Strategic Environmental Assessment and Climate Change: Guidance for Practitioners

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This leaflet explains how climate change issues can be considered in strategic environmental assessment (SEA), with particular reference to the requirements of European Directive 2001/42/EC "on the assessment of the effects of certain plans and programmes on the environment" (the "SEA Directive"). It explains what climate change impacts are and how they can be described, predicted and addressed. However it only touches the surface of the subject. A list of further reading is given at the end. SEA practitioners are advised to familiarise themselves with these documents before carrying out their SEAs.

Climate change and SEA

The earth's climate has changed many times in the past in response to natural causes. But it has suddenly changed over the last century or so, with global temperature rises and more extreme weather events. The world's leading scientists agree that man-made emissions of greenhouse gases – such as carbon dioxide, produced when fossil fuels are burned, and methane – are partly responsible for these changes. Progressive changes in climate are expected even in the absence of future emissions. But emissions are expected to rise, so we will have to deal with the increasing effects of climate change. We must also do what we can to minimise future emissions.

The SEA Directive requires authorities to assess the likely significant effects of their plans and programmes on "*the environment, including on issues such as biodiversity, population, human health, fauna, flora, soil, water, air,* ***climatic factors****, material assets, cultural heritage including architectural and archaeological heritage, landscape* ***and the interrelationship between the above factors***" (Annex If). These effects should include "*secondary, cumulative, synergistic, short, medium and long-term permanent and temporary, positive and negative effects*".

Figure 1 illustrates the main aspects of climate change that are relevant to SEA:

C. Climate change will occur in the future regardless of what we do now, because of our past actions. This will include raised sea levels (Box 1), changes in rainfall and temperature, and changes in the frequency of events such as storms and droughts.

E. These changes will *definitely* have consequences. Likely negative impacts include more flooding, subsidence due to soil movement, and more people dying from excessive heat. Possible benefits could include fewer winter cold deaths. The type and severity of impacts will vary from region to region.

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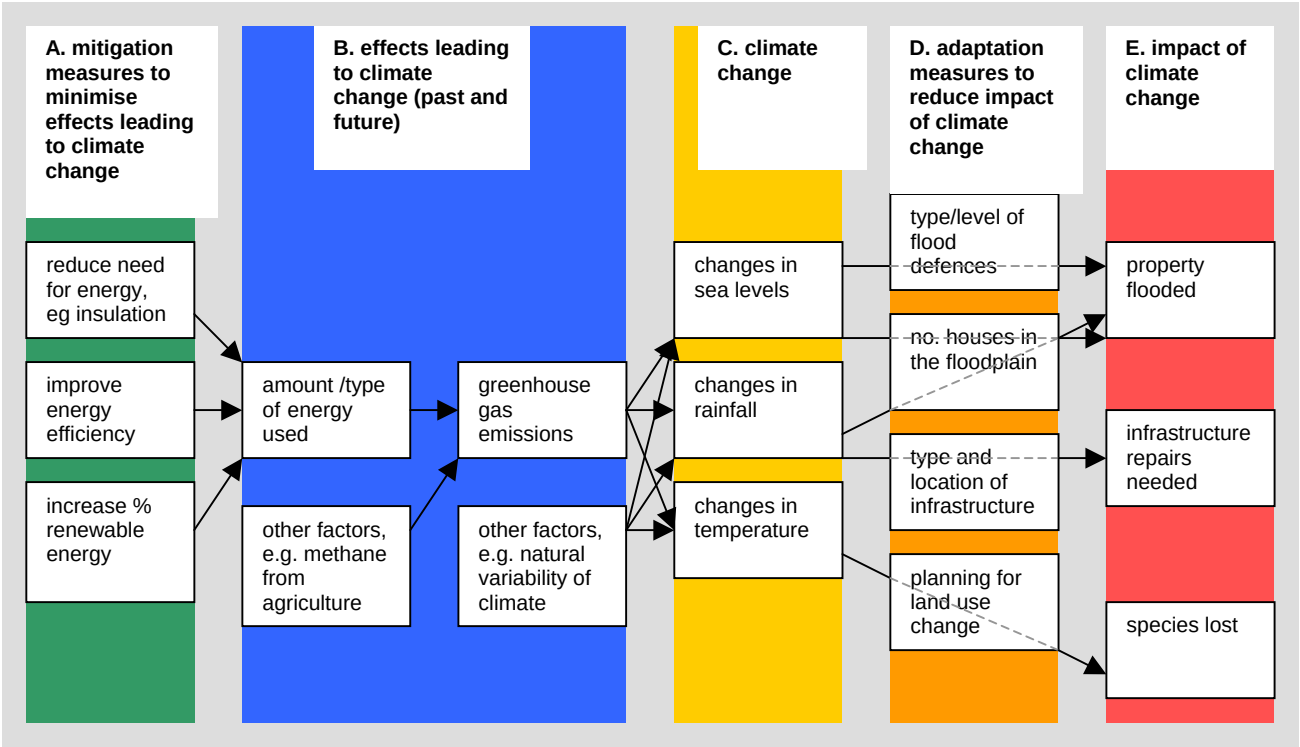
D. The severity of impacts will also depend on what "adaptation measures" are put in place, i.e. how we respond and develop new behaviour and practices to respond to or anticipate climate change. Such measures include improved flood risk management and prevention of inappropriate new construction in floodplains.

B. In addition, it is now widely accepted that greenhouse gas emissions from future activities must be reduced so as to minimise further climate change, over and above the unavoidable changes due to our past actions.

A. Such "mitigation measures" – the direct actions we take to reduce human impact on the climate system, notably by reducing greenhouse gas emissions - include improved energy efficiency, increased insulation of buildings, and increased provision of renewable energy.

Figure 1. Aspects of climate change (examples only)



Box 1. Sea level rise

Sea level rise is a key effect of climate change. Sea levels are rising globally, but with regional variations. For example, northern Britain is still "rebounding" after the retreat of the ice sheets following the last ice age, whilst southern Britain is sinking in relative terms. This vertical land differential is referred to as "isostatic adjustment" and tends to be positive in Northern Britain and negative in the south (see Figure 2).

Climate change needs to be considered at various stages of the SEA process, as shown in Table 1. Further guidance for each stage is provided in the following pages.

Assessing climate change in SEA is different from assessing other effects. First, climate change is one of the most significant and complex cumulative effects: it is due to the accumulation of many actions, each of which has only a limited impact but all of which together cause serious effects. Second, in climate change there are two sets of impacts to contend with: 1. the impact/constraints set by climate change on the plan (normally part of the SEA context/baseline stage), and 2. the effect of the plan on future emissions of greenhouse gases (in the SEA prediction/assessment stage).

Table 1. Climate change in the SEA process

SEA process (based on ODPM, 2003)	**How climate change should be considered in the process**	**see page…**
Setting the context and establishing the baseline • Propose SEA objectives and indicators • Collect baseline data, including data on likely future trends • Identify environmental problems that affect the plan • Identify other relevant plans, programmes and environmental protection objectives, and state their relation to the plan	• Agree climate change objectives and indicators that take account of (the uncertainty of future) climate change • Describe the climate change "baseline" without implementation of the plan • Identify key problems caused by likely future climate change, including constraints on the plan, (e.g. flood risk areas, habitats at risk), referring to UKCIP regional and sub-UK climate change scoping studies.	4 - 6
Deciding the scope of SEA and developing alternatives • Identify strategic alternatives • Choose preferred alternatives • Consult authorities with environmental responsibilities	• Suggest alternatives to deal with key climate change related problems • Assess the effects of the plan on greenhouse gas emissions where possible (this may be difficult to do due to vagueness of plan, uncertainty of effects etc.) and in terms of vulnerability to climate change impacts • Integrate climate change mitigation & adaptation measures into the plan • Consider climate change when choosing preferred alternatives	6 - 8
Assessing the effects of the plan • Predict and evaluate the effects of the plan • Propose measures to prevent, reduce or offset adverse environmental effects		8 7 - 8
Consultation on the draft plan and the Environmental Report • Present the results of the SEA to this point • Seek inputs from the public and authorities with environmental responsibilities • Take consultation results into account • Show how the Environmental Report results were taken into account in the final plan	• Consult authorities responsible for climate change management on particular issues: Environment Agency (flood risk, water resources), English Nature and Countryside Council for Wales (biodiversity). • Consult organisations who can provide advice on best practice: on mitigation – Energy Savings Trust, DEFRA; and on adaptation - UKCIP, regional climate change partnerships, ODPM.	
Monitor the significant effects of implementing the plan on the environment	Monitor climate change, its effects, and the effectiveness of mitigation and adaptation measures	4

Agree climate change objectives and indicators; describe and monitor the climate change "baseline"

SEA objectives and indicators should include those for climate change. Table 2 suggests possible climate change related objectives and indicators: these will need to be selected and adapted to reflect the plan contents. Box 2 lists baseline data sources. Figure 2 shows climate change scenarios that should be assumed as the basis for future assessments.

Table 2. Possible climate change objectives and indicators

	possible objectives	possible indicators: ways of describing and monitoring the environmental baseline
mitigation measures to prevent effects leading to climate change	minimise future climate change, e.g. by: • reducing the need for energy • improving energy efficiency • switching to lower carbon fuels • increasing % renewable energy	• electricity generated from renewable energy sources and CHP located in the area • embodied energy in new buildings • average energy efficiency of buildings
effects leading to climate change		• carbon emissions per person • total vehicle kilometres • total electricity and gas use • greenhouse gas emissions: per region, per capita
climate change		• sea levels • rainfall (see Figure 2) • temperature
adaptation measures to reduce impact of climate change	reduce vulnerability to the impacts of climate change, e.g. by: • providing wildlife corridors • providing adequate health services and infrastructure • ensuring that drainage systems can cope with changing rainfall patterns/intensity • taking a precautionary and risk-based approach to developing in the floodplain • ensuring adequate future water supply and demand management • designing buildings and urban areas to cope with new climate extremes • providing robust transportation infrastructure	• % developments with Sustainable Urban Drainage Systems (SUDS) • no./% homes in floodplain • no./% roads in floodplain
impact of climate change		• ranges of habitats • no. heat/cold deaths • no. cases of subsidence • no. homes flooded • river flows and water quality • air quality, particularly in urban areas • cost of flooding (to insurers, to authority)

Box 2. Sources of baseline data

- Renewable Energy Statistics Database, www.restats.org.uk - renewable energy
- OFGEM, www.ofgem.gov.uk/ofgem - CHP, energy providers
- UK Climate Impacts Programme, www.ukcip.org.uk - baseline climate for 1961-1990, future climate change scenarios, climate impacts and adaptation
- ODPM, www.planning.odpm.gov.uk/lucs17 - land use changes, flood risk
- Environment Agency, www.environment-agency.gov.uk - flood risk maps, river flows, water quality
- British Geological Survey, www.bgs.ac.uk - subsidence risk information
- English Nature and JNCC, www.english-nature.org.uk, Countryside Council for Wales, www.ccw.gov.uk - nature conservation, habitats etc
- Department of Trade and Industry, www.dti.gov.uk/energy/inform/energy_trends - energy trends

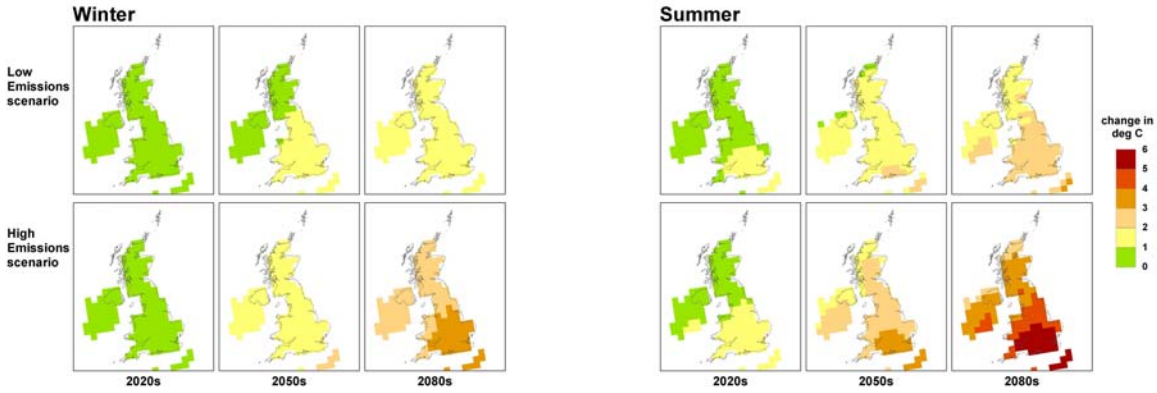
Identify key problems/constraints caused by likely future climate change

As shown in Figure 2, climate change is expected to increase the risks of higher temperatures, wetter winters, drier summers, higher sea levels with increased risk of flooding, and more extreme events (storms, droughts, etc). It is the interrelation of these and other factors that causes a range of impacts:

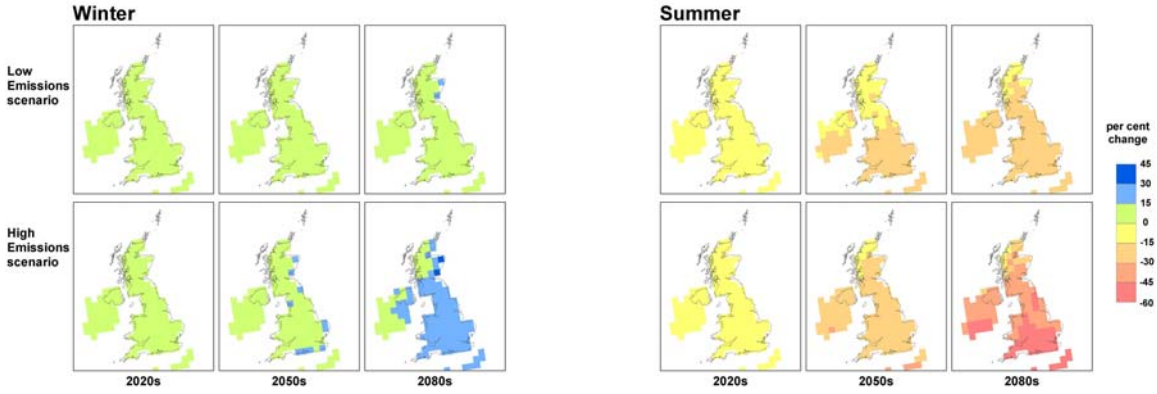
- on water demand and quality - river flows are likely to be lower in summer and higher in winter, which could aggravate water quality problems and water resources issues

Figure 2. Some expected climate changes

Change in average winter and summer temperatures for the 2020s, 2050s and 2080s for the UKCIP Low and High greenhouse gas emissions scenarios



Change in average winter and summer precipitation for the 2020s, 2050s and 2080s for the UKCIP Low and High greenhouse gas emissions scenarios



Vertical land movements and net sea level change

	Regional isostatic uplift (+ve) or subsidence (-ve) (mm/yr) see Box 1	Net sea level change 2020s (cm) relative to 1961-90 (high estimate)
NE Scotland	+0.7	12
SE Scotland	+0.8	10
NE England	+0.3	13
Yorkshire	-0.5	17
East Midlands	-1.0	19
Eastern England	-1.2	20
London	-1.5	22
SE England	-0.9	19
SW England	-0.6	17
Wales	-0.2	15
Northern Ireland	n/a	~14
NW England	+0.2	13
SW Scotland	+1.0	9
NW Scotland	+0.9	10
Orkney & Shetland	n/a	~14
Global average	**n/a**	**14**

Note: Land movement data not available for Northern Ireland and Orkney & Shetland

Source: Climate change scenarios for the United Kingdom: The UKCIP02 Scientific Report

- on biodiversity - summer drought could stress wetlands; changes in temperature could affect the location of habitats and thus cause species migration or extinction; green and open spaces could be used more intensively with more outdoor living, potentially leading to disturbance of species and damage to habitats
- on health - accident incidence and some diseases are sensitive to weather (e.g. lower winter mortality and fewer incidences of fuel poverty), but higher potential summer mortality caused by heat stress: see Box 3); warmer weather could also encourage spread of disease and pests
- on soils and the built environment - subsidence and heave could worsen as clay dries out in dry summers, then wets again in winter
- on "material assets" – disruption of transport services from flooding and warmer temperatures; the insurance industry could be exposed to increased volume of claims and the public to increased premiums; increased temperatures could attract more tourists to the UK
- on the cultural heritage - wetter winters and drier summers could adversely affect older properties, with more rain causing flooding and dry summers causing subsidence; archaeology in coastal areas could be lost as sea levels rise.

These problems will vary by region. The UKCIP regional scoping studies are an excellent source of information on climate change impacts (see Box 4).

Box 3. Health effects of climate change

In the summer of 2003, 35,000 deaths were recorded throughout Europe that are attributed to the heatwave. In the UK the figure was 2045.

Suggest alternatives to deal with key climate change related problems; Integrate climate change mitigation and adaptation measures into the plan

Climate change effects can only be dealt with through multiple actions. Two types of "*measures… to prevent, reduce and as fully as possible offset any significant adverse effects on [climate change] of implementing the plan*" (SEA Directive, Annex Ig) need to be considered. First, under the Kyoto Protocol and government targets, the plan should aim to reduce greenhouse gas emissions in all cases: these "mitigation measures" are essentially reducing problems for future generations. Table 3 gives examples of mitigation measures. Second, the plan will need to ensure that enough "adaptation measures" are in place to deal with the present and future impacts of climate change. Assessment of effects may be needed to ensure that enough adaptation is undertaken. Table 4 lists categories of adaptation and provides some examples.

Principles for selecting good climate change adaptation options include:

- Keeping options open and flexible, so that further measures or other strategies can be put in place in the future
- Finding 'no-regret' or 'low-regret' adaptation options. 'No regret' options deliver net benefits, whatever the extent of climate change and should always be implemented if they exist. If an authority is already experiencing weather-related problems, then cost-effective actions to deal with them should be 'no regret' options.

- Avoiding decisions that will make it more difficult to manage climate risks in the future. These are called adaptation constraining decisions. One example is inappropriate development in a flood risk area.
- Finding win-win options. Win-win options are ones that contribute to both climate change mitigation and adaptation and to wider plan objectives, e.g. business opportunities from energy efficiency measures.

Table 3. Categories of mitigation and some examples

Mitigation measure	Notes
Avoid using energy	Use natural daylighting and ventilation in buildings, to avoid artificial light or air conditioning
	Build cycle paths and keep shops and facilities in walking distance of where people live
Use less energy	Well-insulated buildings need little energy to keep warm
	Buy small, efficient cars. Use local transport plans to reduce the need to travel and promote non-car modes of transport
	Buy locally-produced goods (bricks, food, wood products)
	Use light emitting diodes for traffic lights and low-energy street lights
	Generate electricity locally and reduce transmission losses
	Buy equipment with low standby (computers, monitors, photocopiers). Require suppliers to be energy efficient in their own premises
	Get your local authority Energy Efficiency Accredited
	Set an energy efficiency target for your housing stock and achieve it
Use wasted energy	Install a heat network to use the hot water from a power station
	Capture and use landfill gas efficiently (>85%)
	Use sunshine to heat hot water (solar thermal panels) or to produce electricity (photovoltaics)
Prevent methane emissions	Encourage composting
	Capture the leakage from old coal mines
Downsize	Encourage the construction of smaller homes, at a high density
Fuel switching	Use less coal, oil, electricity and more renewables
	Generate green electricity locally, through wind turbines, photovoltaics, combined heat and power
	Grow energy crops (biomass)

Table 4. Categories of adaptation and some examples

Adaptation strategy type	Notes
Use of risk-based policy and project appraisal process and techniques	Proactive. Organisations that adopt risk assessment will be more flexible and better able to cope with climate risks.
Delay and buy time	Proactive. A delay strategy can help to deliver a better decision, if the delay time is used to improve your knowledge – for instance by combining it with research or monitoring.
Research	Proactive or strategic. e.g. use research to better understand climate risks and performance of adaptation options.
Monitoring	Proactive: system performance monitoring. Reactive: climate impact monitoring. e.g. monitoring numbers of properties affected by flooding / subsidence.
Information supply, education, awareness-raising	Proactive or reactive. Can be used to raise awareness of the need to adapt. e.g. increase public awareness about coping with flooding at home.
Contingency planning	Strategic planning for low probability, high consequence events. e.g. ensure emergency procedures and equipment are updated to meet increased risks.
Diversification or bet-hedging	Proactive technical or policy response. 'Don't put all your eggs in one basket'.

Insurance	Proactive, fiscal response. e.g. insure business against weather losses.
Defend and manage	Proactive or reactive technical measures. e.g. strengthen building foundations to cope with increased subsidence risk. Upgrade wastewater systems to cope with increasing intensity of rainfall.
Change of use	Proactive or reactive. Includes planning responses, with or without technical measures.
Retreat and abandon	Proactive or reactive. Includes strategic planning response. e.g. accept loss of some coastal areas to sea level rise.
Safety factors, climate headroom, buffering measures	Proactive or strategic. Includes technical and regulatory response. e.g. create wildlife corridors and 'stepping stones' to help species migrate.

Assess the effects of the plan on greenhouse gas emissions and on vulnerability to climate change

The plan's effects on climate change cannot be assessed directly because of the many other factors affecting climate and the global scale of the consequences. However its effects on greenhouse gas emissions generally can be determined.

The vulnerability of the plan to climate change can normally be assessed as part of the baseline and problem identification stages. The main effects of climate change on the plan are where it interrelates with other environmental risks associated with the plan. These will commonly include biodiversity, human health, buildings and infrastructure etc. SEA practitioners will need to decide whether the relevant issues are best tackled as separate "climatic risk factors" or integrated into the analysis of the other impacts associated with the plan. The latter should, in general, be preferred.

Many different aspects of climate change and its impacts could potentially be assessed in SEA. A clear focus is needed on:

- The plan's effects on greenhouse gas emissions (implementation and operational phases)
- The plan's likely secondary/incidental environmental consequences, including their likelihood and magnitude/severity.
- How these risks might be increased/decreased by climate change over the plan's lifetime.

Box 4. Further reading

On SEA:

- European Directive 2001/42/EC "on the assessment of the effects of certain plans and programmes on the environment", http://europa.eu.int/eur-lex/pri/en/oj/dat/2001/ l_197/l_19720010721en00300037.pdf.
- ODPM (2003) *The Strategic Environmental Assessment Directive: Guidance for Local Planning Authorities*. http://www.odpm.gov.uk – to be revised summer 2004.
- Therivel, R. (2004) *Strategic Environmental Assessment in Action*, Earthscan, London.
- Environment Agency (2004 forthcoming) *Good Practice Guidelines for SEA*.
- English Nature, CCW, EA, RSPB (2004) *SEA and Biodiversity: Guidance for Practitioners.*

On climate change (reports available from UKCIP website www.ukcip.org.uk or in hard copy from UKCIP):

- The **UKCIP02 climate change scenarios** provide information about expected climate changes in the UK over the 21st century.
- The UKCIP report **'Climate adaptation: Risk, uncertainty and decision-making'**, developed with the Environment Agency, provides an 8-stage decision-making framework to help assess climate risks and incorporate suitable adaptation measures into a decision.
- **Sub-UK scoping studies on the impacts of climate** change are available for most English regions, Scotland, Wales and Northern Ireland, providing information across a wide range of sectors.
- **Sectoral studies** on climate change impacts and adaptation are complete or underway in the following sectors: agriculture; built environment; business; health; local authorities; marine environments; nature conservation; and water demand.