The Scottish Government

Environmental Assessment Team

Consideration of Climatic Factors within Strategic Environmental Assessment (SEA)

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1. INTRODUCTION

1.1 Climate change is expected to have profound effects on Scotland and action is required at all levels of the public sector in order to meet the challenges these effects will bring.

1.2 The Climate Change (Scotland) Act 2009 (2009 Act) introduces a statutory framework of year-on-year reductions for Scotland's greenhouse gas emissions, with an interim target of at least 42% reduction by 2020 (compared to 1990 levels) and at least 80% by 2050. Under the 2009 Act, Scottish Ministers are required to produce guidance for the public bodies in relation to the above climate change duties. The 2009 Act includes provisions on duties of public bodies[1] relating to climate change. A public body must, in exercising its functions, act:

- in the best way calculated to contribute to the delivery of the emission reduction targets,
- in the best way calculated to help deliver any programme for adapting to the impacts of climate change, and
- in a way that it considers most sustainable.

1.3 Consumption within our society continues to grow, and most aspects of modern life currently give rise to greenhouse gas emissions, such as; electricity and heat generation, construction, manufacturing, operating buildings, information and communications technologies, transport and travel, and food production. However, the shift to a low carbon economy is a major economic opportunity for Scotland. In addition, it is important that infrastructure and services are resilient to the impacts of climate change now and in the future.

1.4 SEA can offer an opportunity to:

- explore the potential contribution a plan, programme or strategy (PPS) makes to greenhouse gas emissions, with the aim of avoiding or reducing these emissions where possible;
- consider whether future Scottish PPS are resilient to the expected effects of climate change;
- identify measures to address any adverse effects a PPS may have on the climate; and
- help the public sector to make informed decisions about how to reduce the greenhouse gas emissions of PPS and ensure they are resilient to the future climate, thereby supporting the public bodies. Although adherence to this guidance is not a statutory requirement, it aims to help public bodies to fulfil their duties relating to climate change, as set out in the 2009 Act and within the Scottish Climate Change Declaration objectives.

Who is this guidance for?

1.5 This guidance is primarily aimed at SEA practitioners undertaking assessments in Scotland. However, it could also prove useful to plan-makers, ensuring that climate change considerations are embedded into Scottish PPS preparation consistently and uniformly across the public sector. The information provided in this guidance aims to stimulate good practice in the assessment of climatic factors within the SEA.

[1] Public Bodies are defined in the Climate Change (Scotland) Act 2009 as those bodies which are included in Schedule 1 of the Freedom of Information (Scotland) Act 2002.

What can the guidance do for you?

For detailed information on climate change science and the global picture, visit the Met Office website:

www.metoffice.gov.uk/climatechange/science/

1.6 The guide offers advice to Scottish practitioners on how to consider climate change within the terms of the Environmental Assessment (Scotland) Act 2005 (2005 Act) when undertaking a SEA. It is important to remember that 'climatic factors' is only one environmental issue within SEA and that it is likely that this topic will have to be considered in relation to the other environmental topic areas.

1.7 The guidance is not a step by step guide to the SEA process. This is provided by The Scottish Government's SEA Tool Kit.

2. CLIMATE CHANGE BACKGROUND

In this guidance:
CLIMATE CHANGE MITIGATION: means reducing Scottish greenhouse gas emissions.

CLIMATE CHANGE ADAPTATION: means preparing Scotland for the future climate and building resilience to impacts that are already occurring.

Full definitions are available at *http://www.ipcc.ch/*

2.1 The effects of climate change are already being witnessed and are predicted to steadily increase in the future. The consensus of scientific opinion indicates that climate change is being driven by emissions resulting from human activities. Therefore the need to reduce greenhouse gas emissions and limit dangerous climate change (climate change mitigation) is apparent. In addition, there is also a need to build resilience into Scottish PPS, to address the impacts of climate change that are now inevitable due to past and present emissions (climate change adaptation).

2.2 The United Nations Framework Convention on Climate Change, the UK Climate Change Act 2008 and the Climate Change (Scotland) Act 2009 include emissions reduction targets covering carbon dioxide and five other key greenhouse gases, these are: methane, nitrous oxide, hydrofluorocarbons, perfluorcarbons and sulphur hexafluoride. The five latter emissions are produced in smaller quantities but are more powerful in their greenhouse effect per unit volume than carbon dioxide - this is known as Global Warming Potential (GWP).

2.3 One tonne of methane, which has a GWP of 25 can be represented by 25 tonnes of carbon dioxide equivalent. Human activities can increase the concentrations of these gases in the atmosphere. **Figure 1** outlines the six greenhouse gases and their main sources from human activity.

Greenhouse Gas	Sources from human activity
Carbon dioxide (CO_2)	burning fossil fuels, burning biomass, land use changes, some industrial processes, transport
Methane (CH_4)	landfill sites, livestock
Nitrous oxide (N_2O)	fertiliser, some industrial processes
Hydrofluorocarbons (HFCs)	refrigeration and air conditioning equipment (manufacture and end of life)
Perfluorocarbons (PFCs)	refrigeration sector, aluminium production, fire extinguishing systems
Sulphur hexafluoride (SF_6)	electrical substations, magnesium smelters, production of consumer goods such as tennis balls and training shoes

Figure 1 – Greenhouse Gas types and their main sources

3. SCOTLAND'S GREENHOUSE GAS EMISSIONS

3.1 In Scotland in 2007, approximately 61.3 million tonnes of carbon dioxide equivalents (Mt CO_2e) were emitted. **Figure 2** below shows the sources of these emissions. It is important to note that forestry and other land uses can absorb some emissions. This reduced Scotland's overall emissions by 4.4 Mt CO_2e, meaning Scotland's net carbon dioxide equivalent emissions for 2007 were 56.9 Mt CO_2e.[2]

3.2 Scotland accounts for approximately 0.15% of global greenhouse gas emissions due to human activities. As Scotland only has around 0.08% of the world's population - we produce far greater level of emissions than the average, when considered in proportion to our population size. In 2007, Scotland's net greenhouse gas emissions were made up of around 80% carbon dioxide emissions and 20% of the other five greenhouse gases.

3.3 Scotland's bogs, wetland and upland systems act as a vital "carbon bank". Scotland's organic soils hold 10,028 Mt CO_2e[3], this compares with a total of 418 Mt CO_2e in UK surface vegetation[4]. To put this into context, Scotland's net 2007 greenhouse gas emissions equate to around 0.6% of Scotland's total soil carbon bank.

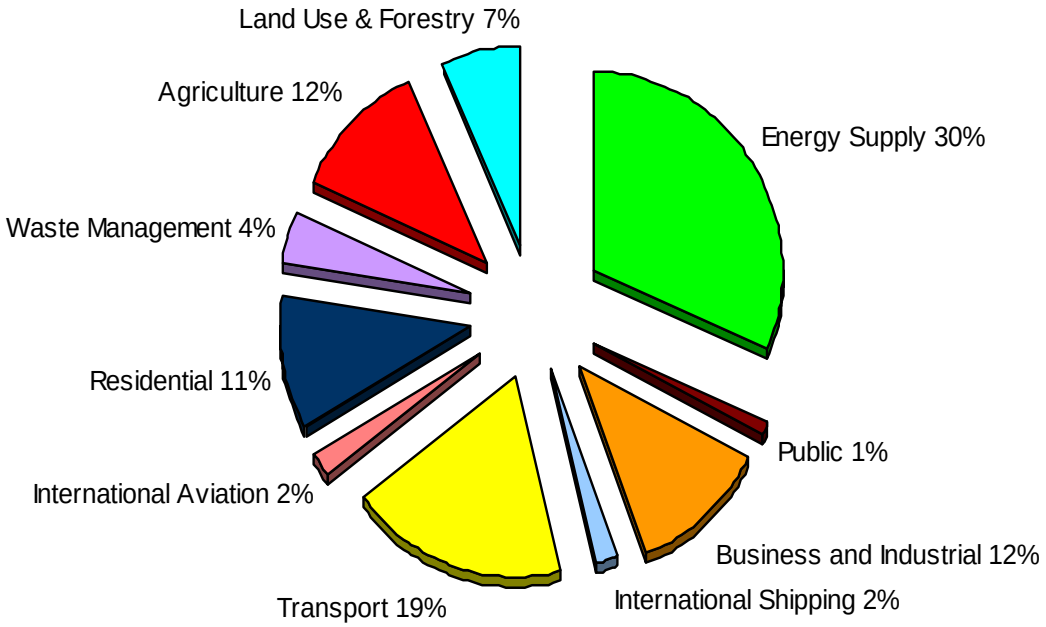

Figure 2 – Sources of Scottish Greenhouse Gases by sector, 2007[5]

[2] http://www.scotland.gov.uk/Resource/Doc/175776/0086006.xls
[3] Smith, P. Ecosse - estimating carbon in organic soils; sequestration and emissions. 2007. Edinburgh, Scottish Executive.
[4] Bradley, R. I., Milne, R., Bell, J., Lilly, A., Jordan, C. and Higgins, A. (2005) A soil carbon and land use database for the United Kingdom. *Soil Use and Management* 21, 363-369.
[5] *http://www.scotland.gov.uk/Resource/Doc/175776/0086006.xls*

4. CLIMATE CHANGE IMPACTS - OBSERVED TRENDS ACROSS SCOTLAND

4.1 **Figure 3** below sets out some observed patterns of climatic change in Scotland from 1961 to 2004[6].

	Recorded change in Scottish climate between 1961 and 2004
Temperature	Temperatures have risen in every season in Scotland.
Rainfall	Scotland had become 20% wetter by 2004, with an increase of almost 70% in precipitation in northern Scotland. Heavy rainfall events have increased significantly in winter, particularly in northern and western regions.
Snow cover	The snow season has shortened across the country, with the season starting later and finishing earlier in the year. The greatest reductions have occurred in northern and western Scotland.
Growing season	The growing season has increased significantly, with the greatest change occurring at the beginning of the season.
Days of frost	There has been more than 25% reduction in the number of days of frost (both air and ground frost) across the country.
Sea level	Changes in sea levels around Scotland vary. All mainland gauges have recorded a rise over the last 100 years but in Shetland there has been a decrease since 1957.

Figure 3 – Observed trends in climate from 1961 to 2004

5. UK CLIMATE PROJECTIONS

5.1 The UK Climate Projections have been created to help the UK to plan for a changing climate. The most recent work on climate projections (UKCP09) was launched on 18th June 2009. This contains information on observed and future climate change, based on the latest scientific understanding. More information can be found at the introductory site http://ukcp09.defra.gov.uk and the technical site http://ukclimateprojections.defra.gov.uk .

5.2 UKCP09 provides information on how the UK's climate is likely to change in the 21st century, as it responds to rising levels of greenhouse gases in the atmosphere. The projections are based on different emissions scenarios and can be presented for varying levels of probability. They show the effects of current levels of emissions, and also what would happen if emissions were to increase or decrease. The data offer greater accuracy and understanding of possible scenarios. Although it is not possible to predict with 100% certainty exactly how much the climate will change by a given time, UKCP09 sets out the amount of change and the associated probability of being less than, or greater than, each value at a given point in time. It is also important to note that the next 30 to 40 years of climate change are determined by the current levels of emissions in the system and are therefore highly likely. Regardless, uncertainty should not form a barrier to adaptation. Robust options within a range of scenarios can be viewed as planning for resilience in any case.

[6] *Source: SNIFFER Handbook of Climate Trends Across Scotland SNIFFER (2006) Handbook of Climate Trends across Scotland and Scotland's seas: towards understanding their state http://www.scotland.gov.uk/Publications/2008/04/03093608/0*

5.3 UKCP09 gives information about the changing climate (e.g. precipitation) but not the effects the climate may have (e.g. whether or where it might flood). The UKCP09 information can be used to feed into risk assessments of what the impacts of a changing climate might be, for example, rail networks, habitats, health services or coastal defences.

5.4 The UKCP09 projections are set out on maps (an example is provided in **Figure 4** below) that show a range of climate change scenarios depending on future emissions. The scenarios cover average and maximum temperatures, precipitation, humidity and cloud levels. The maps cover 25km grid squares and can be searched by regional areas of Scotland and by river basins.

Figure 4 – Example maps from UKCP09 showing annual mean temperature change for high emissions scenario[7].

[7] *Current global greenhouse gas emissions continue to increase. If this continues it will put us on a trajectory to the medium or high emission scenarios.*

6. CLIMATE CHANGE IMPACTS AND CONSEQUENCES

6.1 Observed and predicted climate change in Scotland may lead to a range of impacts and consequences. **Figure 5** below summarises these, while **Appendix 1** provides further details about anticipated impacts and consequences.

Key messages for Scotland

- **By 2050, Scotland is likely to have hotter, drier summers and warmer, wetter winters.**
- **By 2080 summer temperatures in Scotland could increase by more than 3ºC if emissions continue at their present rate.**
- **Snowfall could also reduce by 60 per cent or more in the mountains, and might stop completely in some parts of Scotland.**

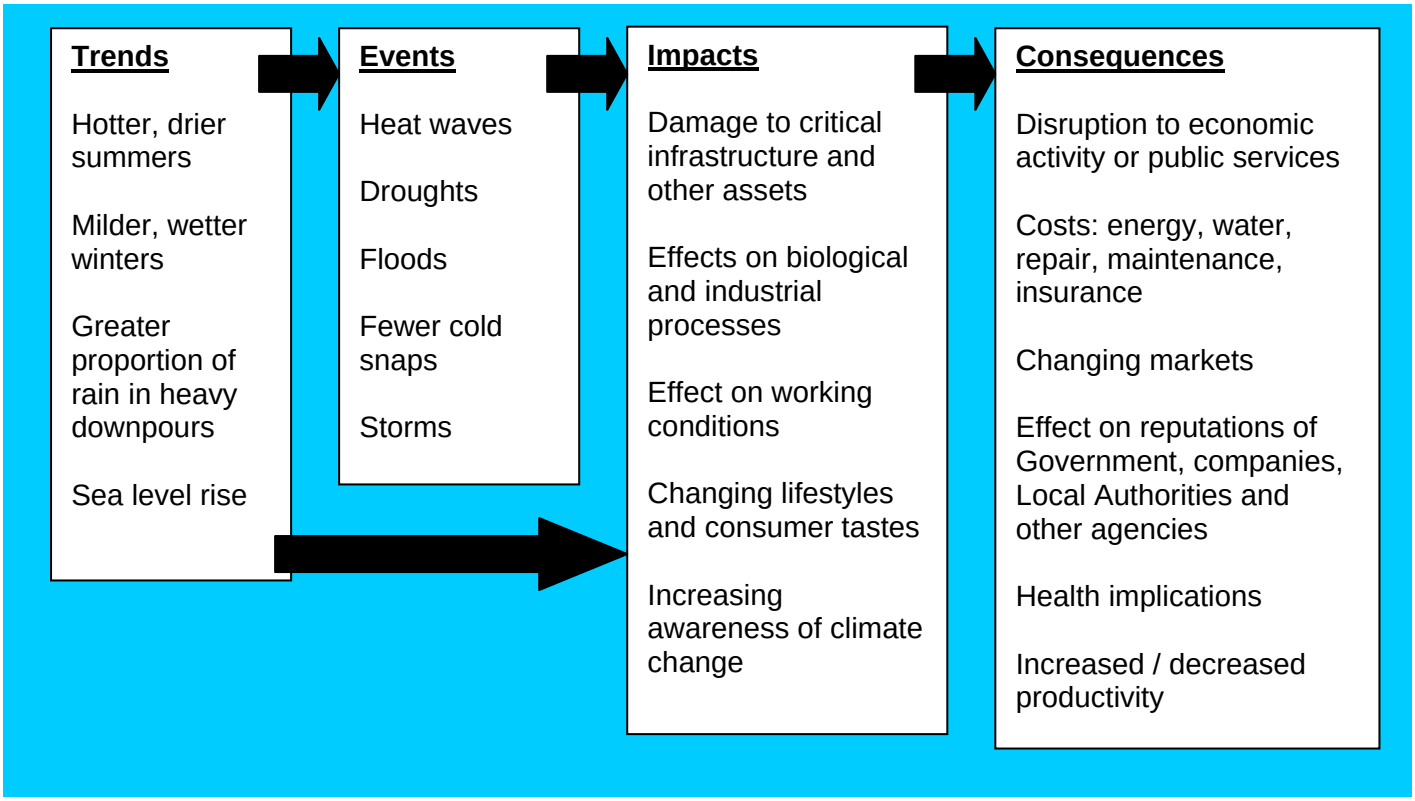

Figure 5 – Illustration of the climate trends and the potential social, economic and environmental impacts and consequences (adapted from UKCIP)

7. CONSIDERING CLIMATE CHANGE AT DIFFERENT STAGES WITHIN SEA

7.1 The 2005 Act includes "climatic factors" within a wide spectrum of environmental issues that have to be considered when undertaking an SEA. Reducing greenhouse gas emissions and preparing Scotland for future climate changes should therefore be considered within an SEA.

7.2 In terms of the measures to prevent any significant environmental effects, under the terms of the 2005 Act, public PPS can help to address climate change by reducing their greenhouse gas emissions, or at least not increasing them. This has become a consistent challenge for the Scottish public sector, along with ensuring that PPS are also resilient to the effects of climate change, now and in the future.

7.3 At each key reporting stage of the SEA process it is important to consider how climatic factors are likely to be affected by the PPS being prepared and the variety of ways to prevent, reduce or if necessary offset as far as possible, the adverse effects, while enhancing the favourable effects. The key reporting stages within SEA and potential climate change actions are outlined below.

Stage	Actions	Reason
Screening	• Determine whether the PPS is likely to significantly increase or reduce greenhouse gas emissions, either directly or indirectly. • Identify whether the PPS is likely to significantly affect the ability to adapt to the effects of climate change, in the area, in the future. • To gauge the magnitude of the likely effects, it is important to examine the influence of the PPS on other plans.	• Allows you to judge whether the SEA process and procedures are statutorily required.
Scoping	• Consider whether the PPS, including any adaptation measures, is likely to have a significant effect on climatic factors and set out an assessment method that ensures climate impacts are assessed in an appropriate way.	• Demonstrates how you propose to align the assessment with the areas of the PPS that are likely to have significant environmental effects and how the environmental report will be set out.
Environmental Report	• Summarise the significant effects of the PPS on climatic factors. • Identify any mitigation measures to prevent, reduce or offset those parts of the PPS that may lead to adverse effects. • The public have to be consulted on the elements of the PPS that are likely to have significant environmental effects, including climatic factors.	• The environmental report provides the public with a means to gauge what the likely effects of their preferred choice will be along with any reasonable alternatives.
Adoption and Monitoring	• Take impacts on climatic factors into account when finalising the PPS. • Align monitoring with the potential climate impacts of the PPS.	• A means to ensure that the environment is taken into account when taking key decision and where effects are uncertain, monitoring is ready to identify any unforeseen effects and ensure appropriate remedial action is considered.

8. SCREENING

8.1 Different PPS will have a variety of impacts on climate change, depending on their subject, level of detail, geographic area and the specific environmental challenges within that area.

8.2 **Figure 6** can help with consideration of whether a PPS is likely to lead to significant effects in relation to climatic factors. Answering affirmatively to any of the questions outlined in the table below could be an indication that the PPS is likely to lead to significant effects, either positive or negative, in relation to climatic factors. However, it is important to remember the table is not exhaustive and influences of the PPS not captured by this table could have significant environmental effects. **Figures 9 – 12** (later in the guidance) may also help to determine whether a PPS is likely to have significant environmental effects.

Climate Change Mitigation	Climate Change Adaptation
• Can the PPS affect greenhouse gas emissions in the key sectors of: energy, transport, business, agriculture, residential and waste management? • Can the PPS affect travel patterns, including the number and length of journeys made and the mode of travel • Can the PPS protect or impact on the use/disturbance of carbon rich soils? • Can the PPS affect the generation of energy from renewable sources? • Can the PPS affect the energy efficiency of buildings? • Can the PPS affect opportunities for the development of low carbon business and low carbon technologies? • Can the PPS increase or decrease waste, particularly waste disposed to landfill? • Can the PPS impact on use of building materials?	• Can the PPS influence the location and design of new developments, critical infrastructure and public services, ensuring they are not at risk of flooding? • Can the PPS influence the location and design of new development in areas – particularly on the coast – subject to erosion? • Can the PPS impact on the use of water, including water supply in times of drought? • Can the PPS impact on the management of water systems, including drainage? • Can the PPS influence the location and design of new development to be resilient to storms? • Can the PPS influence the protection of existing infrastructure, including essential services, from risks such as flooding, erosion and storm damage? • Can the PPS impact on ecosystem services (e.g. natural flood management, maintaining soil carbon)? • Can the PPS impact on habitat networks and corridors for the movement of species?

Figure 6 – Potential influences of PPS on climatic factors

9. SCOPING

9.1 At scoping, it is useful to begin to define the wider framework of the environmental objectives that form the context for the PPS and assessment, as this is a requirement for the subsequent environmental report, (under Schedule 3(5) of the 2005 Act). In Scotland there are several key legislative and policy drivers **(Figure 7)** which provide the framework for meeting the challenging target set in the Climate Change (Scotland) Act 2009, to reduce greenhouse gas emissions by 80% by 2050. These are of crucial importance when considering climate change in SEA. **Appendix 2** provides a fuller list of relevant legislation and policy.

9.2 In addition, the scoping stage can usefully begin to explore the baseline information which will be used in the assessment and set out in the environmental report (as required by Schedule 3 (2)(3) and (4) of the 2005 Act). In the interests of proportionality, it is important to tailor the approach for baseline information collection to the scope of the PPS. A comprehensive description of global climate change is unlikely to be of direct relevance to the assessment of many local level plans, but specific information about emissions from a defined sector may provide an insight into the key aspects of climate change that the PPS is likely to influence.

9.3 The baseline information sources listed in **Figure 8** could be useful at scoping and in the subsequent assessment stage. A longer list of climate change information, which could also be referred to where relevant, is set out in **Appendix 3**.

Climate Change (Scotland) Act 2009
www.opsi.gov.uk/legislation/scotland/acts2009/pdf/asp_20090012_en.pdf

Flood Risk Management (Scotland) Act 2009
www.opsi.gov.uk/legislation/scotland/acts2009/pdf/asp_20090006_en.pdf

Scottish Government Adaptation Framework
www.scotland.gov.uk/AdaptationFramework

Climate Change Delivery Plan
http://www.scotland.gov.uk/Publications/2009/06/18103720/0

Scottish Government Renewables Action Plan
www.scotland.gov.uk/Publications/2009/07/06095830/0

Energy Efficiency Action Plan
http://www.scotland.gov.uk/Publications/2009/10/07160816

Renewable Heat Plan
http://www.scotland.gov.uk/Publications/2009/07/06095830/0

Scotland's Climate Change Declaration
www.sustainable-scotland.net/climatechange/

Figure 7 – Key Scottish Legislation & Policy

Baseline Information Source
UK Climate Impacts Programme (UKCIP) www.ukcip.org.uk UKCIP helps organisations to adapt to inevitable climate change. It works with the public, private and voluntary sector to assess how a changing climate will affect everything from construction and demand for goods and services, to biodiversity and health. A major product produced by UKCIP is the UK Climate Projections 2009. This represents the most comprehensive package of future climate information available for the UK to date. It provides probabilistic projections of climate change up to 2099 over both land and sea and contains sub-surface marine data. Further information on UKCIP and the UK Climate Projections 2009 can be found at http://ukclimateprojections.defra.gov.uk

Scottish Climate Change Impacts Partnership (SCCIP) www.sccip.org.uk SCCIP was established to "increase the resilience of organisations and infrastructure in Scotland to meet the challenges and opportunities presented by the impacts of climate change". On this site you will find: • data on climate trends and impacts in Scotland • the latest research and project information including sharing best practice • tools and resources to support action in adapting to and mitigating climate change • information on training and support events
Scotland and Northern Ireland Forum for Environmental Research (SNIFFER) Handbook of Climate Trends across Scotland. www.sniffer.org.uk The handbook highlights experienced climate trends in Scotland since 1961 in an accessible form. It has been designed for use by a broad range of stakeholders to help inform preparation for and adaptation to the impacts of climate change. The handbook presents up to date information on climate trends over the last century in Scotland and provides a benchmark against which we can measure future climate change.
Scottish Government Scottish Environmental Statistics online www.scotland.gov.uk This website provides a range of climate change statistics, including greenhouse gas emissions by Sector

Figure 8 - Useful sources of baseline information

9.4 Although some PPS are unlikely to have a significant effect on climatic factors and could potentially 'scope out' this issue, some Responsible Authorities may wish to 'scope in' climatic factors where resources permit. Whilst the contribution to climatic factors of the individual PPS may be relatively small in scale when viewed from a global perspective, it can nevertheless contribute to important and challenging Scottish targets. Each contribution, however small, moves Scotland closer to achieving its greenhouse gas reduction goal and could therefore be viewed as significant. Including climatic factors in the assessment can enable comprehensive consideration of the issues and challenges across the public sector and in the future provide information that can be used to measure the overall reduction. It can also ensure that other measures, which are not directly linked to reducing emissions, such as adaptation driven actions, are explored.

10. ASSESSMENT

10.1 The environmental report provides the findings of the assessment, identifying the likely significant effects of a PPS, and the reasonable alternatives to it, on all relevant environmental topic areas. The assessment of climatic factors should seek to identify the key ways in which the PPS is likely to increase or reduce greenhouse gas emissions or where it is increasing or decreasing the resilience to future environmental change caused by changes in climate.

Understanding the potential effects of the PPS on climatic factors

10.2 The first step within the assessment involves identifying the strategic actions which could have an impact on climatic factors. This will vary between different types of plan, but the questions set out in **Figure 6** provide a useful point of reference for identifying where these interactions might take place. To ensure the assessment also takes into account scope for adaptation, should also consider the potential effects of climate change on the area and sectors covered by the plan. **Appendix 1** explains these interactions in more detail.

10.3 As a further point of reference, for those who are embarking on an assessment, **Figures 9 – 12** (next pages) highlight potential links between actions within different types of PPS and climate change. This is not an exhaustive list, but these tables show that different plans interact with climatic factors in different ways. By highlighting possible positive as well as negative effects, the tables can be used to help identify the best possible options for climate change mitigation and adaptation.

Alternatives

10.4 Consideration of reasonable alternatives within the assessment is required by the 2005 Act. This offers an opportunity to explain the contribution that different options may have for addressing climate change. Whilst the likely effects on climatic factors should ideally influence the content of the PPS, it is recognised that this is just one of many issues that need to be taken into account. In some cases, the best option in relation to climate change may differ from the one which is preferred in relation to other environmental topic areas. SEA provides a means of evaluating this and making the choice of options transparent.

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

Figure 9 – Typical influences on climatic factors from land use Development Plans

Plan Type	Climate Change Mitigation					Climate Change Adaptation			
	Reduce all GHG emissions	**Reduce impact of transport through a 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 increase in precipitation, flood risk and flooding**	**Resilience to increase in high winds and storminess**	**Resilience to warmer climate, droughts and heat waves**	**Resilience to erosion and landslides**
Transport Plans	Reduce emissions from transport sector through technological change Improve energy efficiency of transport systems Improve fuel efficiency Provide an effective and integrated public transport system	Provide transport choices to encourage modal shift Encourage walking and cycling Demand management schemes Encourage car sharing Green travel plans	Encourage use of renewable sources of fuel – e.g. sustainably sourced / alternative fuels	Manage construction and demolition waste generated during infrastructure sustainably	Consider the impact on carbon rich soils from transport developments	Ensure existing transport infrastructure is protected from future flood risk Ensure that new transport infrastructure is located in areas that are not at risk of flooding or where flood mitigation measures can be implemented	Ensure new transport infrastructure considers increased high winds and storminess	Ensure that new transport infrastructure is designed and located to withstand future changes in climate e.g. roads resistant to warmer temperatures Provision of habitat corridors for the movement of biodiversity	Avoid developing new transport infrastructure in areas at risk from erosion, including coastal erosion

Figure 10 – Typical influences on climatic factors from transport plans

Plan Type	Climate Change Mitigation					Climate Change Adaptation			
	Reduce all GHG emissions	**Reducing impact of transport through a reduction in the need to travel and modal shift**	**Reducing energy use, increasing energy efficiency and enabling renewable energy generation**	**Reducing resource use (e.g. Reducing waste to landfill)**	**Reduce carbon loss from soils**	**Resilience to increase in precipitation flood risk and flooding**	**Resilience to increase in high winds and storminess**	**Resilience to warmer climate, droughts and heat waves**	**Resilience to erosion and landslides**
Energy and Resources (including minerals) and Waste Planning	Improve energy efficiency Reduce demand for energy Develop new technologies such as carbon capture and storage Improve the energy performance of buildings	Transport emissions from resource development and waste management Modal shift to more sustainable transport of waste	Provide a policy framework to support renewable energy development Use of Combined Heat and Power (CHP) / energy from waste Renewables obligation	Energy production via thermal treatment of waste will reduce landfill and generate power Increase recycling levels	Protect peat soils from loss / sealing from energy developments (e.g. windfarms)	Increase river flows in some areas for hydropower Ensure supply is protected from disruption from floods	Take into account through design and specification of infrastructure	Take account of lower river flows for hydropower Provide habitat corridors that would allow movement of biodiversity	Ensure generation and supply is protected from disruption from landslides

Figure 11 – Typical influences on climatic factors from energy and resource plans

Plan Type	Climate Change Mitigation					Climate Change Adaptation			
	Reduce all GHG emissions	**Reducing impact of transport through a reduction in the need to travel and modal shift**	**Reducing energy use, increasing energy efficiency and enabling renewable energy generation**	**Reducing resource use (e.g. Reducing waste to landfill)**	**Reduce carbon loss from soils**	**Resilience to increase in precipitation flood risk and flooding**	**Resilience to increase in high winds and storminess**	**Resilience to warmer climate, droughts and heat waves**	**Resilience to erosion and landslides**
General e.g. agriculture, forestry, economic development, corporate strategies etc…	Reduce methane emissions from livestock (e.g. agriculture plans) Development of low carbon technologies (e.g. economic development) Energy demands from business (economic development)	Reduce need to transport crops / timber long distances (agriculture, forestry) Transport resources using more sustainable modes (agriculture, forestry)	Providing biomass as a substitute for fossil fuels (forestry)	Reduce farm waste (agriculture plans)	Protect areas contributing to net sink for carbon from damaging agricultural or forestry activities Protect peatland from forestry or agricultural uses (forestry and agriculture plans)	Flooding affecting supply of goods and services (economic development)	Disruption of goods and services supply by increased storm events (economic development plans)	Preparing organisation for future climate e.g. through risk management (corporate plan) Provide habitat corridors that would allow movement of biodiversity Design for environmental performance – reduce need for cooling	Identify area that may be vulnerable to landslides and consider how forestry could reduce that risk (forestry)

Figure 12 – Typical influences on climatic factors from other types of plans

Assessment Methods

10.5 Having established the relevant existing and potential strategic actions of the PPS and the possible alternatives to it, the next step involves considering how the plan might affect the existing environmental baseline. The description of the baseline can be established using information sources outlined earlier in this guidance. In the interests of proportionality and conciseness, the baseline description should be confined to information which is relevant to the level of PPS being considered (i.e. what is the PPS likely to significantly influence?)

Climate Change Mitigation	*Generic example:* To reduce greenhouse gas emissions
	Plan specific example (e.g. transport): To reduce greenhouse gas emissions resulting from [insert sector]
	Target based example: To reduce greenhouse gas emissions from [transport] by XX% by [date].
Climate Change Adaptation	*Generic example:* To reduce vulnerability to the effects of climate change
	Plan specific example (e.g. spatial plans): To reduce vulnerability of people and property in the plan area to flooding
	Target based example: to reduce the number of properties at risk of flooding by XX by [date]

Figure 13 – Examples of SEA Objectives

10.6 To highlight where the actions from the PPS connect with the baseline, many assessments are structured using a set of defined 'SEA objectives'. Where this approach is used, objectives should cover both climate change mitigation and adaptation as appropriate. The SEA Tool Kit provides examples of possible objectives for this topic area. **Figures 13 and 14** provide additional examples and some supporting questions that can be used to explore the likely effects of a PPS on climate change related objectives. These should be selected and adapted to suit different types of PPS. Applying few pertinent objectives to highlight the most significant effects of the PPS, is preferable to a broader assessment which loses sight of the most relevant and significant effects of the PPS.

Question: Will the plan, programme or strategy…	
Climate Change Mitigation	reduce the need for energy?
	improve energy efficiency in the sector?
	increase the percentage of energy generated from renewable sources?
	support a switch to lower carbon fuels?
	reduce the amount of waste going to landfill (to reduce methane emissions)?
	improve land use practices to reduce emissions?
	protect natural carbon sinks such as peat soils?
	encourage transport choice and promote modal shift?
	consider the carbon impact in the construction phase?
	consider the carbon impact of adaptation measures?
Climate Change Adaptation	reduce overall flood risk e.g. developing in flood plain, flood protection schemes?
	consider present and future climate impacts in the design of buildings and urban areas e.g. green roofs, urban greenspace, sustainable urban drainage?
	consider present and future climate impacts for infrastructure e.g. transport?
	provide adequate health services?
	ensure adequate future water and drainage supply?
	avoid actions that may close or limit future adaptation?
	develop ecologically resilient and varied landscapes e.g. ecological networks, drainage?
	consider opportunities presented from climate change impacts?

Figure 14 – Further examples of SEA objectives

10.7 However, in some cases, an objectives based approach to the assessment may not be the best way of identifying the effects of some types of PPS on climatic factors. For example, the following methods may be more appropriate in certain situations:

- Assessments of high-level, strategic PPS could explore climatic factors thematically, providing a commentary on the current baseline, future predictions, and simply evaluating the likely effects in a descriptive way that draws on available evidence as appropriate.

- Use of tools that measure greenhouse gas emissions, therefore enabling a more quantified comparison between different options may also be helpful. Under its ongoing local footprint project, the Sustainable Scotland Network is exploring ways in which this can be achieved in a series of example projects.

- Adaptation issues may be more appropriately explored by considering the PPS in spatial terms, taking into account mapped baseline information such as future flood risk and the UKCIP09 scenarios.

Secondary, cumulative and synergistic effects

10.8 As required by Schedule 3(6e) of the 2005 Act, it is also important to consider the secondary, cumulative and synergistic effects of the PPS. **Figure 15** below provides some examples of the types of effects which are relevant to climatic factors.

Cumulative Combined effects of small unco-ordinated measures to adapt may combine to decrease resilience – e.g. incremental loss of floodplain through individual decisions on development, which may lead to increased flood risk elsewhere.
Cumulative Combined effects of small increases in greenhouse gas emissions caused by individual decisions – e.g. incremental increase in emissions from new road schemes.
Cumulative Combined effects of a number of renewable energy developments in one area based on individual decisions - e.g. incremental impact on habitats, species and the water environment
Indirect / Secondary Ensuring that measures to adapt to climate change do not compromise ability to reduce greenhouse gas emissions – e.g. emissions resulting from construction of major flood prevention schemes.
Indirect Increasing emissions resulting from other environmental improvements – e.g. greater treatment of waste water will improve water quality at point of discharge, but require more energy and emissions to achieve it.
Indirect Increasing coastal erosion in one area as a result of improving coastal protection in another area.

Figure 15 – Examples of cumulative and other effects

Mitigation

10.9 A very valuable part of SEA is considering ways in which any adverse effects of a PPS can be addressed through mitigation. Taking action to address climate change now, is expected to be much cheaper over the long term than inaction.

10.10 Where PPS are found to have adverse effects on climatic factors, it is important that mitigation measures are identified and implemented. Such measures might include:

- alterations to the PPS to ensure the adverse effects are avoided or, where possible, it makes a positive contribution to reduce greenhouse gas emissions and to building resilience to the impacts of climate change;
- measures to be consistently enacted in higher or lower tier PPSs;
- measures to be enacted through other actions (e.g. Environmental Impact Assessment); or
- compensatory measures (e.g. use of compensatory storage where part of a functional floodplain is lost).

10.11 Enhancement of the PPS to ensure it contributes positively to climate change mitigation and adaptation is also recommended. The SEA could recommend that the PPS incorporates further commitments to positive actions that had not previously been considered. **Figures 9-12** again provide a useful resource for ensuring that the potential contribution of the plan is maximised in this way.

11. ADOPTION AND MONITORING

11.1 Following adoption of the PPS, an SEA Statement is prepared which summarises its effects and explains how they have been addressed. Indicators are commonly used to assist with monitoring. Although many related datasets are available to measure the performance of PPS in relation to climatic factors, those applied in monitoring should be relevant to the PPS so that its specific contribution to climate change mitigation and adaptation can be measured in a reasonable and realistic way.

The SEA Tool kit provides advice on what information to include in an SEA Statement

11.2 Monitoring should focus on the identified significant environmental effects of the PPS. Some ideas for climate related indicators are provided in **Figure 16** overleaf.

Potential effect of the PPS	Possible Indicator	Data Sources	Possible relevance within the hierarchy of PPS
Increased / reduced greenhouse gas emissions	Total GHG emissions for Scotland (including by sector)	http://www.scotland.gov.uk/Topics/Statistics/Browse/Environment/seso/Q/TID/1	Likely to be more relevant to strategic or national level PPS than local level plans.
Increased / reduced road transport, generating secondary effects in terms of emissions	Vehicle Statistics for Scotland	Scottish Government – Scottish Transport Statistics www.scotland.gov.uk/Publications/2007/12/14120610/0	Potentially relevant to PPS which directly or indirectly influence travel distances or modes at a strategic or national level.
Reduced energy sector emissions arising from support for renewable energy generation	Energy generated by renewable sources for Scotland	http://www.scottishrenewables.com/	May be a useful indicator where the PPS promotes renewable energy development across an area as a whole.
Positive contribution to climate change adaptation through ecological network enhancement	Extent and characteristics of ecological networks that contribute to adaptation	Informal and varying information about project level activities that aim to secure habitat enhancement or restructuring. SNH may be able to advise further.	Where the PPS has sought to contribute to biological adaptation by improving ecological networks, over the short term, reviews of project level activities could provide a useful measure of progress.
Reduced emissions arising from the promotion of sustainable construction activities	Deployment of sustainable materials in new developments	Data collection via monitoring of outcomes from the development management process	Likely to be relevant to more local level plans.
Undermining / support for resilience to increase in precipitation, flood risk and flooding	Number or % of properties at risk of flooding in area % of new developments incorporating sustainable urban drainage Number or % of infrastructure at risk from flooding in area River flows and levels Water quality	SEPA floodmaps provide an indication of areas at risk from fluvial and coastal flooding at the 1:200 return period www.sepa.org.uk/flooding/flood_map.aspx SEPA has historic data for all river gauging stations in Scotland: www.sepa.org.uk/water/river_levels/river_level_data.aspx SEPA has classified Scotland's waterbodies based on their ecological status as part of River Basin Management Plans (see Annex 2 – Classification) www.sepa.org.uk/water/river_basin_planning.aspx#Interactivemap	Potentially relevant to establish whether a lower level plan has successfully reduced the risk of new development being affected by changing flood risk over time.

Figure 16 – Examples of indicators

APPENDIX 1

Potential Impacts and Consequences of Climate Change on Scotland

The consequences of changes in Scotland's climate – past and future – will affect Scotland across sectors, income groups and communities. The implications and associated challenges of a changing and more variable climate on Scotland's key sectors may include:

Critical national infrastructure – energy, water, transport

- Assets such as sewerage and drainage systems may not be able to cope with sudden and intense storm events which could lead to increased flooding. Retrofitting assets for new weather conditions could present a considerable cost;
- Increased flooding, potentially leading to disruptions to customers' utilities supplies, including energy or water;
- Increased variability in factors such as soil moisture having the potential to cause ground movements that make national infrastructure more vulnerable to damage;
- Inaccessible assets that are vulnerable to flooding and storm damage;
- Increased insurance costs to suppliers and generators;
- Increasing variability of water availability (water resource planning) and water quality (rainfall run-off) potentially impacts water service delivery;
- Hydro-electricity production, which may be affected by drier summers and wetter winters;
- Existing requirements (e.g. water quality) that may generate emissions and become harder to achieve due to climate change effects;
- Increased storm events may disrupt the supply of goods and services to island communities;
- Fewer transport disruptions as a result of cold weather and less need for spreading salt, but potential for greater disruption from landslides or floods;
- Cost of adapting road and rail infrastructure to changed climatic conditions – e.g. routing transport away from vulnerable coastlines; and
- Impacts on port infrastructure from more severe storms as well as broader implications of greater service demand as new global shipping routes open.

Land and property ownership

- Current building design standards may not be appropriate for the full lifetime of buildings;
- Increased maintenance or retrofitting costs for existing buildings to cope with more intense rainfall events, increased algal and fungal growth etc;
- Conflict between land use planning systems, for example managing flood risk while pursuing sustainable economic development;
- Need to protect vulnerable historical sites and buildings from extreme weather events or greater severity of current threats (e.g. soil erosion and vegetation growth);
- Increased need for cooling of buildings in warmer weather;
- Increased insurance costs and potential uninsurability as extreme weather events such as flooding happen more frequently; and
- Need to raise awareness amongst private property owners of their responsibility to be proactive in the face of a changing climate.

Natural environment and resource management

- Loss of distinctive Scottish biodiversity (e.g. mountain habitats); biodiversity which helps to regulate the climate (e.g. peatland), reduces vulnerability to flooding (e.g. wetland and machair), and provides other ecosystem services (e.g. grouse moors);

- Increased impact from pests and diseases, including on sustainably used wild species such as red grouse, commercial species such as trees, crops and livestock; and impacts of non-native species such as seaweeds;
- Shifts in distributions of fish and other species, and possible effects on seabird populations as a result of increased sea temperatures;
- Unpredictable effects of increasing ocean acidification on marine species and food webs from increased absorption of carbon dioxide;
- Impact of climate change on hydrology affecting both flood risks and water security;
- Challenges for the management of soils, e.g. water-logging, erosion, damage from land, crop and livestock practices that developed under historic/recent climatic conditions;
- Risk of fluctuations in water availability to crops, stocks and industry; and
- Potential to change or increase tree species and forested land.

Health and wellbeing

- Both positive and negative impacts on the employment, activities, health, leisure and tourism opportunities for people living in and visiting Scotland;
- Impacts on Scottish business, and related employment, through their supply chains and overseas markets;
- Less cold-related illness and mortality;
- Impacts on air quality (e.g. increased likelihood of smog or increased algal or fungal growth in buildings) which may affect respiratory conditions;
- Longer growing seasons that may have implications for allergies;
- Immediate and long-term health impacts caused by extreme weather events - disproportionately affecting vulnerable and high risk groups; and
- Warmer temperatures that may encourage more outdoor recreation.

Climate Change Legislation and Policy

Legislation

Climate Change (Scotland) Act 2009
www.opsi.gov.uk/legislation/scotland/acts2009/pdf/asp_20090012_en.pdf

SPICe Briefings on Climate Change (Scotland) Bill
www.scottish.parliament.uk/s3/bills/17-ClimateChange/index.htm

Flood Risk Management (Scotland) Act 2009
www.opsi.gov.uk/legislation/scotland/acts2009/pdf/asp_20090006_en.pdf

SPICe Briefings on Flood Risk Management (Scotland) Bill
www.scottish.parliament.uk/s3/bills/15-FloodRisk/index.htm

UK Climate Change Act 2008
http://www.defra.gov.uk/environment/climatechange/uk/legislation/

UK Carbon Reduction Commitment
http://www.decc.gov.uk/en/content/cms/what_we_do/lc_uk/crc.aspx

European Union Emissions Trading Scheme
http://www.sepa.org.uk/climate_change/solutions/eu_emissions_trading_scheme.aspx

EU Climate and Energy Package
http://ec.europa.eu/climateaction/eu_action/index_en.htm

Policy

Scottish Government Climate Change Delivery Plan
www.scotland.gov.uk/Publications/2009/06/18103720/0

Scottish Government Adaptation Framework
www.scotland.gov.uk/AdaptationFramework

Scottish Government Renewables Policy and Renewables Action Plan
http://www.scotland.gov.uk/Topics/Business-Industry/Energy/Action

UK Government Carbon Capture and Storage
http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/ccs/ccs.aspx

UK Government Low Carbon Transition Plan
http://interactive.bis.gov.uk/lowcarbon/2009/07/the-uk-low-carbon-transition-plan/

UK Government Low Carbon Industrial Strategy
http://interactive.bis.gov.uk/lowcarbon/2009/07/low-carbon-industrial-strategy/

UK Renewable Energy Strategy
http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/renewable/res/res.aspx

UK Government Low Carbon Transport Plan
http://interactive.bis.gov.uk/lowcarbon/2009/07/low-carbon-transport-a-greener-future/

Further information sources

- **Carbon Trust** - www.carbontrust.co.uk
  Set up by Government in 2001 as an independent company, the Carbon Trust's mission is to accelerate the move to a low carbon economy, by working with organisations to reduce carbon emissions and develop commercial low carbon technologies.

- **Historic Scotland** - www.historic-scotland.gov.uk/climatechange
  Historic Scotland is contributing to the Government's strategy to tackle climate change and reduce Scotland's carbon footprint whilst maintaining prosperity.

- **HM Treasury Stern Review on the Economics of Climate Change** - www.hm-treasury.gov.uk/sternreview_index.htm
  Published in 2006, the review focuses on the impacts and risks arising from uncontrolled climate change, and the costs and opportunities associated with action to tackle it. It considers scientific evidence, the economic effects on human life and the environment, and approaches to modelling that ensure the impacts that affect poor people are weighted appropriately.

- **Intergovernmental Panel on Climate Change (IPCC)** - www.ipcc.ch/
  The IPCC is a scientific intergovernmental body set up by the World Meteorological Organisation (WMO) and by the United Nations Environment Programme (UNEP) to provide decision-makers and others interested in climate change with an objective source of information.

- **Met Office** - www.metoffice.gov.uk/climatechange/
  The centre is responsible for leading international research into what could happen under climate change, and the impacts on current and future generations.

- **Scottish Climate Change Impacts Partnership (SCCIP)** – www.sccip.org.uk
  SCCIP was established to "increase the resilience of organisations and infrastructure in Scotland to meet the challenges and opportunities presented by the impacts of climate change".

- **Scottish Environment Protection Agency** – www.sepa.org.uk/climatechange
  SEPA has a key role in helping Scotland limit and adapt to Climate Change, particularly in relation to its regulation of emissions to the environment and its role in flood management. SEPA may provide climate change advice when consulted through SEA.

- **Scottish Government** - www.scotland.gov.uk/Topics/Environment/climatechange
  The Scottish Government recognises that climate change will have far reaching effects on Scotland's economy, its people and its environment and is determined to play its part in rising to this challenge. The Climate Change (Scotland)s Act 2009 introduced targets to reduce emissions and will drive new thinking, new solutions, and new technologies putting Scotland at the forefront of building a sustainable low carbon economy. The Climate Change Delivery Plan sets out how these targets will be met.

- **Scottish Natural Heritage** – www.snh.org.uk/strategy/sr-pc06.asp
  SNH views climate change as the most serious threat over coming decades to Scotland's natural heritage. SNH aims to understand the effects of climate change on the natural heritage, and to help deliver the contribution that the natural heritage can make in limiting it and adapting to it. SNH may provide climate change advice when consulted through SEA.

- **UK Climate Impacts Programme (UKCIP)** – www.ukcip.org.uk
  Since 1997, the UKCIP has been working with public, private and voluntary sectors to help organisations adapt to inevitable climate change. It publishes scenarios of projected future climate change, most recently the UKCIP09 projections. The 2009 projections are available at: http://ukclimateprojections.defra.gov.uk/ .