature – adapted from Desmond et al. (2009)*

| Climate variable | Observed changes | Scientific confidence | Projected changes | Scientific confidence in Projection |
|---|---|---|---|---|
| **Phenology**[5] | Terrestrial: Longer growing season; earlier spring development in some species. Ocean: Expansion of growth season in upper trophic levels. | High/Medium | Longer growing season; earlier spring. | High |
| **Ground and surface water runoff** | Greater variability in flow rates. Some evidence of decreased flood return periods. | Low, very low for extremes | Increased flow to rivers in winter and less in summer. | Medium |
| **Surface freshwater temperatures** | Probably consistent with observed changes in air and soil temperature. | Low/Medium | Consistent with air and soil temperatures. | Low/Medium |
| **Soil temperature** | Consistent with the observed changes in air temperature. | Medium | Consistent with air temperature: warmer in south-east. | Medium |

*Table 3.3 Observed and Projected Changes for Sea Temperature, Sea Chemistry and Sea Level Rise – Adapted from Desmond et al. (2009)*

| Climate variables | Observed changes | Scientific confidence | Projected changes | Scientific confidence in projection |
|---|---|---|---|---|
| **Sea temperature** | Sea surface temperature increased by 0.6°C/decade since 1994, which is unprecedented in the 150 year record. Greatest warming in the Irish Sea. | High | Ongoing increase in mean sea temperature. | Medium |

5 Phenology is the study of cyclic and seasonal natural phenomena, especially in relation to climate and plant and animal life. Trophic levels represent different hierarchical levels in an ecosystem, consisting of organisms sharing the same function in the food chain and the same nutritional relationship to the primary sources of energy.

| Climate variables | Observed changes | Scientific confidence | Projected changes | Scientific confidence in projection |
|---|---|---|---|---|
| **Sea chemistry (pH and salinity)** | Increased seawater acidity observed; salinity changes vary with region. Atlantic waters freshened from 1960 to 1990 and are now becoming more saline. Associated changes in water mass formation/circulation. No significant changes observed on shelf. | High for acidity, low for salinity | Acidity is projected to increase; salinity changes vary with region. Changes in rainfall will affect coastal salinities. | High for acidity, low or salinity |
| **Sea-level rise (SLR) <1 m** | During the satellite era, sea level rise of 4–6 cm per decade has been observed. | Low to medium | Rise of 60 cm to 2100. Changes in sea level predicted to magnify impacts of storm surges and wave patterns in coastal areas. | Medium |
| **SLR > 1 m** | | | Sea level rise may exceed 1m if there is a considerable melting of land ice (polar shelves and glaciers). | Low to medium |

# Sectoral Impacts of Climate Change

# 4. Sectoral Impacts of Climate Change

**Chapter 4 Summary**

*Sector-specific guidance including agriculture, biodiversity, peatlands, forests, and water quality*

A brief summary of the potential impacts of climate change on specific sectors is shown below. Where relevant, further detailed information is available in the report entitled *A Summary of the State of Knowledge on Climate Change Impacts for Ireland* (Desmond et al., 2009) and the National Climate Change Adaptation Framework (DECLG, 2012).

## 4.1 Agriculture

Agriculture's main impacts on climate change will result from changes in air and soil temperature, precipitation and extreme events. Some crops, such as potatoes, will become economically viable only with irrigation and considerable investment in surface and groundwater infrastructure to store winter rain may be necessary in eastern parts of Ireland. A Teagasc report entitled *The Impact of Climate Change on Irish Farming* (Teagasc, 2010) has identified that cereal production in all regions would be negatively affected by changes in precipitation, air and soil temperature and extreme weather events.

Food Harvest 2020 is an industry-led plan to increase agricultural efficiency/productivity across a range of agri-sectors supported by the Department of Agriculture, Food and the Marine. It includes a commitment to reducing the carbon intensity of agricultural activities and enhancing carbon sinks.

Grassland coverage will be reduced over large parts of the south and east of the country due to summer droughts, and grass silage may be replaced by maize. Increased problems with slurry storage and spreading in the wetter western parts of the country may occur. The drying out of soils in response to climate change (including in wetlands) could result in deterioration of soil quality. Increased rainfall may cause increased soil erosion. Subsidence and soil heave may be caused by alternate dry summers and wet winters.

*Table 4.1 – Key Impacts for Agriculture: Adapted from Desmond et al. (2009)*

| Related aspects | Effects on agriculture |
|---|---|
| ■ Air temperature<br>■ Soil temperature<br>■ Extreme weather events<br>■ Water availability | ■ Decrease in soil condition<br>■ Increase in pests, pathogens and invasive species<br>■ Increase in plant growth<br>■ Animal welfare<br>■ Infrastructure and access to the land<br>■ See also Table 3.2, especially in relation to phenology |

## 4.2 Biodiversity

The European Commission's Guidance on *Integrating Climate Change and Biodiversity into Strategic Environmental Assessment* (EC, 2013) sets out how biodiversity and climate change aspects can be integrated into the SEA process, including the long-term/cumulative nature of impacts, complexity of issues, cause-effect relationships and uncertainty.

*Table 4.2 – Key Aspects for Biodiversity: Adapted from Desmond et al. (2009)*

| Key aspects | Effects on biodiversity |
|---|---|
| ■ Precipitation<br>■ Air temperature<br>■ Soil temperature and water availability<br>■ Sea level rise | ■ Soil condition<br>■ Plant growth<br>■ Animal welfare<br>■ Reduction/deterioration of supporting habitat<br>■ Competition between species for resources<br>■ Spread of invasive species |

## 4.3 Peatlands

Table 4.3 lists aspects of peatlands to be taken into account. The areas identified as being most vulnerable to climate change are those where the peat has been degraded through loss of vegetation and structure (Climate Change Risk Assessment, 2012). A Draft National Peatland Strategy (NPS) has been prepared by the National Parks and Wildlife Service in 2014 and sets the framework for the management of peatlands at a national level. Lower level plans with the potential to impact on peatlands will need to take the finalised NPS into account.

*Table 4.3 – Key Aspects for Peatlands: Adapted from Desmond et al. (2009)*

| Key aspects | Effects on peatlands |
|---|---|
| ■ Temperature<br>■ Precipitation<br>■ Extreme weather events<br>■ Peatland archaeology | ■ Increase in decomposition<br>■ Reduction in peat formation<br>■ Increased erosion<br>■ Possible species composition changes<br>■ Loss of carbon storage potential<br>■ Increase in $CO_2$ emissions<br>■ Potential reduction in Sphagnum mosses/peat forming vegetation<br>■ Soil/Peatland erosion may impact on archaeological site/ monument preservation conditions.<br>■ Increased precipitation may improve preservation conditions in raised bog archaeological sites |

## 4.4 Forests

Table 4.4 lists aspects of forests to be integrated as appropriate into PPPS. Summary information on the key aspects of forestry and the likely effects of climate change on forestry is given below.

*Table 4.4 – Key Aspects for Forests: Adapted from Desmond et al. (2009)*

| Key aspects | Effects on forestry |
|---|---|
| ■ Air temperature<br>■ Precipitation<br>■ Extreme weather events | ■ Soil condition<br>■ Animal welfare<br>■ Plant growth<br>■ Spread of invasive species |

## 4.5 Water Quantity and Quality

The aspects of water quantity and water quality that may be affected by climate change, and the associated effects of climate change are summarised in Table 4.5.

*Table 4.5 – Key Aspects for Water Resources: Adapted from Desmond et al. (2009)*

| Key aspects | Effects on water resources |
|---|---|
| ■ Precipitation<br>■ Air Temperature | ■ Increased evaporation leading to lowering of resource volumes<br>■ More stress on water service infrastructure<br>■ Greater concentration of pollutants/contaminants, and less assimilative capacity of waters during summer months<br>■ See also Table 3.2, especially "ground and surface water runoff" and "surface freshwater temperatures"<br>■ Flood risk (fluvial) |

## 4.6 Coastal and Marine Resources and Flood Risk

Table 4.6 provides a summary of the key climate variables, observed and projected changes associated with coastal and marine resources. In-combination effects of high tides, high river levels from prolonged periods of precipitation and stormy conditions may combine to exacerbate flooding risk in low-lying areas.

*Table 4.6 – Observed and Projected Changes for Coastal and Marine Resources and Flood Risk: Adapted from Desmond et al. (2009)*

| Climate variables | Observed changes | Projected changes |
|---|---|---|
| **River flooding** | Linked to precipitation patterns. | Increase in risk of river flooding. |
| **Coastal flooding** | Linked to storm patterns and sea-level rise. | Increased risk of coastal flooding due to storm surge. |
| **Flooding of poorly drained land** | Linked to precipitation patterns. | Increased duration of standing water on poorly drained lands in winter. Greater drying of turlough/rain-fed lakes in summer. |
| **Sea level rise** | Linked increase in wave heights. | Coastal wetlands and estuaries at risk from salt water intrusion, increases in erosion; predicted worse impacts of changing storm surge and water patterns. |

## 4.7 Human Health

The potential impacts of climate change on human health may occur at some significant periods of hot or cold weather events. Prolonged heat or cold spells may give rise to heat/cold stresses and associated effects. Prolonged periods of significant icy/flood events may affect emergency services' ability to deal with emergencies.

*Table 4.7 – Key Aspects for Human Health: Adapted from Desmond et al. (2009)*

| Key Aspects | Effects on Human Health |
|---|---|
| ■ Temperature<br>■ Precipitation | ■ Warmer winters may lead to reduction in use of fuels, lowering cold-related deaths<br>■ Higher summer temperatures may lead to increase in heat stress related cases<br>■ Unforeseen icy/flood conditions can affect the provision of critical services/emergency services/transport services |

## 4.8 The Economy and Society

Flood events and consequent subsidence may damage critical infrastructure such as road, rail, electricity, water and communications, as well as domestic and commercial buildings. This could cause substantial losses to productivity, economic confidence and societal wellbeing. These may lead to increases in insurance premiums due to increases in the number and magnitude of claims being made, in turn diminishing consumer spending power and increasing business overhead costs. Prolonged hot or wet periods may also affect crop yields.

However, some opportunities may exist for the Irish economy and society from a changed climate. For example, a warmer climate may make the country a more favourable tourist destination, particularly compared with continental Europe and the Mediterranean region, which may be increasingly affected by severe heat waves and droughts (Sweeney et al., 2013). Diversification/ intensification in food production as a result of a warmer climate for certain crops may also prove beneficial. However, any proposed intensification of agriculture production may itself lead to increases in greenhouse gas production, from ruminant sources and increased use of fertilisers, and may adversely impact on water quality, soil infiltration rates and biodiversity. Opportunities may also exist in terms of the green economy and business opportunities such as ecosystem services.

# Considering the Relationship with Other Relevant Plans and Programmes

# 5. Considering the Relationship with Other Relevant Plans and Programmes

The SEA Directive requires that the Environmental Report must describe "the relationship with other relevant plans or programmes". The study Integrating Climate Change Adaptation into Sectoral Policies in Ireland (Desmond and Shine, 2010) identifies other PPPSs with relevance to climate change objectives. It identifies where climate change has been or could be integrated into a number of relevant policy sectors, including agriculture, water, flooding, coastal and marine and spatial planning.

The above study suggests the key stages when climate adaptation is being integrated into sectoral decision-making. Table 5.1 shows an example of the information provided in terms of considering integration of climate adaptation in energy-related decision-making. Further sectoral information is given and recommendations are made in relation to decision-making for sectors including industry, communications, transport, heritage, tourism, spatial planning, human health & social protection, coastal & marine, flooding.

*Table 5.1 – Entry points for integrating adaptation into energy decision making (amended from Desmond and Shine, 2010)*

| Policy level | Key national actors | Policy cycle stage | Possible Key Entry Points (possible ✔) |
|---|---|---|---|
| EU-DG Energy | DCENR | All | Review of Energy Policy ✔ |
| National | DCENR | Implementation | Engagement with the Commission on Energy Regulation (CER) with a view to integrating climate change adaptation into guidelines and regulations for the energy sector ✔ |
| National | DCENR | Formation | Climate change impacts and adaptation could be integration into future National Renewable Energy Action Plans ✔ |
| National | DCENR/ Infrastructure owners | Implementation | Review of codes and standards for the design and safety of structures, power plants, electricity and gas network substations, oil storage and dams based on climate change projections ✔ |
| National | DCENR/ Infrastructure owners | Implementation | Review of coastal protection measures where energy infrastructure is located, e.g. reserve oil storage, pipelines power generation, network substation and subsea cables ✔ |
| Local level | Infrastructure owners | Implementation | Energy plant output could be reviewed in the context of climate change, e.g. outputs from wind, wave and hydro-power ✔ |
| Sectoral research | DCENR | Implementation | Review of wind and wave atlases could take climate change impacts and projections into account ✔ |

# Climate Change Objectives and Indicators

# 6. Climate Change Objectives and Indicators

**Chapter 6 Summary**

*Information on climate change objectives, indicators, suggested mitigation and adaptation measures, information sources*

The SEA Directive requires that the environmental report should determine the *"environmental protection objectives, established at international, European Union or national level, which are relevant to the plan and the way those objectives and any environmental considerations have been taken into account during its preparation"*.

Following identification of the key issues associated with the plan, the plan/SEA-making team should develop Climate Change Objectives and Indicators as part of the identification of Strategic Environmental Objectives. A range of climate change objectives and indicators are shown in Tables 6.1 and 6.2. These should be taken into consideration in the PPPS as appropriate.

*Table 6.1 – Possible SEA Climate Change Objectives (based on EA, 2011)*

| Section | Possible SEA objectives |
|---|---|
| **Mitigation measures** | Minimise future climate change through:<br>■ Reducing the need to travel/increased use of public transportation.<br>■ Increasing energy efficiency.<br>■ Utilisation of lower carbon fuels.<br>■ Decreasing usage of fossil fuels and increasing renewable source usage.<br>■ Spatial planning – restriction of inappropriate development/land use zoning in flood risk zones, inclusion of green infrastructure, SuDS technologies.<br>■ Controlling abstraction of drinking water (surface and ground water).<br>■ Maintaining/protecting natural carbon sinks (bogs/marshes/forests). |

| Section | Possible SEA objectives |
|---|---|
| **Adaptation measures** | Reducing vulnerability to the impacts of climate change through:<br>■ Providing adequate health and critical service infrastructure.<br>■ Adequate surface water drainage infrastructure to adapt to changes in seasonal rainfall; SuDS technologies.<br>■ Zoning and rezoning of land uses to restrict potentially inappropriate development in flood-prone areas.<br>■ Supporting the utilisation of energy- and water-efficient building design to better equip homes and businesses to cope during times of shortage and service interruption, such as grey-water recycling, passive house.<br>■ Integrated coastal zone management.<br>■ Robust transport infrastructure.<br>■ Increased green infrastructure provision in land use plans.<br>■ Avoiding situations that limit adaptation to climate change.<br>■ Developing ecologically resilient and varied landscapes.<br>■ Establishing and preserving ecological networks.<br>■ Fostering adaptive management practices in the face of uncertainty, favouring flexible adaptation options and allowing for alteration of PPPS as monitoring and evaluation data become available. |

*Table 6.2 – Suggested Climate Change Indicators and Sources of Information[6] (Adapted from EA, 2011)*

| Aspects of climate change | Possible indicators | Potential information sources |
|---|---|---|
| **Causes** | ■ Carbon emissions per person<br>■ Greenhouse gas emissions | DECLG<br>EPA<br>EEA |
| **Climate variables/ weather** | ■ Sea level<br>■ Precipitation<br>■ Temperature (air, ground, sea surface)<br>■ Flood levels in rivers<br>■ Weather extremes (heat waves/cold snaps/ prolonged heavy rainfall) | DECLG<br>EPA<br>Met Éireann<br>OPW<br>Marine Institute |

6 Another key resource, the EPA 'Ireland's Climate Information Platform', (ICIP) is under preparation. The ICIP will provide a "one stop shop" resource that will assist in: 1) information provision; 2) capacity building; and 3) decision support, associated with actions to meet the challenges of climate change.

| Aspects of climate change | Possible indicators | Potential information sources |
|---|---|---|
| **Local impacts of climate/weather** | ■ Annual hosepipe bans/rationing<br>■ Effects on biodiversity<br>■ Human health (excess deaths attributed to weather)<br>■ No. of cases of subsidence/insurance claims for subsidence<br>■ New instances of recurring flooding<br>■ Surface water flow and quality | Local Authorities<br>DECLG/NPWS<br>NBDC<br>HSE/HSA<br>Insurance companies<br>OPW<br>EPA<br>Teagasc<br>IFI |
| **Mitigation measures** | ■ Household energy/water usage<br>■ Total electricity and gas usage<br>■ Distance travelled (per person/per year) public/private transport<br>■ % energy supplied by renewable sources<br>■ % energy efficiency of buildings<br>■ % of homes receiving subsidy for improving energy conservation installations<br>■ % of existing houses achieving good energy rating<br>■ % of new houses achieving top energy ratings | DCENR<br>SEAI<br>NRA<br>NTA<br>Bord Gáis<br>ESB |
| **Adaptation Measures** | ■ No. or % houses in flood plains<br>■ % roads/railway in flood plains<br>■ No. of planning permissions granted contrary to ABP recommendations on flood risk grounds<br>■ % of developments incorporating SuDS<br>■ % land zoned for green infrastructure in urban setting (drought resistant)<br>■ Enhancement of ecological networks/linkages through habitat creation/restoration | Local Authorities<br>OPW<br>Iarnród Éireann<br>NTA<br>NRA<br>DAHG<br>NPWS<br>etc. |

# Climate Change (mitigation and adaptation) Responses

# 7. Climate Change (mitigation and adaptation) Responses

**Chapter 7 Summary**

*Examples of mitigation and adaptation measures for spatial and non-spatial PPPS*

*Examples of how aspects of climate change can be integrated into PPPS*

This chapter provides information on how mitigation and adaptation measures can be incorporated into SEA effectively. Different types of suggested commitments are also described to provide examples of how these mitigation and adaption measures can be integrated.

## 7.1 Inclusion of Mitigation and Adaptation Measures in SEA

The plan-maker must consider mitigation and adaptation measures if a PPPS has been assessed to have significant adverse impacts on climatic factors, or to result in increased vulnerability to climate change. This should be done as early as possible and be taken into consideration when assessing alternative development scenarios. While a PPPS may include proactive initiatives and commitments to avoid climate change impacts, these may not succeed in reducing greenhouse gas emissions or vulnerability to climate change. This is due to other factors such as lifestyle choices affecting car choices, and car usage can counteract even the most well-intentioned PPPS commitment.

Tables 7.1 and 7.2 suggest a wide range of measures to mitigate and adapt to climate change. The principles to be applied in identifying appropriate mitigation and adaptation measures are as follows.

- Keep options open and flexible, so that further measures or strategies can be put in place to meet needs identified in the future. Given the uncertainties inherent in predicting future change, consideration should be given to factoring flexibility into Plans, through e.g. provision of buffer zones between development and sites of ecological importance, avoiding inappropriate development in areas of known flood risk, or ensuring that sufficient flexibility is maintained within the PPPS to alter course should future climate impacts differ significantly from those anticipated. Where uncertainty exists or baseline data are unavailable, this should be highlighted in the PPPS. Prioritising addressing data gaps should inform determinations as to how the environment is changing within the PPPS area and allow the Plan to be reviewed against up-to-date information.
- Avoid decisions that will make it more difficult to manage climate risk in the future. One example is inappropriate development in flood risk areas. Another is installing air conditioning units, which deal with the short-term problem of over-warm buildings but at the cost of increasing energy consumption and global warming.

- Consider the level of "regret" involved in implementing the option; will it be effective regardless of how climate change is manifest in the future?

  i. No-regret adaptation options are those that deliver societal benefits regardless of the future climate impact regime encountered. Examples include capacity-building actions or activities, or savings-targeted activities such as reducing leakage from water systems in drought-threatened areas.

  ii. Low-regret adaptation options are those that carry relatively low cost but offer the potential for significant climate resilience enhancement. Examples include raising the minimum floor height of new build dwellings in areas that may be flood-prone in the future, or acting to ensure the long-term health and well-being of natural climate buffering habitats such as dune systems and wetlands.

- Seek win-win measures if possible. Win-win options are those that serve a dual purpose, enhancing resilience to climate change impacts while also providing an alternative societal benefit, such as responding to the threat posed by increased storm intensity and sea level rise by building an artificial reef, thus dissipating wave energy to prevent coastal erosion and also serving to provide recreational opportunities for surfers and a nursery habitat for inshore fisheries.

- Choose to implement flexibility/adaptive management in planning for climate change, staging the implementation of adaptation options incrementally over time wherever possible. Options that score highly in terms of their flexibility are those that allow for changing course as new information becomes available, allowing planners and manager to learn how best to respond to climate impacts without committing resources inappropriately or unnecessarily. This type of adaptation option is typically prefaced by a period of observation and monitoring, which then leads into the commitment of resources to a particular course of action. An example of flexible adaptation would be the prevention of future residential zoning and the dezoning/rezoning of existing residential lands in areas at significant risk of flooding, particularly in areas where flood alleviation measures are not viable to establish/maintain.

Optimal adaptation policy responses should ideally be based on 'win-win' or 'co-benefit' decision-making processes. Decision-making, which includes adaptation, mitigation, and wider sustainable development objectives, which would generate net social and/or economic benefits irrespective of how the impacts of anthropogenic climate change unfold, should be encouraged.

## 7.2 Climate Change Mitigation Responses

Mitigation is primarily concerned with limiting the production of greenhouse gases. Table 7.1 shows a range of possible mitigation measures.

*Table 7.1 Categories of Mitigation and Some Examples (Adapted from EA, 2011)*

| Mitigation Measure | Example for spatial PPPS | Examples for non-spatial PPPS |
|---|---|---|
| **Buildings** | ■ Support energy-efficient building design<br>■ Promote building of energy-efficient smaller homes/ higher density appropriate to demographics and with greatest infrastructure provision<br>■ Promote renewable and low carbon energy<br>■ Create or enhance carbon sinks | ■ Retrofit existing houses with insulation to increase energy efficiency<br>■ Promote re-use of recyclable building materials with low embodied energy<br>■ Promote renewable energy through plans such as Offshore Renewable Energy Development Plan, County Wind and Renewable Energy Strategies, Building Design Guidelines (included in County Development Plans), etc. |
| **Transport** | ■ Support construction of green routes/cycleways/pedestrian routes<br>■ Support car-free developments<br>■ Strengthen public transportation linkages and encourage their use<br>■ Support localisation of jobs/ shops/services to minimise needs for most common travel patterns | ■ National/Regional Transport Strategies such as Greater Dublin Area Transport Strategy, National Transport Authority Cycle Network Plan), County/ Local Traffic Management Plans, Primary and Secondary Roads Needs Studies, etc.<br>■ Support improved fuel efficiency in vehicles<br>■ Support public transport<br>■ Encourage local holiday destinations, reduce need for air travel<br>■ Promote purchasing of local foods/farmer's markets etc. |
| **Energy production** | ■ Promote energy-efficient building design<br>■ Promote links between developments and renewable energy resources, for instance by sourcing energy on-site (renewably or from low-carbon fuel sources) | ■ Development of Sustainable Energy Action Plans which promote generation of localised electricity, use price incentives that rise with increased energy usage/congestion charging to discourage wasteful energy usage |

| Mitigation Measure | Example for spatial PPPS | Examples for non-spatial PPPS |
|---|---|---|
| **Minerals/Waste** | ■ Locate developments strategically (e.g. waste materials) to minimise need to travel, subject to health aspects/ business needs | ■ Encourage capture and re-use of landfill gas.<br>■ Encourage home composting and promote provision of brown bin service where possible. |
| **Agriculture, Land Management and Forestry** | ■ Establish new community woodlands in urban/urban fringe areas<br>■ Support production of sustainable biofuels (farm contributions to localised energy supplies – biofuels/wind energy production)<br>■ Implement higher level Plan recommendations/objectives/ policies | ■ Maintain/enhance natural carbon sinks such as bogs/wetlands/ forests<br>■ Reduce carbon loss from agricultural soils<br>■ Support recycling of food waste into biogas/organic fertiliser – anaerobic digestion systems<br>■ Implement River Basin Management Plans/Freshwater Pearl Mussel Sub Basin Management Plans/Biodiversity Action Plans, Nutrient Management Plans, etc. with aim of protecting biodiversity resources from intensification of agriculture |

## 7.3 Climate Change Adaptation Responses

Adaptation measures are planned responses to the impacts of current and future climate change. Table 7.2 shows a range of examples of measures that can be included In PPPS.

*Table 7.2: Categories of Adaptation and Relevance for PPPS (Adapted from EA, 2011)*

| Sector | Examples for spatial PPPS | Examples for non-spatial PPPS |
|---|---|---|
| **Buildings** | ■ Establish exclusion zones for development in flood risk areas<br>■ Specify design standards that minimise disruption/losses during periods of extreme weather/ drought)<br>■ Consider effects of building density and mixed developments on energy consumption<br>■ Include green roofs and good ventilation<br>■ Enhance flood resilience of buildings, e.g. elevated work surfaces and storage facilities, raised sockets and electrical infrastructure, enhanced flood boards<br>■ Rezoning/dezoning flood risk lands<br>■ Assess existing infrastructure for "fitness for purpose" under new climatic conditions<br>■ Consider how to maintain required comfort conditions in buildings, especially hospitals, schools, retirement homes, etc.<br>■ Promote the use of permeable surfaces to decrease runoff rates<br>■ Institute grey-water recycling schemes to decrease abstraction of potable surface water resources, thus reducing water stress during periods of low rainfall<br>■ Maximise water conservation<br>■ Plant drought-resistant plants/ trees in public amenity areas to provide shade and increase green infrastructure linkages | ■ Introduction of water meters and associated charging for water supply<br>■ Promotion of energy and efficiency in building design, materials, transport infrastructure etc.<br>■ Conservation of water resources |

| Sector | Examples for spatial PPPS | Examples for non-spatial PPPS |
|---|---|---|
| **Water management** | ■ Increase resilience to flooding through Sustainable Drainage System (SuDS)<br>■ Harvest rainwater/grey water<br>■ Ensure adequate/appropriate water supply and drainage provision.<br>■ Prepare Water Conservation Strategies | ■ Reduce water leakage and water usage, increase permeability of pavements, parking areas, roadways, etc.<br>■ Limit agricultural/industrial/ domestic discharges to surface waters |
| **Infrastructure, including flood defences** | ■ Ensure critical infrastructure and services (particularly emergency services) are resilient to new climatic conditions | ■ Upgrade Waste Water Treatment Systems to cope with increased intensity of rainfall<br>■ Accept some loss of coastal areas to sea level rise<br>■ Construct flood/surge defences where feasible and ecologically/ economically rational<br>■ Assess/maintain/upgrade drainage networks, infrastructure design and capacity, road/rail design, undergrounding of cables, etc. |
| **Agriculture, forestry and land management** | ■ Support diversification of rural economy to promote crop viability options etc.<br>■ Encourage afforestation (where environmentally appropriate) to enhance interception and infiltration of precipitation within river basin catchments.<br>■ Support restoration of peat bogs when turf cutting has ceased.<br>■ Incorporate recommendations from the National Peatlands Strategy upon its adoption | ■ Plant drought-resistant crops/ flood-resistant crops<br>■ Establish low-impact chemical approaches to controlling pests/ disease in crops arising under new conditions<br>■ Support recommendations of National Rural Development Programme upon its adoption |
| **Wildlife and biodiversity** | ■ Create/enhance ecological linkages and buffer zones from development<br>■ Create/protect ecologically resilient and varied landscapes to help support a wide range of species | ■ Protect designated sites, habitats and species and associated linkages |

| Sector | Examples for spatial PPPS | Examples for non-spatial PPPS |
|---|---|---|
| **Economy and tourism** | ■ Support opportunities for increased tourism as a result of warmer summers, within limits of existing infrastructure<br>■ Promote dual-usage (low-regret) adaptation options, such as dune/wetland restorations that buffer against storm surges/ sea level rise while providing enhanced tourism and recreation amenities<br>■ Promote Wetlands Ecosystems Services to development where relevant and appropriate | ■ Develop skills to respond to climate change (emergency planning, develop new goods/ services)<br>■ Take advantage of opportunities for increased tourism as result of warmer summers |
| **Human Health, Risk and Insurance** | ■ Providing green infrastructure to provide shade in urban areas<br>■ Provide building methods and materials to reduce the impacts of heat stress<br>■ Appropriate maintenance of surface water drainage infrastructure to avoid flood risk<br>■ Using Flood Risk Assessments to direct development and zoning of lands to appropriate areas based on vulnerability of land use or development function | ■ Ensure health sector has the capacity to meet increased peak demand during periods of heat stress<br>■ Insure against weather and flood loss<br>■ Ensure emergency services and equipment able to meet increased risks.<br>■ Increase public awareness about how to cope with flooding and heat waves<br>■ Install community-based early warning systems for flooding etc.<br>■ Monitor and take steps to prevent the emergence of potentially novel disease vectors as a result of changing climatic conditions and patterns of trade/migration (e.g. minimise conditions supporting development of mosquito larvae) |

Table 7.3 shows examples of how aspects of climate change may be integrated into a particular PPPS, either through inclusion of specific commitments in Policies/Objectives or through reference to higher level Plans which need to be integrated as appropriate into the PPPS.

*Table 7.3 – Examples of Climate Change Aspects, Suggested Commitments and Relevant PPPS (Adapted from EA, 2011)*

| Climate change aspect | Suggested commitment in PPPS | Key relevant PPPS |
|---|---|---|
| **Energy conservation** | ■ Improve building energy efficiency/design<br>■ Improve insulation<br>■ Regeneration of housing areas to modernise and increase energy efficiency | ■ Sustainable Energy Action Plans<br>■ SEAI (2013) Guidance Documents<br>■ Regeneration Master Plans for Local Authority (LA) areas (e.g. in Limerick &, Dublin) |
| **Traffic management** | ■ Identify traffic issues linked to Plan area and seek to address in the Plan itself or implement higher level Traffic Management Plan aspects as relevant.<br>■ Consider integrated Land Use and Transportation Strategies | ■ County & Local Traffic Management Plans, Regional/ National Transport Strategies, Regional Planning Guidelines, etc. |
| **Public transport (PT)** | ■ Promote increased use of PT, upgrade PT infrastructure, support establishment of integrated ticketing for all PT<br>■ Integrate all PT, to facilitate regional, national and international travel<br>■ Provide/upgrade/maintain PT and cycle ways/walkways within area as appropriate, in line with requirements of higher level Plans | ■ Greater Dublin Area (GDA) Transport Strategy, Regional Planning Guidelines, County Development Plans<br>■ Coordinating/integrating service schedules of all PT (Intercity, city, international), to provide most integrated system and further promote use of PT<br>■ LA Cycling and Walking Strategies |
| **Air pollution** | ■ Promote integrated traffic management, to avoid congestion and poor air quality from transport-related greenhouse gas emissions | ■ National, Regional Level, County & Local related Traffic Management PPPS |
| **Drainage infrastructure** | ■ Assess/maintain/upgrade/map drainage infrastructure within a PPPS area. Consider implications for increased heavy precipitation events/flooding etc.<br>■ Incorporate SuDS technologies into developments | ■ Development Plan/Local Area Plan level<br>■ Arterial Drainage Studies<br>■ Catchment-based Flood Risk Assessment and Management Studies (CFRAMS)<br>■ Flood Risk Management Guidelines (DEHLG, 2009) |

| Climate change aspect | Suggested commitment in PPPS | Key relevant PPPS |
|---|---|---|
| **Transport infrastructure** | ■ Assess/maintain/enhance/ upgrade transport infrastructure to determine potential impacts due to flooding, slope failure, etc. | ■ National Roads Authority/Iarnród Éireann/Bus Éireann/Dublin Bus, Luas/Dart Transport PPPS<br>■ Local Authority transport PPPS |
| **Flood defence infrastructure** | ■ Support and integrate recommendations of catchment-based flood strategies/coastal zone management plans. Assess, maintain and upgrade flood defences where appropriate | ■ CFRAMS, Integrated Coastal Zone Management |
| **Spatial planning** | ■ Be aware of environmental issues, such as flood risk zones in land use plans. Identify public transport linkages when planning location of civic amenities and services to minimise travel/promote public transport usage | ■ Land Use Plans/Development Plans<br>■ Regional Planning Guidelines<br>■ County Development Plans<br>■ Lower level Plans<br>■ Non-land use Plans: Offshore Renewable Energy Development Plan, GRID25 Implementation Programme, etc. |
| **Green infrastructure** | ■ Protect and enhance ecological corridors/linkages not only to benefit biodiversity, but to provide shade and shelter to people during warmer periods in urban areas and locally act as carbon sinks.<br>■ Plant drought-resistant plants/ trees in public parks to minimise water use for park maintenance. Care should be taken not to impact significantly on protected species that may use these areas | ■ Land Use Plans (Biodiversity Action Plans, Heritage Plans, Green Infrastructure Strategies, etc.).<br>■ Habitats Mapping to determine what habitats/species are present within the area to be considered when upgrading/maintaining green infrastructure, and how they may be impacted by Climate Change |
| **Water conservation** | ■ Recycle grey water within buildings; promote harvesting of rainwater, meter water usage | ■ County Development Plans.<br>■ Water Services PPPS<br>■ Irish Water Metering Installation Programme, etc. |

# Integration of SEA findings into the PPPS

# 8. Integration of SEA findings into the PPPS

**Chapter 8 Summary**

*Reminder to integrate SEA findings into PPPS and suggests resources for sector-specific plans.*

The SEA and Draft PPPS should be carried out concurrently, so that the SEA findings can influence the PPPS as early as possible in the process. High-level commitments may include ensuring the obligations of the National Climate Change Adaptation Framework (NCCAF) are met, while lower level PPPS may seek to restrict zoning of lands outside flood plains, promote energy and water conservation measures, etc.

Where higher level PPPS include commitments to address certain environmental aspects, such as energy conservation, it may be sufficient, in lower level Plans to explain how the commitments are to be implemented rather than "reinventing the wheel".

With regard to the preparation of climate change adaptation strategies (CCAS), as required under the NCCAF, adaptation and mitigation considerations should be taken into account during the review stage of County and City development plans. Where necessary, amendments/variations may be required to incorporate climate change adaptation/mitigations into their statutory plans following this review.

Guidance on the preparation of CCAS for plan-making authorities is currently under preparation by the EPA Research Programme, which should provide assistance in this regard. In seeking to implement CCAS, the requirements of the SEA Directive should be integrated, as appropriate, to each sectoral plan carrying out CCAS.

## 8.1 SEA Statement

Upon completion of the SEA, the SEA Statement should provide information on how the Plan incorporates climate change measures. This should outline the key climate change aspects and how the Plan has taken these aspects into consideration.

# Monitoring, Evaluation and Follow-up

# 9. Monitoring, Evaluation and Follow-up

**Chapter 9 Summary**

*Current challenge to develop appropriate climate change indicators/guidance to allow short-medium-term PPPS to incorporate long-term climate change baseline data*

*Reference to summary report for guidance on approaches to climate monitoring, suggested indicator and evaluation considerations*

It is acknowledged that the inclusion of climate change related monitoring data in SEA is challenging, given that climate change monitoring tends to take a long-term approach whereas many local authority PPPSs tend to have a much shorter timeframe (typically 6–12 years).

A useful summary report, Monitoring & Evaluation for Climate Change Adaptation: A Synthesis of Tools, Frameworks and Approaches (Bours et al., 2013) provides summaries of different models in relation to the use of climate indicators; monitoring and evaluation approaches for different scenarios.

The challenge of developing climate change adaptation indicators is recognised internationally. Most countries across Europe are beginning a process of developing such indicators. Nationally, it is hoped to begin the development of adaptation indicators in conjunction with the implementation of adaptation actions.

# Acronyms/Abbreviations and Glossary

# Acronyms/Abbreviations

CCAS – Climate Change Adaptation Strategies
CCRP – Climate Change Research Programme (EPA)
CDP – County Development Plan
CFRAMS – Catchment Flood Risk Assessment and Management Study
DECLG – Department of the Environment, Community and Local Government
DEHLG – Department of Environment, Heritage and Local Government
EA UK – Environment Agency (UK)
EEA – European Environment Agency
EIA – Environmental Impact Assessment
EPA – Environmental Protection Agency
ESB – Electricity Supply Board
FWPM SBMP – Freshwater Pearl Mussel Sub Basin Management Plan
GDA DTS – Greater Dublin Area Transport Strategy
GHG – Greenhouse Gas
GISEA – Strategic Environmental Assessment Geographic Information System
HSA – Health and Safety Authority
HSE – Health Service Executive
ICZM – Integrated Coastal Zone Management
IFI – Inland Fisheries Ireland
IPCC – Intergovernmental Panel on Climate Change
LA – Local Authority
NBDC – National Biodiversity Data Centre
NCCAF – National Climate Change Adaptation Framework
NPWS – National Parks and Wildlife Service
NRA – National Roads Authority
NTA – National Transport Authority
OPW – Office of Public Works
OREDP – Offshore Renewable Energy Development Plan
PPPS – Plan/Programme/Policy/Strategy
RBMP – River Basin Management Plan
SEA – Strategic Environmental Assessment
SEAI – Sustainable Energy Authority of Ireland
SLR – Sea Level Rise
SuDS – Sustainable Drainage System
WWTS – Waste Water Treatment System

# Glossary

| | |
|---|---|
| **Adaptation** | "Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities." (IPCC, 2007b) |
| **Adaptive capacity** | "The ability of a system to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities, or to cope with the consequences." (IPCC, 2007b) |
| **Adaptive management** | "A systematic process for continually improving management policies and practices by learning from the outcomes of previously employed policies and practices. In active adaptive management, management is treated as a deliberate experiment for purposes of learning." (MEA, 2005) |
| **Climate change** | "Refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural processes or external forcing, or to persistent anthropogenic changes in the composition of the atmosphere or in land-use." (IPCC, 2007b) |
| **Coping capacity** | "… the manner in which people and organisations use existing resources to achieve various beneficial ends during unusual, abnormal, and adverse conditions of a disaster event or process. The strengthening of coping capacities usually builds resilience to withstand the effects of natural and other hazards." (Levina and Tirpak, 2006) |
| **Coping range** | "Is the range of climate where the outcomes are beneficial or negative but tolerable; beyond the coping range, the damages or loss are no longer tolerable and a society (or a system) is said to be vulnerable." (Levina and Tirpak, 2006) |
| **Ecological resilience** | "The level of disturbance that an ecosystem can undergo without crossing a threshold to a situation with different structure or outputs. Resilience depends on ecological dynamics as well as the organizational and institutional capacity to understand, manage, and respond to these dynamics." (MEA, 2005) |
| **Exposure** | "… the presence (location) of people, livelihoods, environmental services and resources, infrastructure, or economic, social, or cultural assets in places that could be adversely affected by physical events and which, thereby, are subject to potential future harm, loss, or damage." (IPCC, 2012) |

| | |
|---|---|
| **Impacts** | "The effects of climate change on natural and human systems. Depending on the consideration of adaptation, one can distinguish between potential impacts and residual impacts: Potential impacts: all impacts that may occur given a projected change in climate, without considering adaptation. Residual impacts: the impacts of climate change that would occur after adaptation." (IPCC, 2007b) |
| **Low Regret Options** | Low-regret adaptation options are those that carry relatively low cost but offer the potential for significant climate resilience enhancement. |
| **Mitigation** | "An anthropogenic intervention to reduce the anthropogenic forcing of the climate system; it includes strategies to reduce greenhouse gas sources and emissions and enhancing greenhouse gas sinks." (IPCC 2007b) |
| **No-Regret Options** | No-regret adaptation options are those that deliver societal benefits regardless of the future climate impact regime encountered. |
| **Resilience** | "Refers to three conditions that enable social or ecological systems to bounce back after a shock. The conditions are: ability to self-organize, ability to buffer disturbance and capacity for learning and adapting." (Tompkins et al., 2005) See also: Ecological resilience |
| **Scenario** | "Scenarios describe possible future developments. They can be used in an exploratory manner or for a scientific assessment in order to understand the functioning of an investigated system." (Metz and Davidson, 2007) |
| **Sensitivity** | "Is the degree to which a system is affected, either adversely or beneficially, by climate related stimuli. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise)." (IPCC, 2007b) |
| **Win Win Options** | Win-win options are those that serve a dual purpose, enhancing resilience to climate change impacts while also providing an alternative societal benefit. |
| **Vulnerability** | "The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity." (IPCC, 2007b) |

# Appendices

# Appendix A – References and Further Reading

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# Appendix B – Additional National Climate Resources: Data and Information

Projections: Projections of climate change in Ireland for 2050 and 2100 utilise outputs from Global Climate Models (GCMs). These are downscaled using both dynamic and statistical approaches. The main contributors to this area are Met Éireann/University College *Dublin, Ireland in a Warmer World: Scientific Predictions of the Irish Climate* (McGrath and Lynch, 2008) (www.c4i.ie), the National University of Ireland Maynooth, Climate Change Indicators for Ireland (Sweeney et al., 2002), *Key Meteorological Indicators of Climate Change in Ireland* (McElwain and Sweeney, 2007).

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Impacts, vulnerability: Information on climate change impacts in Ireland has been summarised in a State of Knowledge Report (Desmond et al., 2009). The information in this report is largely based on work carried out in earlier studies, e.g. *Climate Change Scenarios and Impacts for Ireland* (Sweeney et al, 2003).

*Climate Change: Refining the Impacts for Ireland* (Sweeney et al., 2009). Relevant sectoral studies have been undertaken on the oceans (Marine Institute, 2009), critical infrastructure (IAE, 2009), heritage and tourism (Heritage Council, 2009) and business (Forfás, 2010).

**Ireland's Climate Information Platform (ICIP)**, available as Climate Ireland (www.climateireland.ie), aims to provide the key stakeholders working on climate change adaptation with a one-stop web-based resource of climate and adaptation information that is specifically designed to facilitate climate adaptation planning in Ireland. ICIP aims to create awareness and understanding of climate change, the impacts of these changes and adaptation. ICIP will form a key support to the implementation of the NCCAF.

In Phase 1, the key areas of resource development include: Climate Change Explained; Climate Information Provision, and Decision Support. Phase 2 will see the functionality of the platform enhanced through the provision of greater data analysis and decision support tools that are specifically designed to facilitate decision makers in meeting the requirements of the NCCAF. Phase 2 development has commenced and aims to be available to end users by 2015.

There are also other sector-specific climate change information systems. For example, CLIMADAPT is a web-based decision support system (DSS) based on ecological site classification (ESC) developed specifically for Irish forestry. The system is based on soil and climatic information that can be used to assess species suitability and yield of different species for individual sites under current and future climate change scenarios (Ray et al., 2009). http://www.coford.ie/researchprogramme/thematicareapolicyandpublicgoods/forestsandclimatechange/climadapt/

**EPA Environmental Baseline Data:** Information on the most recent baseline data available is published on the EPA website and can be consulted at the following links http://www.epa.ie/monitoringassessment/. Data sets which may be useful in the preparation of particular SEAs are also available here http://www.epa.ie/pubs/advice/ea/.

# An Ghníomhaireacht um Chaomhnú Comhshaoil

**Is í an Gníomhaireacht um Chaomhnú Comhshaoil (EPA) comhlachta reachtúil a chosnaíonn an comhshaol do mhuintir na tíre go léir. Rialaímid agus déanaimid maoirsiú ar ghníomhaíochtaí a d'fhéadfadh truailliú a chruthú murach sin. Cinntímid go bhfuil eolas cruinn ann ar threochtaí comhshaoil ionas go nglactar aon chéim is gá. Is iad na príomhnithe a bhfuilimid gníomhach leo ná comhshaol na hÉireann a chosaint agus cinntiú go bhfuil forbairt inbhuanaithe.**

**Is comhlacht poiblí neamhspleách í an Ghníomhaireacht um Chaomhnú Comhshaoil (EPA) a bunaíodh i mí Iúil 1993 faoin Acht fán nGníomhaireacht um Chaomhnú Comhshaoil 1992. Ó thaobh an Rialtais, is í an Roinn Comhshaoil, Pobal agus Rialtais Áitiúil.**

## ÁR bhFREAGRACHTAÍ

### CEADÚNÚ

Bíonn ceadúnais á n-eisiúint againn i gcomhair na nithe seo a leanas chun a chinntiú nach mbíonn astuithe uathu ag cur sláinte an phobail ná an comhshaol i mbaol:

- áiseanna dramhaíola (m.sh., líonadh talún, loisceoirí, stáisiúin aistrithe dramhaíola);
- gníomhaíochtaí tionsclaíocha ar scála mór (m.sh., déantúsaíocht cógaisíochta, déantúsaíocht stroighne, stáisiúin chumhachta);
- diantalmhaíocht;
- úsáid faoi shrian agus scaoileadh smachtaithe Orgánach Géinathraithe (GMO);
- mór-áiseanna stórais peitreail;
- scardadh dramhuisce.

### FEIDHMIÚ COMHSHAOIL NÁISIÚNTA

- Stiúradh os cionn 2,000 iniúchadh agus cigireacht de áiseanna a fuair ceadúnas ón nGníomhaireacht gach bliain.
- Maoirsiú freagrachtaí cosanta comhshaoil údarás áitiúla thar sé earnáil – aer, fuaim, dramhaíl, dramhuisce agus caighdeán uisce.
- Obair le húdaráis áitiúla agus leis na Gardaí chun stop a chur le gníomhaíocht mhídhleathach dramhaíola trí comhordú a dhéanamh ar líonra forfheidhmithe náisiúnta, díriú isteach ar chiontóirí, stiúradh fiosrúcháin agus maoirsiú leigheas na bhfadhbanna.
- An dlí a chur orthu siúd a bhriseann dlí comhshaoil agus a dhéanann dochar don chomhshaol mar thoradh ar a ngníomhaíochtaí.

### MONATÓIREACHT, ANAILÍS AGUS TUAIRISCIÚ AR AN GCOMHSHAOL

- Monatóireacht ar chaighdeán aeir agus caighdeáin aibhneacha, locha, uiscí taoide agus uiscí talaimh; leibhéil agus sruth aibhneacha a thomhas.
- Tuairisciú neamhspleách chun cabhrú le rialtais náisiúnta agus áitiúla cinntí a dhéanamh.

### RIALÚ ASTUITHE GÁIS CEAPTHA TEASA NA HÉIREANN

- Cainníochtú astuithe gáis ceaptha teasa na hÉireann i gcomhthéacs ár dtiomantas Kyoto.
- Cur i bhfeidhm na Treorach um Thrádáil Astuithe, a bhfuil baint aige le hos cionn 100 cuideachta atá ina mór-ghineadóirí dé-ocsaíd charbóin in Éirinn.

### TAIGHDE AGUS FORBAIRT COMHSHAOIL

- Taighde ar shaincheisteanna comhshaoil a chomhordú (cosúil le caighdéan aeir agus uisce, athrú aeráide, bithéagsúlacht, teicneolaíochtaí comhshaoil).

### MEASÚNÚ STRAITÉISEACH COMHSHAOIL

- Ag déanamh measúnú ar thionchar phleananna agus chláracha ar chomhshaol na hÉireann (cosúil le pleananna bainistíochta dramhaíola agus forbartha).

### PLEANÁIL, OIDEACHAS AGUS TREOIR CHOMHSHAOIL

- Treoir a thabhairt don phobal agus do thionscal ar cheisteanna comhshaoil éagsúla (m.sh., iarratais ar cheadúnais, seachaint dramhaíola agus rialacháin chomhshaoil).
- Eolas níos fearr ar an gcomhshaol a scaipeadh (trí cláracha teilifíse comhshaoil agus pacáistí acmhainne do bhunscoileanna agus do mheánscoileanna).

### BAINISTÍOCHT DRAMHAÍOLA FHORGHNÍOMHACH

- Cur chun cinn seachaint agus laghdú dramhaíola trí chomhordú An Chláir Náisiúnta um Chosc Dramhaíola, lena n-áirítear cur i bhfeidhm na dTionscnamh Freagrachta Táirgeoirí.
- Cur i bhfeidhm Rialachán ar nós na treoracha maidir le Trealamh Leictreach agus Leictreonach Caite agus le Srianadh Substaintí Guaiseacha agus substaintí a dhéanann ídiú ar an gcrios ózóin.
- Plean Náisiúnta Bainistíochta um Dramhaíl Ghuaiseach a fhorbairt chun dramhaíl ghuaiseach a sheachaint agus a bhainistiú.

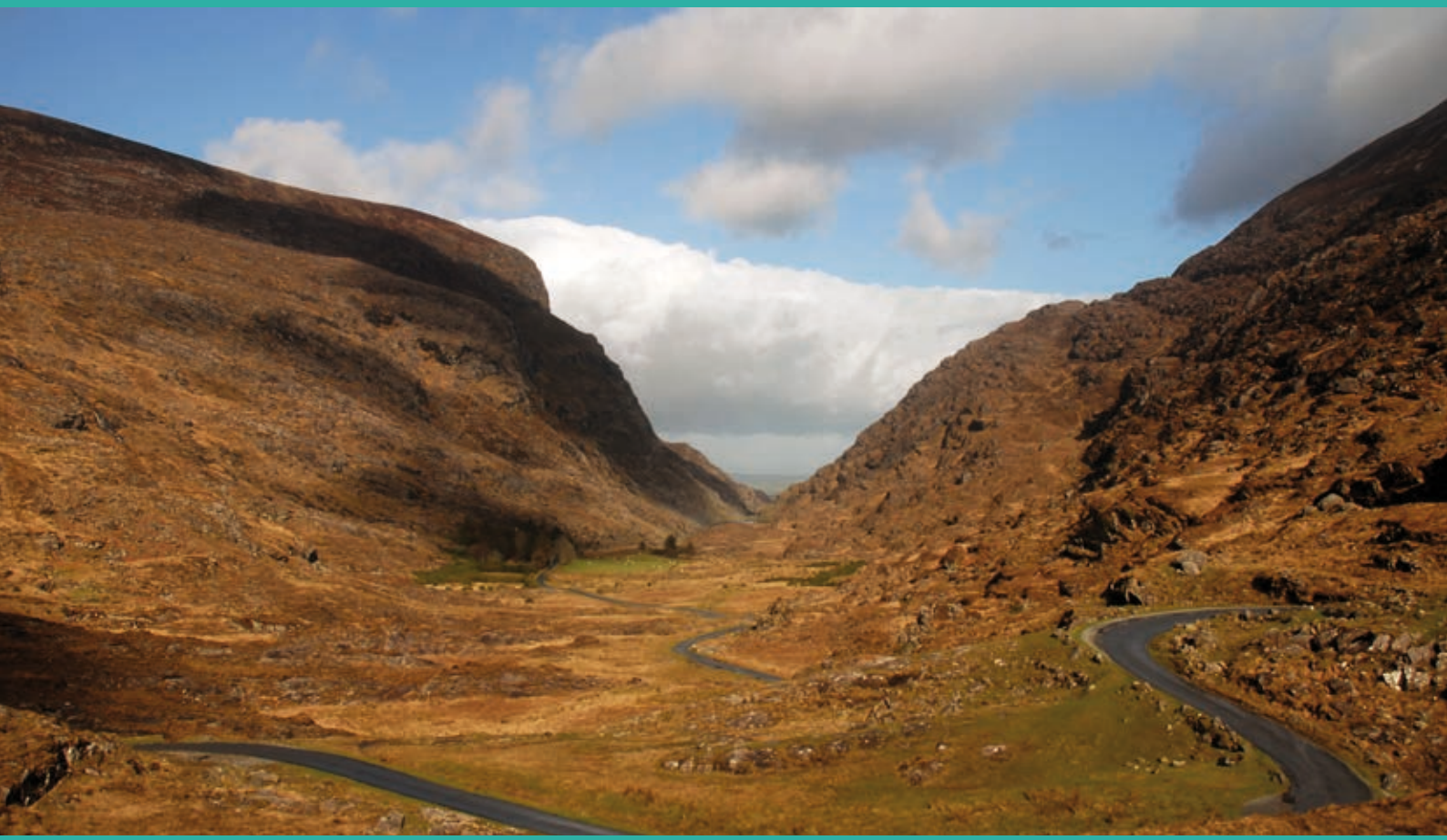
### STRUCHTÚR NA GNÍOMHAIREACHTA

**Bunaíodh an Ghníomhaireacht i 1993 chun comhshaol na hÉireann a chosaint. Tá an eagraíocht á bhainistiú ag Bord lánaimseartha, ar a bhfuil Príomhstiúrthóir agus ceithre Stiúrthóir.**

Tá obair na Gníomhaireachta ar siúl trí ceithre Oifig:

- An Oifig Aeráide, Ceadúnaithe agus Úsáide Acmhainní
- An Oifig um Fhorfheidhmiúchán Comhshaoil
- An Oifig um Measúnacht Comhshaoil
- An Oifig Cumarsáide agus Seirbhísí Corparáide

**Tá Coiste Comhairleach ag an nGníomhaireacht le cabhrú léi. Tá dáréag ball air agus tagann siad le chéile cúpla uair in aghaidh na bliana le plé a dhéanamh ar cheisteanna ar ábhar imní iad agus le comhairle a thabhairt don Bhord.**



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*An Ghníomhaireacht um Chaomhnú Comhshaoil*