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Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

Climate Change Research Programme (CCRP) 2007-2013
Report Series No. 1

A Summary of the State of Knowledge on Climate Change Impacts for Ireland

SSTI
Strategy for Science, Technology and Innovation

Comhshaol, Oidhreacht agus Rialtas Áitiúil
Environment, Heritage and Local Government

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, Heritage and Local Government.

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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.

EPA Climate Change Research Programme 2007-2013

A Summary of the State of Knowledge on Climate Change Impacts for Ireland

(2008-CCRP-2.1A)

CCRP Report

Prepared for the Environmental Protection Agency

by

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DISCLAIMER

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

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Executive Summary

This report presents a summary of the current state of knowledge on climate change and expected impacts for Ireland. It will be of use to policy-makers and stakeholders interested in or working on adaptation to climate change. The information is largely based on work carried out by Met Éireann, the National University of Ireland Maynooth and material from the Intergovernmental Panel on Climate Change Fourth Assessment Report. An expert workshop on climate change hosted by Met Éireann (12 November 2008) contributed to this material. Sectoral experts have also reviewed the source material used.

Signals of climate change impacts are evident in Ireland. These are in line with changes that are occurring at regional and global levels. They are expected to continue to increase in the coming decades and up to at least the end of this century. These include changes to key meteorological parameters such as average temperature, rainfall intensity and patterns, as well as ecosystem changes. The report provides information on observed and projected changes in the atmospheric, terrestrial, hydrological and ocean domains. Headline impacts are outlined for a number of sectors with indicative uncertainty levels.

Addressing uncertainties is a key challenge for actions on adaptation. These uncertainties remain in relation to both the rate and extent of climate change impacts that Ireland will experience. Some of these are due to scientific uncertainties, inherent variability and the chaotic nature of some of the phenomena being considered, e.g. rainfall. Uncertainty also currently exists in the ambition and effectiveness of future international actions to address climate change. This will eventually determine the full extent of climate change and the level of adaptation that will be required.

The report provides outline recommendations for further steps based on an adaptation framework in four areas:

- advancing the knowledge base and capacity building;
- integration of climate change impacts and adaptation into key policy areas;
- continued engagement with international processes;
- assessment of costs and benefits of adaptation options.

1. Introduction

Changes in Ireland's climate during the last century are in line with global and regional trends associated with human-induced climate change. These changes are projected to continue and increase over the coming decades and up to the end of this century. Adaptation actions will be required in order to avoid the adverse impacts of these changes.

This report presents a summary of the current state of knowledge on climate change and expected impacts for Ireland. It will be of use to policy-makers and stakeholders interested in or working on adaptation to climate change. The information is largely based on work carried out by Met Éireann, the National University of Ireland Maynooth and material from the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4). An expert workshop on climate change hosted by Met Éireann (12 November 2008) contributed to this material. Sectoral experts have also reviewed the source material in this report.

The report focuses on key information on the atmospheric, terrestrial, hydrological and ocean domains. Headline impacts are outlined for a number of sectors, including water resources, biodiversity, coastal and marine, agriculture, natural resources (peat, forestry, soil carbon), industry, energy, transport and communication, settlement and society, human health, tourism, and insurance.

In recent years significant progress has been made in improving climate models at the global level. This progress is outlined in AR4. However, uncertainties remain. These uncertainties increase at regional and local levels where geographical or local factors can dominate climate conditions. The IPCC has developed methods to assess and convey such uncertainties, e.g. through confidence levels. The robustness of trends and projections in the main climate variables are expressed here in confidence levels, which are in line with the definitions set out in the AR4.

The implications of uncertainties and how they can be managed in implementation of actions on adaptation is beyond the scope of this report. They can be explored through a stakeholder engagement process facilitated by this report and open access to the source material. Some issues such as the rate at which future climate change will occur and the extent of such impacts are also subject to processes outside the scientific domain. These issues are being considered under the United Nations Convention on Climate Change (UNFCCC) processes in order to determine the levels of actions required to address climate change.

The information presented here can provide a basis for progressing actions on climate proofing, planning, investment and policies. The source material summarised here, can be accessed via http://erc.epa.ie/safer. This database will be further developed as new information becomes available, e.g. it is anticipated that new analysis of extreme events will be available in 2009.

1.1 Analyses of Climate Change in Ireland

Met Éireann hold an important archive of meteorological data for Ireland. Some records are more than 100 years duration. These data are subject to ongoing development and analyses and are reported to international databases. Sweeney et al. (2002), and McElwain and Sweeney (2007) have provided analyses of these records in line with the international standards, i.e. the data are referenced to the standard 30-year average.

The published analysis shows that Ireland's climate has changed over the period covered by the instrumental record and that this change is in line with global and regional trends. These data are used here as a basis for the information on observed trends.

Ireland also has important long-term records of flora and fauna. These are reported to international databases, e.g. the European Phenology Network. Analyses of flora and fauna show that natural systems in Ireland are reacting to climate change. These patterns of change are similar to those that are occurring at regional and global levels as reported by the AR4.

Global climate models (GCMs) provide projections of future climate conditions based on different atmospheric greenhouse gas levels or, more broadly, different levels of radiative forcing[1] of the climate system. The AR4 provided the most recent systematic analysis of outputs from a range of global climate models using greenhouse gas (GHG) emission scenarios contained in the IPCC's Special Report on Emissions Scenarios (SRES). This shows that climate changes will continue to develop over the coming decades with increased levels of impacts. This was also the case for a reference case in which GHG levels were stabilised at 2000 levels.

Projections of climate change in Ireland for 2050 and 2100 utilise outputs from the GCMs. These are downscaled, using both dynamic and statistical downscaling approaches in order to provide high-resolution analyses required at local levels. The information on climate projections presented here is based on work carried out by Met Éireann and the National University of Ireland Maynooth. A number of other groups are also engaged in climate analysis and have contributed to this report via an expert workshop hosted by Met Éireann, cf. Appendix 1.

Considerable uncertainties remain in relation to future climate conditions and the rate of climate change. The development of actions on adaptation requires appropriate approaches such as risk management to address these uncertainties. These approaches may vary according to the impacts, vulnerabilities and adaptation actions required, and will be considered in the follow-up processes.

Paleoclimate analysis and other archives provide information on climate conditions in Ireland over periods outside the historical records. These data provide important information on climate variability and the stability of key factors that determine Ireland's climate, such as the Meridional Overturning Circulation (MOC) or Thermohaline Circulation (THC), locally known as the Gulf Stream. While studies are progressing in this area the data sets are not used in this report.

[1] Radiative forcing refers to a sum of different factors which act to warm and cool the planet, i.e. greenhouse gases and aerosols beyond the natural balance that existed before the Industrial Revolution.

2. Current Knowledge on Climate Change

This section summarises the state of knowledge on climate change across key domains of atmosphere, terrestrial and hydrology, and oceans. The material is based on published reports and expert input.

2.1 Atmosphere

Air temperature: The standard measurement of temperature in the atmosphere is taken at synoptic and climatic stations across Ireland. The analysis is based on up to 100 years of records (and over 100 years for certain stations).

Precipitation: In the Irish context precipitation refers almost exclusively to rainfall although snow and hail are included in the definition. Precipitation is measured at synoptic and climatic stations across Ireland. However, the localised nature and temporal variability of precipitation make it less amenable to statistical analyses.

Extreme weather: This refers to extremes in surface-wind speed as indicative of intensity of Atlantic storms and thunderstorms.

Large-scale circulation: This refers to patterns of weather and ocean currents, which occur on spatial scales of the order of 1,000s of kilometres. An important example of one of these ocean currents is the THC, which in the North Atlantic manifests as the so-called Gulf Stream.

Table 2.1. Observed and projected changes for temperature variables.

Climate Variable	Observed Changes	Scientific Confidence	Projected Changes	Confidence Projection
Air temperature	Temperatures increased by 0.7°C since 1890, i.e. an average of 0.06°C per decade. The increase was 0.4°C during the period 1980–2008, i.e. equivalent to 0.14°C per decade.	High	1–3°C to 2100, compared to the 1961–2000 average.	Medium (depends on scenario), medium for extremes
	All seasons are warmer but more so in winter.	High	Continued night-time heating.	Medium
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

2.2 Terrestrial and Hydrology

Soil temperature: This is measured throughout Ireland by Met Éireann, Teagasc and other bodies. In general, measurements are made in the surface layers of the soil most pertinent to microbial activity, and plant growth and development.

Ground- and surface-water runoff and freshwater temperatures: Information regarding surface and groundwater is based on the National Water Quality Monitoring Network, which comprises the EPA, the Office of Public Works (OPW) and local authority facilities.

Phenology is the study of the timing of recurring natural events (both terrestrial and marine) and includes leaf unfolding, bird migration and the occurrence of algal blooms. Many natural events of this kind are strongly influenced by weather and, hence, climate.

Table 2.2. Observed and projected changes for precipitation variables.

Climate Variable	Observed Changes	Scientific Confidence	Projected Changes	Confidence Projection
Precipitation	There has been a significant increase in total rainfall in the north and west; many stations also show increases in March and October.	Medium (low confidence for local detail and very low confidence for extremes)	Wetter winters in the west, Drier summers in the south-east.	Medium
	Less snow days	High	Less snow throughout.	Medium/High
	Drier summers	Medium (2007 and 2008 were anomalous but did not reverse trend)	Drier summers: 5-25% less rainfall in 2021 to 2060 compared to 1961 to 2000.	Low

Table 2.3. Observed and projected changes for synoptic variables.

Climate Variable	Observed Changes	Scientific Confidence	Projected Changes	Scientific Confidence Projection
Extreme weather	There has been an observed decrease in the frequency of storms; however, the intensity of storms has increased. At present this finding is not statistically significant.	Medium (less for extremes); spatial detail lacking – need high resolution	Slightly fewer storms, but more intense. Northward shift in storm tracks.	Medium
Large-scale circulation	**Atmospheric**: No discernible change in large-scale circulation patterns affecting Ireland. **Ocean**: No coherent trends observed, significant inter-annual variability impacts on large scale hydrographic conditions and climate.	Medium	**Atmospheric**: Greater frequency of blocking high-pressure systems; increase risk of prolonged heat wave events. **Ocean**: THC may slow during 21st century.	Low/Medium

Table 2.4. Observed and projected changes for soil temperature.

Climate Variable	Observed Changes	Scientific Confidence	Projected Changes	Scientific Confidence Projection
Soil temperature	The changes are consistent with the observed changes in air temperature.	Medium	Consistent with air temperature: warmer in south-east.	Medium

2.3 Oceans and Seas

Sea temperatures: Globally, ocean temperatures are increasing and thermal expansion of water is currently the main driver of the observed sea-level rise. Observations of ocean temperatures are largely based on surface measurements such as satellite observation, and observations from research vessels and ships of opportunity.

Sea chemistry (pH and salinity): Globally, evidence is emerging that sea chemistry is changing in response to higher concentrations of CO_2 in the atmosphere and climate change. Marine biological systems have been shown to be very sensitive to changes in water chemistry. In Ireland significant work has been done on the impacts of changes in chemistry on natural systems and growth. As far as we are aware, no systematic measurements have been made of pH in Ireland.

Sea-level rise (SLR): Measurements in Ireland are based on analysis of sea gauges. Isostatic uplift, i.e. geological rebound following de-glaciation after the

Table 2.5. Observed and projected changes for hydrological variables.

Climate Variable	Observed Changes	Scientific Confidence	Projected Changes	Scientific Confidence Projection
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 air and soil temperatures.	Low/Medium	Consistent with air and soil temperatures.	Low/Medium

Table 2.6. Observed and projected changes for phenology.

Climate Variable	Observed Changes	Scientific Confidence	Projected Changes	Scientific Confidence Projection
Phenology	**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

last ice age distorts the signal, but has been accounted for in the analysis of SLR around Ireland.

Waves and surges: Ocean waves are driven by local winds: surges are the apparent rise in sea level due to distant storms at sea. Waves and surges impact on a wide variety of human activities, including coastal infrastructure, shipping, settlement, coastal erosion, etc.

2.4 Cross-cutting Areas

Flooding: The pattern of human settlement in Ireland has concentrated urban development along the rivers and coasts. Many areas of importance are already vulnerable to flooding. Climate-change projections indicate increased risk of flooding. Many climate variables such as precipitation and storms, and other

Table 2.7. Observed and projected changes for sea temperatures.

Climate Variable	Observed Changes	Scientific Confidence	Projected Changes	Scientific Confidence Projection
Sea temperature	Increases in Irish coastal water temperatures since the 1980s. There has been an observed 0.85°C rise in Irish coastal sea since 1950. 2007 was warmest year in Irish coastal record.	High	Increased intensity of storms: ongoing increase in mean sea temperature.	Medium

Table 2.8. Observed and projected changes for sea chemistry.

Climate Variable	Observed Changes	Scientific Confidence	Projected Changes	Scientific Confidence Projection
Sea chemistry (pH and salinity)	Increased seawater acidity observed; salinity changes vary with region. Atlantic waters freshened from 1960–1990 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	With increasing CO_2 in the atmosphere. the acidity is projected to increase; salinity changes vary with region. Changes in rainfall will affect coastal salinities, implications for coastal dynamics, water column stability, water quality, etc.	High for acidity, low for salinity

Table 2.9. Observed and projected changes for sea level rise.

Climate Variable	Observed Changes	Scientific Confidence	Projected Changes	Scientific Confidence Projection
Sea-level rise (SLR) < 1 m	During the satellite era, SLR of 3.5 cm per decade has been observed.	Low to medium	Rise of 60 cm to 2100. Changes in sea level predicted to magnify impacts of changing storm surge and wave patterns in coastal areas.	Medium
SLR > 1 m			There is concern about SLR greater than 1 meter if there is a considerable melting of land ice (polar shelves and glaciers). In this case, SLR becomes a cause of concern in its own right.	Low to medium
Waves and surges	Some evidence of significant increase in wave heights during winter months, up to 30 cm. Also an increase in the frequency of extreme wave heights in the north-west.	Medium	Higher waves, more intense surges.	Medium

parameters such as urban fabric and land use increase this risk.

Soil: The condition and ecosystem function of soils is influenced by a wide variety of parameters including climate, land use and land management. Analysis of this cross-cutting issue requires development.

Table 2.10. Observed and projected changes for cross cutting variables.

Climate Variable	Observed Changes	Projected Changes
River flooding	Linked to precipitation patterns	Increase risk of river flooding.
Coastal flooding	Links to storm patterns and sea-level rise	Increase risk of coastal flooding due to surge/storm.
Inundation of poorly drained land	Linked to precipitation patterns	Increased duration of standing water on poorly drained lands in winter. Greater drying of turlough and rain-fed lakes in summer.

3. Sectoral Impacts: Current State of Knowledge

The sectors identified for this report are: agriculture, biodiversity, forest and peatlands; water resources and coastal and marine; settlement and society, human health and tourism; transport and communications, energy, industry and insurance. We have attempted to group together those sectors sharing a high degree of commonality in terms of the climate variables that have the greatest impact for them. Where there is no information available we have left the cells blank.

3.1 Agriculture, Biodiversity, Forest and Peatlands

These sectors have been grouped together because of their biological basis.

Agriculture: This is largely a managed system. The main impacts are due to changes in air and soil temperature, extreme events and water availability. These impact on soil condition, pests and pathogens, plant growth, animal welfare, invasive species, infrastructure and access to the land.

Biodiversity: This is a measure of the ecological health of natural systems. It represents the degree of genetic variety and the degree of resilience of the system. The main climatic drivers for change are precipitation, temperature and extreme weather, which impact on soil condition, plant growth and animal welfare.

Forests and peatlands: These are managed and natural systems and the main concern is with precipitation, air temperature and extreme weather, which impact on soil conditions, plant growth and animal welfare.

3.2 Surface Water, Coastal & Marine Resources

These sectors have been grouped together because of their hydrological basis and their interface at the coastal zone.

Water resources: the majority of the population in Ireland derives its water from surface water sources such as rivers and lakes. Changing patterns of precipitation will clearly impact on service provision. There is also a threat from pollution and contamination

Coastal and marine resources: Sea-level rise is a major issue for coastal zones, including urban, agricultural and natural systems. However, more dramatic impacts will be felt due to increased storm intensity and surge.

3.3 Settlement and Society, Human Health and Tourism

These sectors have been grouped together because of their implications for day-to-day human activity.

Settlement and society: This sector covers the whole range of human activity; planning and development, residential energy use, and infrastructure. The analysis in this sector is preliminary.

Human health: This sector discusses the infrastructural requirements related to climate change impacts on well-being, human mortality, disease control and accident and emergency response. The analysis in this sector is preliminary.

Tourism: This is a major sector in the Irish economy. The analysis in this sector is preliminary but a more comprehensive report is imminent.

3.4 Transport and Communication, Energy, Industry and Insurance

These sectors have been grouped together because of their implications for economic activities.

Transport and communications: In this sector the main concerns will derive from the structural stresses placed on the infrastructural networks such as roads, electricity, and telecommunications. These are largely

Table 3.1. Sectoral impacts for agriculture, biodiversity and forests and peatlands.

Climate Variable	Agricultural	Biodiversity	Forests and Peatlands
Air temperature	Warmer temperatures will impact on pest survival and arrival of new pests. Improved conditions for plant growth; may increase yields, especially in spring and autumn. However autumn droughts may reduce this potential. Potential benefits for animal husbandry related to shorter housing periods in some areas.	Phenological studies across Europe sugg areas est both animals and plants respond to temperature changes in a variety of ways; but this is species dependent and thus complex. Interrelationships may be disrupted causing stresses to viability. Opportunities for invasive species may increase.	**Peatlands**: increased evaporation and transpiration during summer is likely to increase CO_2 emissions. The growing season is likely to be extended. **Forestry**: increased growth but also increased threat of pests pathogens, timber quality impacted due to rapid growth. **Soil-carbon** potential for sequestration might be decreased due to changes in the balance between anaerobic to aerobic activity. **Cross-cutting issue:** Increases in dissolved organic carbon in run off in peatland is a projected impact of drier, warmer conditions.
Heat waves	Plants and animal systems may be stressed in heat waves, e.g. lower productivity in crop yields and milk production. More research is needed in this area.	Many ecological systems may suffer increased stresses.	All natural resources are vulnerable. **Peatlands** may be vulnerable to mass “die-off” of spagnum, irreversible in the short term.
Cold snaps/ frost days/ nights	Less frost damage to spring crops. Kill off of pests and pathogens will be reduced. Potential improved conditions for horticulture crops. Less cold stress to animals.	Significant impacts on plant phenology. There is evidence of mismatches or asynchrony between plants, birds and insects.	**Forestry**: certain species need frost (integral part of growth cycle). Die off of tree pests will be reduced.
Precipitation	**Wetter winters**: machinery mobility on fields may be adversely affected. Timing of planting impacted. Timing of manure and fertiliser spreading impacted. Higher risk of soil poaching.		**Peatlands**: higher mobility of peat material may increase the risk of bogburst in particular, but landslides in general. Higher precipitation may lead to further damage of eroded areas, thus more peat is lost. Higher precipitation may maintain water table.
	Drier summers may give rise to a variety of responses such as the need to irrigate certain high-value crops.	Probable impacts across wide range of animal and plant species and ecosystems, e.g invasive species (heat and rain will drive this).	**Peatlands** are vulnerable. Damaged peatlands are particularly at risk as the water table is subject to more extreme fluctuation weakens the whole bog considerably. Extreme hydrological can cause severe erosion. **Forestry**: present species mix is vulnerable.
Extreme weather	Enhanced soil erosion in hill and mountain areas and areas of high vulnerability due to disturbance.	Potential arrival of exotic species. Destruction of fragile ecosystems. Coastal ecosystems could be more vulnerable. Storms can cause damage to community structures.	**Forestry**: increased windfall; increased impact of sea spray and salt deposition. Impacting on plant development in coastal areas, and potentially leading to a regional impact on soil and surface water pH (depends on local soil and geology).

Table 3.1. Sectoral impacts for agriculture, biodiversity and forests and peatlands (*continued*).

Climate Variable	Agricultural	Biodiversity	Forests and Peatlands
Soil temperature	Plant responses to warmer temperatures vary according to species.	Increased pathogens and pests.	**Peatlands**: growing seasons will be longer, increase in CH_4 emissions. However the main driver of CH_4 emissions is the water table.
Ground- and surface-water runoff	Increased drainage during high-precipitation events, and possible irrigation during growing season for high-value crops. Nutrient leaching, poaching of ground, pollution, soil erosion. Reduced trafficability in winter and spring.	Varied responses from different species and ecosystems. Large impacts on seasonally flooded ecosystems such as turloughs. Opportunities for invasive species. Changes in flow rates will negatively impact on specific flora and fauna and increase eutrophication.	Greater variability in the water table will increase the vulnerability of **peatlands** to erosion and degradation. Increase in water colour (DOC) due to increase mobility of **soil carbon** (especially peatland catchments).
Surface freshwater temperatures	Where linked to soil temperature change there may be impacts for plants and micro-organisms, e.g. the frequency of blight conditions may change.	Opportunities for invasive species. Vulnerability of native species, e.g. Arctic char, smelt and salmon, and Atlantic salmon. **Cross cutting**: changes to migration patterns and survival of salmonids.	**Peatlands**: microbial processes accelerate under higher temperatures, lead to increased decay through CO_2 and CH_4 release, might also impact on micro fauna profile.
Phenology	Many and varied such as longer growing seasons.	Many and varied impacts, in both terrestrial and marine flora and fauna. Disruption of food web and stress on breeding cycles.	**Peatlands**: consistent with other natural ecosystems. **Forestry**: increased growth impacting on quality of timber.
Sea temperatures	None	Variety of species in Irish waters will change. There is the potential for exotic “captive” species (aquaculture) to establish as invasive. Seabird changes in range and migration patterns and prey availability.	None
Sea chemistry (pH, salinity)	None	Micro fauna are very sensitive to pH; high pH impacts severely on organism growth (especially corals, molluscs and crustacean); widespread implication on food web, which will impact on prey species	None
Sea-level rise	Some loss of coastal farm lands. River basin impact with potential loss of some agricultural land.	Loss of coastal habitats and ecosystems.	Loss of natural resources in vulnerable areas, cf. Coastal and Marine sector.

Table 3.2. Surface Water, Coastal & Marine Resources.

Climate Variable	Water Resources	Coastal and Marine
Increased air temperature; heatwaves	Enhanced evaporation from water bodies. Significantly enhanced evaporation.	Human impacts on coastal facilities (beaches, marine recreation etc). Stresses to aquaculture due to extreme water temperatures.
Cold snaps/frost days/nights	Less frost/ice damage to water infrastructure.	None
Precipitation	**Wetter winters**: increased risk of flooding in river systems; replenishing groundwater. Risk of contamination and pollution of water supplies.	Local flooding in estuarine regions in combination with high tides and surge events. Coastal ecosystems might be impacted by increased sediment, colour, nutrients and freshwater (lower salinity).
	Drier summers: water resources are vulnerable especially in the east and south-east.	None
Extreme weather	Increased coastal erosion, dune erosion and movement, abrasive erosion of soft cliffs.	
Soil temperature	Increased evaporation from soil: increased microbial activity.	
Ground- and surface-water runoff	Water shortages in the summer leading to greater pressure on groundwater sources. Winter recharge possible for ground water. Increased pressure on water purification during extremes and increase in water colour (DOC).	More silting of estuaries, eutrophication increased flooding.
Surface freshwater temperatures	Microbial activity increase. Perceived need for cooling of drinking water.	May impact on thermal profile in estuarine areas. Impact on freshwater aquaculture and species selection; non-native species become viable and potential impact on wild species.
Phenology	None	Change in biodiversity of zooplankton. Increased occurrence of invasive species. Zooplankton: a northward shift in the spatial distribution of zooplankton (i.e. fish food). Phenological change with some species occurring earlier in the season.
Sea temperatures	None	Fish in general are very sensitive to variations in seawater temperatures and respond by migrating. Impacts might also include coral bleaching with attendant consequences for marine habitats, species and the food web. However, Irish deep-sea corals are less vulnerable.
Sea chemistry (pH, salinity)	See point in industry. The uptake of atmospheric CO_2 to the ocean may be adversely impacted. Corals may also be impacted depending on depth to which sea chemistry is modified.	
Tidal currents	No impacts expected. However, there is a coupling to sea-level rise. Impacts of sea-level rise may be local.	

Table 3.2. Surface Water, Coastal & Marine Resources (*continued*).

Climate Variable	Water Resources	Coastal and Marine
Waves and surges	Possible saline intrusion.	Coastal flood plains at risk where high tides and storm surge couple with periods of intense rainfall. Increased coastal erosion. Impact on fisheries and aquaculture in exposed areas.
Sea-level rise < 1 m	Some threat of salination to water table and aquifers.	Coastal wetlands and estuaries at risk from salt water intrusion. Possible increases in rates of erosion due to currents and sedimentation.
Sea-level rise > 1 m	Much increased threat of salination of water table and aquifers.	Changes in sea level predicted to worsen impacts of changing storm surge and wave patterns in coast areas.

engineering concerns. There is no available analysis in this sector.

Energy: The generation and demand for energy, including seasonal changes in energy demand as well as changing generation potential. There is no available analysis in this sector.

Industry resources: The analysis of the impacts of climate change on industrial resources is preliminary. Based on current knowledge extreme weather events and water availability are thought to be the most significant parameters.

Insurance: The market has monetised the impacts of weather (and especially extreme events) through its premiums. These will change with changing climate. There is no available analysis in this sector.

Table 3.3. Sectoral impacts for settlement and society, human health and tourism.

Climate Variable	Settlement Society	Human Health	Tourism
Air temperature	Reduced space heating requirements but with possible need for increased air conditioning.	Increased temperatures will increase potential for diseases. E.g. growth of pathogens in food. Increased sense of well being although confounded by rainfall predictions.	Temperature increases in Ireland are less than those for the rest of Europe; Ireland may become a holiday destination for respite.
Heatwaves	Impacts: heating of urban areas intensified by heat island effects.	Heat stress, particularly amongst the vulnerable. Increased mortality in vulnerable groups.	Outdoor activities will put additional stresses on resources, e.g. water, sewerage, etc. Increased pressure on coastal and amenity areas.
Cold snaps/frost days/nights	Reduce heating needs in winter, less frost damage to water/commercial systems.	Impacts are positive; reduced risk of hypothermia and mortality amongst vulnerable population. Less minor accidents.	Extension of tourism 'shoulder' periods.
Precipitation	**Wetter winters**: increased risk of flooding; problematic on flood plains. Increased energy usage costs due to drying. Higher standards for damp proofing of buildings.	Negative impacts on well being.	Greater demands for winter season breaks abroad.
	Drier summers: domestic water shortages, reduced supply to industry, restricted extraction from river systems.	Positive: well being should improve.	Positive impacts on domestic tourism.

(*Continued*)

Table 3.3. Sectoral impacts for settlement and society, human health and tourism (*continued*).

Climate Variable	Settlement Society	Human Health	Tourism
Extreme weather	Increased risk of structural and infrastructural damage. Loss of property.	Risk of injury and loss of life.	Loss of amenities for boating, fishing, etc.
Soil temperature	A greater variety of plant species may become viable in gardens. Greater threat of introduction of aggressive invasive species.	Pests and pathogens: increased winter survival.	
Ground- and surface-water runoff	Planning and development impacts on settlement and infrastructure.	Increased in pathogens in drinking water.	
Surface freshwater temperatures	Positive impacts on human well being.	Risk of loss of life in water accidents.	More recreational activities in freshwater increased water-based activities; pressure on coastal tourism infrastructure.
Sea temperatures	None	Increased well being; greater opportunities for sea bathing.	
Sea chemistry (pH, salinity)	Greater demand for sea-front development.	None	Potential impacts for diving, loss of biodiversity.
Waves and surges	Waves and surges may inundate coastal settlements and infrastructure.	Injury and loss of life.	Increased potential for extreme surfing (niche markets).
Sea-level rise < 1 m	Loss of land as a consequence of inundation and increased erosion, and increased risk of flooding both at the coast and inland along major river networks during major storm surge events.	None	Moderate degradation of coastal amenities, especially sandy beaches.
Sea-level rise > 1 m	Loss of land as a consequence of inundation and increased erosion; increased risk of flooding both at the coast and inland along major river networks.		Severe degradation of coastal resources, especially sandy beaches.

Table 3.4. Sectoral impacts for transport and communications, energy, industry and insurance.

Climate Variable	Transport Communication	Energy	Industry	Insurance
Air temperature	Thermal expansion on public rail transport should not be a major issue for 3°C increase in mean temperature.	Seasonal heating demand change. Possible increase in summer electricity demand for air conditioning.	Less space heating required during winter, but may be a need for additional cooling during food production and transport in summer.	None
Heatwaves	Heat stress on public transport has proven to be an issue in many cities.	Increased solar power generation potential coinciding with lower wind generation potential.	Air condition and space cooling will be issues. Damage to plants and materials possible.	Health-insurance costs, damage to perishable goods.
Cold snaps/ frost days/ nights	Positive effects for transport: less disruption. However, reduced awareness of safe practices.	Less heating demand in winter.	None	Less incidences of minor accidents may impact positively on personal, motor and household insurances.
Precipitation	**Wetter winters**: impact on transport infrastructure, especially from flooding. Dangerous road conditions, etc. Comfort on public transport may be an issue.	Reduced potential for solar. Biomass – depends on species response to high water availability in winter.	Increased need for drying of raw materials.	Water and flood damage impacts on insurance costs.
	Less snow: positive effects for transport; less disruption. However, reduced awareness of safe practices.		Positive: less work days lost due to snow.	See comments related to frost.
	Drier summers	Water cooling of power stations will be impacted.	Industries with great water demand will be impacted.	None
Extreme weather	Increased risk of storm damage to telecommunication systems. Fallen trees blocking transport routes.	Impacts on wind and wave.	Increased risk of storm damage to larger industrial infrastructure and mobile machinery.	Higher insurance costs.
Soil temperature	Effects on transport infrastructure, increased depreciation of assets.	Increased potential for geothermal/heat-exchange systems.		Higher health insurance costs.
Ground- and surface-water runoff	Increased risk of flooding.	Micro generation of hydroelectric power may be unviable. Management impact on large-scale hydroelectric generation may be impacted.	Water intensive industries will be impacted, including both water extraction and permissible discharge to water systems.	Flood insurance.

(*Continued*)

Table 3.4. Sectoral impacts for transport and communications, energy, industry and insurance (*continued*).

Climate Variable	Transport Communication	Energy	Industry	Insurance
Surface freshwater temperatures		Micro generation for heating from rivers (heat-pump systems) would increase.	Costs to industry when water is used as coolant.	None
Phenology	None	Impacts on bioenergy crops.	None	None
Sea temperatures		Large-scale heat exchange from the marine environment has not been mooted as a mitigation option.	Viability of fisheries: mariculture and marine industries may be impacted.	None
Sea chemistry (pH, salinity)	None	None	Possible greater corrosion to marine infrastructure.	None
Waves and surges	Shipping transport: negative impacts.	Potential for greater damage to wave and tidal systems in extreme events.	Marine and fisheries industries and associated infrastructures.	High risks in coastal zones; higher insurance premiums.
Sea-level rise < 1 m	Infrastructure in coastal areas threatened.		Exposure of industrial infrastructural assets.	
Sea-level rise > 1 m	Infrastructure in coastal areas severely threatened and losses in the south-east, e.g. rail network could be vulnerable.		All activities threatened close to the coastline.	Significant withdrawn of insurance cover from vulnerable areas.

4. Recommendations

This report provides an overview of climate change impacts. Adaptation actions will be required to avoid the adverse impacts of these changes and take advantage of any positive changes. In order to facilitate this process, an adaptation framework is needed. This would aim to advance work within and across sectors at a number of levels, from communication of scientific knowledge to implementation of actions. This adaptation framework would enable synergies between groups and avoid duplication of efforts. The framework would encompass:

- Advancing the knowledge base and capacity building.
- Integration of climate change impacts and adaptation into key policy areas.
- Engagement with international processes.
- Analysis of costs and benefits.

4.1 Advancing the Knowledge Base and Capacity Building

Development of the scientific knowledge base on climate change is ongoing at national and international levels. This ranges from research in fundamental sciences to socio-economic analysis of impacts. Key elements of this process for Ireland include:

- Development of observations systems of essential climate variables and analysis of trends and changes, e.g. Dwyer (forthcoming).
- Improvement of climate projections and near-time climate forecasting, e.g. periods from years to decades as well as mid and end of century information.
- Support for development of analysis of systems fundamental processes, which drive the rate and extent of climate change, e.g., oceans systems and precipitation.

Future Requirements

Improved structures and processes are required to build capacity and advance information exchanges, especially with practitioners and sectoral experts. This would improve targeting of analyses and identification of gaps in knowledge and would enable sectoral experts to influence and better utilise the mainstream scientific activities. Aims would include:

- Improved understanding of impacts.
- Analysis of current and emerging vulnerabilities and the identification of key areas for adaptation actions.
- Development of vulnerability and process indicators to track progress on implementation of adaptation actions.
- Improved understanding of resilience and adaptive capacity.
- Development of a shared information platform for the research community, practitioners and policy makers. This will be based on the EPA Environmental Research Centre (ERC) Secure Archive for Environmental Research Data (SAFER) system[2]
- Building capacity among the planning and policy-making community, through provision of outreach material and guidance tools.

4.2 Policy Integration

It is already being addressed in a number of policy areas, e.g. the Water Framework Directive (WFD), the Floods Directive, and through tools such as the Environmental Impact Assessment (EIA) and the Strategic Environmental Assessment Directives (SEA).

[2] http://erc.epa.ie/safer/

Future Requirements

There is a need to insure that climate change issues are being included in all relevant policy areas. This should insure that climate change integration is being implemented in an effective manner and at a level commensurate with the associated risks, in the context of uncertainties about the possible impacts over relevant timescales. This is likely to be an iterative process and will require appropriate indicators, benchmarks and review processes linked to emerging science, e.g. the production of relevant IPCC reports.

Aims would include:

- Assessment of policy frameworks such as water, flooding, agriculture and energy, to establish where barriers and opportunities exist to integration.
- Evaluation of existing instruments such as SEA and EIA for climate-change adaptation and provide guidance for integration.
- Assessment of the governance structures to ensure that adaptation policy and options are appropriate to the levels of institution responsibilities.
- Identification of investment opportunities for adaptation actions.

4.3 Engagement with International Processes

The global nature of climate change means than engagement with international processes is important for the advancement of the above elements. On a scientific level, links with global and regional activities are essential to insure that work in Ireland is informed by and uses the best international analysis.

Future Requirements

Adaptation policy actions are being identified and implemented at EU level and wider international levels, including actions under the UNFCCC. Developments in Ireland should take account of these processes and utilise international approaches that are appropriate for Ireland. This will also serve to inform benchmarking with international practices and will provide opportunities for shared information and experiences.

Aims would include:

- Continued interaction at the level of the UN and EU policy-making processes.
- Participation in international research networks such as the Climate Impact Research Coordination for a Larger Europe (CIRCLE), and utilisation of research findings.
- Development of shared information systems, platforms and tools.

4.4 Analysis of Costs and Benefits

Analysis of costs and befits needs to be an integral part of decision making on adaptation options. This needs to take account of the time horizon for actions and impacts and should included analysis of costs of inaction and remediation actions associated with options. These analyses need to be updated as part of ongoing assessment and decision making on adaptation actions.

Future Requirements

The analysis of costs and benefits needs to be updated as part of ongoing assessment and decision making on adaptation actions.

Aims would include:

- Use of appropriate costing techniques.
- Identification of suitable sources of capital and financial support.

5. Conclusions

This report provides a summary of the current state of knowledge of the impacts of climate change in Ireland across a number of key sectors. It represents the distillation of a large body of work, largely carried out through research activities since 2000. It will be further developed and updated periodically as new information becomes available.

Considerable uncertainties remain in relation to both the rate and extent of climate change impacts that Ireland will experience. These will eventually determine the extent of damages that will occur and/or the level of adaptation that is required to avoid the worst impacts.

Rather than being a barrier to actions, these uncertainties should promote consideration of possible risks and the use of appropriate management tools that are designed to deal with risk. Deferred actions may be more costly in the longer term. Appropriate steps to assess risks and identify response options are therefore required.

This report provides recommendations for further steps based on an adaptation framework in four areas:

- Advancing the knowledge base and capacity building.
- Integration of climate change impacts and adaptation into key policy areas.
- Engagement with international processes.
- Analysis of costs and benefits.

The EPA looks forward to engagement with other groups in further improving and developing these recommendations.

6. References and Sources of Information

Community Climate Change Consortium for Ireland (C4I). *Ireland in a Warmer World: Scientific Predictions of the Irish Climate.* Department of the Environment, Heritage and Local Government: Dublin.

DoEHLG, 2007. *National Climate Change Strategy 2007–2012*. Department of the Environment, Heritage and Local Government: Dublin.

Environmental Protection Agency, 2008. I*reland's Environmen*t. EPA: Wexford.

European Commission, 2007. *Adapting to Climate Change in Europe – Options for EU Action* (COM (2007) 354 final). Green paper from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions.. European Commission: Brussels.

European Commission, 2009. *Adapting to Climate Change: Towards a European Framework for Action*. White paper. Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions. European Commission: Brussels.

IPCC, 2007. *Climate Change 2007. Impacts, Adaptation and Vulnerability*. Working Group 11 Contribution to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Summary for Policymakers and Technical Summary. Cambridge University Press: Cambridge.

McElwain, L. and Sweeney, J. 2007. *Key Meteorological Indicators of Climate Change in Ireland*. Environmental Research Centre. EPA: Wexford.

Sweeney, J., Donnelly, A., McElwain, L. and Jones, M. 2002. *Climate Change: Indicators for Ireland*. EPA: Wexford.

United National Development Programme, 2005. *Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures*. Cambridge: Cambridge University Press.

Acronyms

AR4	Fourth Assessment Report
CIRCLE	Climate Impact Research Coordination for a Larger Europe
DOC	dissolved organic carbon
EEA	European Environment Agency
EIA	Environmental Impact Assessment
GCM	global climate model
GHG	greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
MOC	Meridional Overturning Circulation
NUIM	National University of Ireland, Maynooth
OPW	Office of Public Works
SAFER	Secure Archive For Environmental Research Data
SEA	Strategic Environmental Assessment
SLR	sea-level rise
SRES	Special Report on Emissions Scenarios
THC	Thermohaline Circulation
UNFCCC	United Nations Convention on Climate Change
WFD	Water Framework Directive

Appendix 1: Met Éireann Workshop 12 November 2008

The workshop explored the state of knowledge on key climate variables. This output from this exercise was used in compiling this report. Attendees at the workshop were:

- University College Cork: Professor Robert Devoy, Dr Jeremy Gault, Dr Ned Dwyer, and Dr Paul Leahy.
- National University of Ireland Maynooth: Dr Rowan Fealy and Dr John Coll.
- National University of Ireland Galway: Dr Colin O'Dowd and Dr Sanji Varghesc.
- Trinity College Dublin: Professor Mike Jones and Dr Alison Donnelly.
- Marine Institute: Dr Heather Cannaby.
- Office of Public Works: Mark Adamson.
- Department of Agriculture, Forestry and Fisheries: Jim Casey.
- Met Éireann: Dr Ray McGrath and Dr Tido Semmler.
- Environmental Protection Agency: Dr Margaret Desmond and David Dodd.

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 príomh-nithe 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 agus Rialtais Áitiúil a dhéanann urraíocht uirthi.

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

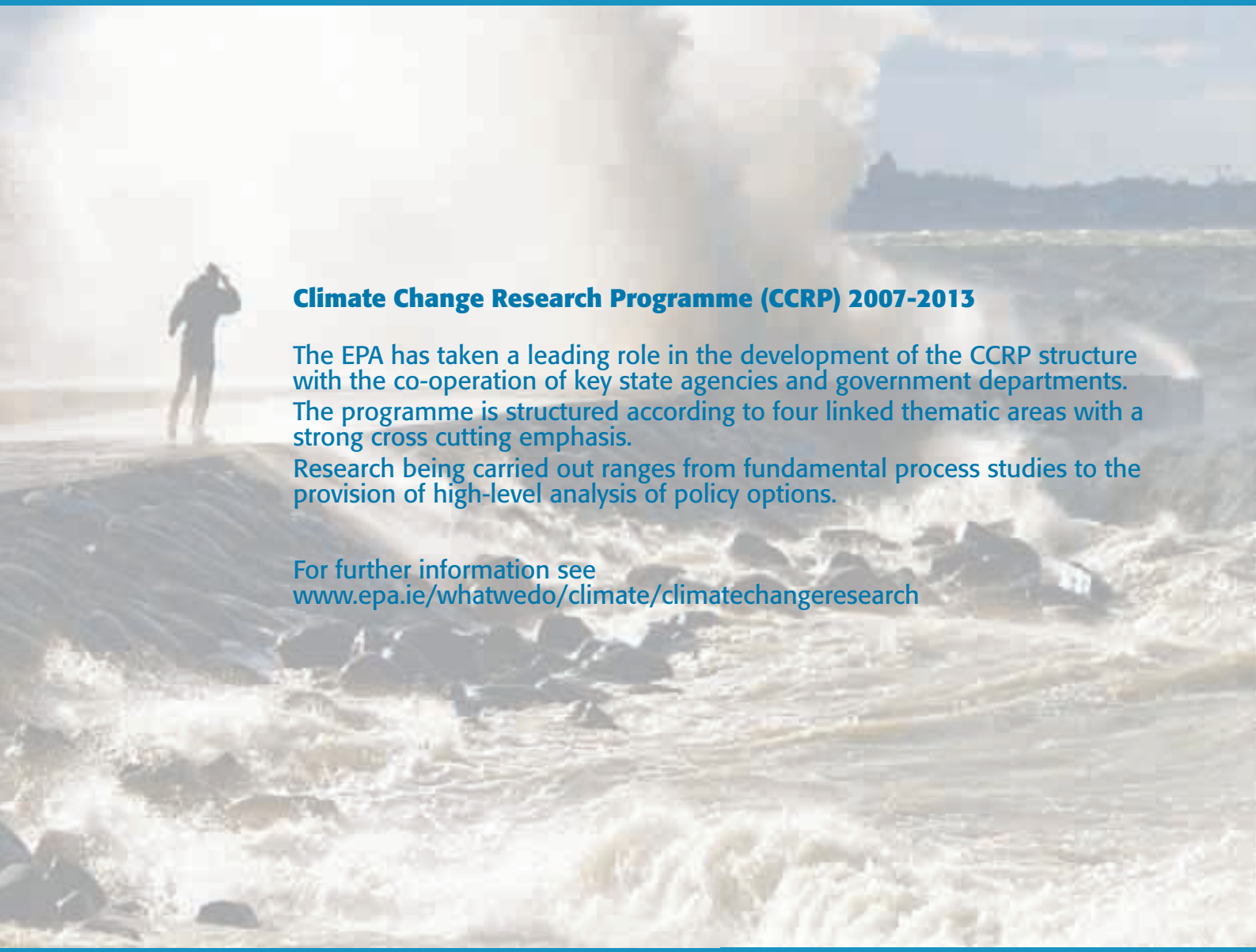
Bunaíodh an Ghníomhaireacht i 1993 chun comhshaol na hÉireann a chosaint. Tá an eagraíocht á bhainistiú ag Bord lánaimseartha, ar a bhfuil Príomhstiúrthóir agus ceithre Stiúrthóir.

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.

NDP
National Development Plan 2007 - 2013



Climate Change Research Programme (CCRP) 2007-2013

The EPA has taken a leading role in the development of the CCRP structure with the co-operation of key state agencies and government departments.

The programme is structured according to four linked thematic areas with a strong cross cutting emphasis.

Research being carried out ranges from fundamental process studies to the provision of high-level analysis of policy options.

For further information see
www.epa.ie/whatwedo/climate/climatechangeresearch

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Strategy for Science, Technology and Innovation

Comhshaol, Oidhreacht agus Rialtas Áitiúil
Environment, Heritage and Local Government