European Commission

Guidance on Integrating Climate Change and Biodiversity into Strategic Environmental Assessment

Environment

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It can be accessed through the Europa server (http://ec.europa.eu).

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Foreword

The need for action on climate change and biodiversity loss is recognised across Europe and around the world. To make progress towards combating and adapting to climate change, and halting the loss of biodiversity and the degradation of ecosystems, it is vital to fully integrate these issues in the plans, programmes and projects implemented across the EU.

It is widely recognised that climate change has enormous economic consequences. The evidence gathered in *The Stern Review: The Economics of Climate Change* (2007) shows that 'ignoring climate change will eventually damage economic growth.' The Review also points out that 'the benefits of strong and early action far outweigh the economic costs of not acting.' The Commission's *White Paper – Adapting to climate change: Towards a European framework for action* (2009) tackles this evidence and includes a commitment that '… the Commission will work with Member States and stakeholders setting guidelines and exchanging good practice, to ensure that account is taken of climate change impacts when implementing the Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA) Directives and spatial planning policies.' It also encourages Member States to adopt ecosystem-based approaches, including green infrastructure. The Commission's *EU Strategy on Adaptation to Climate Change*, to be adopted in 2013, will build on the White Paper.

The loss of biodiversity has become one of our main environmental challenges. Its impact on the delivery of ecosystem services, the society and economy as whole is increasingly recognised, including in the international study by TEEB (2010) of The Economics of Ecosystems and Biodiversity — *Mainstreaming the Economics of Nature: A synthesis of the approach, conclusions and recommendations.* To address this challenge, Member States have committed themselves to halt the loss of biodiversity and ecosystems by 2020 and to restore them in so far as feasible.

This *Guidance on Integrating Climate Change and Biodiversity into Strategic Environmental Assessment* is a response to the above commitments. Most of the projected impacts of climate change are believed to have adverse effects on biodiversity. Since climate change and biodiversity loss — like so many other environmental issues we face — are closely interrelated, they are covered in the same guidance.

It is clear that 'business as usual' will neither achieve our climate change nor our biodiversity objectives. The time has come to make sure that we employ all available tools to tackle these global threats. Environmental Impact Assessments (EIAs) and Strategic Environmental Assessments (SEAs) are legally required and systematic tools, and as such they are well suited to systematically tackle the problems.

As Jose Manuel Barroso, President of the European Commission, said at the Athens Biodiversity Conference in 2009 – 'The success of our climate change policy will also be measured by the success of our efforts in stopping the loss of biodiversity.' Our aim is that this guidance will help the impact assessment community to better integrate these considerations into their work, stepping up global and EU action to combat biodiversity loss and climate change.

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Acronyms and abbreviations

BAP	Biodiversity Action Plan
BBOP	Business and Biodiversity Offsets Programme
BISE	Biodiversity Information System for Europe
CBD	Convention on Biological Diversity
CH_4	Methane
CO_2	Carbon dioxide
ECCP	European Climate Change Programme
EC	European Commission
EEA	European Environment Agency
EIA	Environmental Impact Assessment
ETC/ACM	European Topic Centre for Air Pollution and Climate Change Mitigation
ETC-BD	European Topic Centre on Biological Diversity
EU ETS	EU Emissions Trading System
EU	European Union
GHG, GHGs	Greenhouse gas, Greenhouse gases
GIS	Geographic Information System
IAIA	International Association for Impact Assessment
IEMA	Institute of Environmental Management and Assessment
IPCC	Intergovernmental Panel on Climate Change
JRC	Joint Research Centre
NBSAP	National Biodiversity Strategy and Action Plan
NGOs	Non-governmental organisations
NO_x	Nitrogen oxides
N_2O	Nitrous oxide
OECD	Organisation for Economic Cooperation and Development
PP, PPs	Plan or Programme, Plans and/or Programmes
SAC	Special Area of Conservation
SEA	Strategic Environmental Assessment
SOER	State of the Environment Report (EEA)
SPA	Special Protection Area
TEEB	The Economics of Ecosystems and Biodiversity
UN	United Nations
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
VOCs	Volatile organic compounds

Glossary

Term	Definition
Adaptation (climate change)	The term used to describe responses to the effects of climate change. The Intergovernmental Panel on Climate Change (IPCC) defines adaptation as 'adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.' Adaptation can also be thought of as learning how to live with the consequences of climate change.
Adaptive capacity	The ability of a system to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities and to cope with the consequences. (CLIMATE-ADAPT Glossary)
Adaptive management	A systematic process for continually improving management policies and practices by learning from the outcomes of previous policies and practices.
Article 6(3) appropriate assessment	Article 6(3) of the Habitats Directive requires an appropriate assessment (also referred to as 'Habitats Directive assessment' or 'Natura 2000 assessment') to be carried out where any plans or projects that are not directly linked to the management of that site may have a significant effect on the conservation objectives and would ultimately affect the integrity of the site. Integrity can be defined as the ability of the site to fulfil its function to continue to support protected habitats or species. Annex I to the Habitats Directive includes a full list of protected habitats and Annex II of protected species.
Baseline	A description of the present and future state, if the plan or programme (PP) is not implemented, taking into account changes resulting from natural events and from other human activities.
Biodiversity	The Convention on Biological Diversity (CBD) defines biological diversity as 'the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems' (Article 2).
Biodiversity offsets	Measures taken to compensate for any residual significant, adverse impacts that cannot be avoided, minimised and/or rehabilitated or restored, in order to achieve 'no-net-loss' or a 'net-gain' of biodiversity. Offsets can take the form of positive management interventions such as restoration of degraded habitat, arrested degradation or averted risk, protecting areas where there is imminent or projected loss of biodiversity.
Birds Directive	Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds [codified version], OJ L 20, 26.1.2010, p. 7.
Carbon sequestration	The removal of carbon from the atmosphere and its storage in carbon sinks (such as oceans, forests or soils) through physical or biological processes, such as photosynthesis.
Carbon sink	An absorber of carbon (usually in the form of CO_2). Natural carbon sinks include forests and other ecosystems that absorb carbon, thereby removing it from the atmosphere and offsetting CO_2 emissions. (Modified from EEA Glossary)
Climate	Usually defined as the 'average weather', or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities of variables such as temperature, precipitation, and wind, over a period of time. The conventional period of time over which weather is averaged to calculate climate is 30 years, as defined by the World Meteorological Organisation (WMO). (Modified from IPCC)
Climate change	The IPCC defines climate change as '...any change in climate over time, whether due to natural variability or as a result of human activity.' The United Nations Framework Convention on Climate Change (UNFCCC) defines it specifically in relation to human influence as: 'a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.'
CO_2 equivalent	A metric measure used to compare emissions from various GHGs based upon their global warming potential (GWP). Carbon dioxide equivalents are commonly expressed as 'million metric tonnes of carbon dioxide equivalents (MMTCDE)'.
Cumulative effects	The incremental effects of an action PP when added to other past, present, and reasonably foreseeable future actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time.
Direct effects	Environmental effects caused directly by the implementation of a PP.
Ecosystem services	The Economics of Ecosystem Services and Biodiversity (TEEB) study defines ecosystem services as: 'the benefits people receive from ecosystems'. TEEB also sets out the basis of human dependence on the natural environment. The European-led study builds on the United Nations Millennium Ecosystem Assessment, which defined four categories of ecosystem services that contribute to human well-being:

	• provisioning services e.g. wild foods, crops, fresh water and plant-derived medicines; • regulating services e.g. filtration of pollutants by wetlands, climate regulation through carbon storage and water cycling, pollination and protection from disasters; • cultural services e.g. recreation, spiritual and aesthetic values, education; • supporting services e.g. soil formation, photosynthesis and nutrient cycling. (TEEB, 2010)
Effort Sharing Decision	A Decision that sets annual binding GHG emission targets for Member States for the 2013–2020 period. These targets concern emissions from sectors not included in the EU Emissions Trading System (ETS) — such as transport, buildings, agriculture and waste. It is part of a package of policies and measures on climate change and energy that will help transform Europe into a low-carbon economy and increase its energy security.
EIA Directive	Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment [codification], OJ L 26, 28.1.2012, p.1. The EIA Directive requires that Member States ensure that, before development consent is given, projects likely to have significant effects on the environment because of their nature, size or location are made subject to an assessment of the environmental effects.
Emission trading scheme and **EU Emissions Trading system (EU ETS)**	A market mechanism that allows those bodies (such as countries, companies or manufacturing plants) that emit (release) GHGs into the atmosphere, to buy and sell these emissions (as permits or allowances) amongst themselves. Emissions mean the release of GHGs and/or their precursors into the atmosphere over a set area and period of time. The European Union Emission trading system (EU ETS) is based on the idea that creating a price for carbon offers the most cost-effective way to achieve the significant cuts in global GHG emissions that are needed to prevent climate change from reaching dangerous levels.
Environmental report	Document required by the SEA Directive as part of an environmental assessment, which identifies, describes and evaluates the likely significant effects on the environment of implementing a PP. The SEA Directive states that the environmental report shall mean the part of the plan or programme documentation containing the information required in Article 5 and Annex I.
European Climate Change Programme	A programme launched by the European Commission in June 2000. Its goal is to identify and develop all the necessary elements of the EU strategy to implement the Kyoto Protocol.
Fauna	The animals of a particular region or habitat.
Floods Directive	Directive 2007/60/EC on the assessment and management of flood risks, OJ L288, 6.11.2007, p.27, requires Member States to assess if all water courses and coast lines are at risk from flooding; to map the flood extent and assets and humans at risk in these areas; and to take adequate and coordinated measures to reduce this flood risk. The Directive also reinforces the rights of the public to access this information and to have a say in the planning process.
Flora	The plants of a particular region or habitat.
Green infrastructure	Green infrastructure serves the interests of both people and nature. It can be defined as a strategically planned and delivered network of high quality green spaces and other environmental features. Green infrastructure includes natural and semi-natural areas, features and green spaces in rural and urban, terrestrial, freshwater, coastal and marine areas. It should be designed and managed as a multifunctional resource capable of delivering a wide range of benefits and services. Areas protected as Natura 2000 sites are at the core of green infrastructure.
Greenhouse gas (GHG)	Any atmospheric gas (either natural or anthropogenic in origin) which absorbs thermal radiation emitted by the Earth's surface. This traps heat in the atmosphere and keeps the surface at a warmer temperature than would otherwise be possible.
Habitats Directive	Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, as amended, OJ L 206, 22.7.1992, p.7.
Indirect effects	Effects that occur away from the immediate location or timing affected by the implementation of a PP, e.g. quarrying of aggregates elsewhere as a result of implementing new road proposals included in plan or programme (see also secondary effects).
Kyoto Protocol	The Kyoto Protocol to the UN Framework Convention on Climate Change (UNFCCC) was adopted in 1997 (Kyoto, Japan). It contains legally binding commitments, in addition to those included in the UNFCCC. Countries included in Annex B of the Protocol (most OECD countries and EITs) agreed to reduce their anthropogenic emissions of GHGs (CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6) by at least 5 % below 1990 levels in the commitment period 2008 – 2012.
Maladaptation	An action or process that increases vulnerability to climate change-related hazards. Maladaptive actions and processes often include planned development policies and measures that deliver short-term gains or economic benefits, but increase vulnerability in the medium to long-term.
Maximum sustainable yield (MSY)	Maximum sustainable yield (MSY) is the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological and environmental conditions.

Mitigation (climate change)	A term used to describe the process of reducing GHG emissions that are contributing to climate change. It includes strategies to reduce GHG emissions and enhancing GHG sinks.
Mitigation (SEA)	Measures to prevent, reduce and as fully as possible offset any significant adverse effects on the environment of implementing the PP. (SEA Directive)
Natura 2000	An EU-wide network of nature protection areas established under the Habitats Directive. The aim of the network is to assure the long-term survival of Europe's most valuable and threatened species and habitats. It is comprised of Special Areas of Conservation (SAC) designated by Member States under the Habitats Directive and Special Protection Areas (SPAs) designated under the Birds Directive.
No-net-loss of biodiversity	The point where biodiversity gains from targeted conservation activities match the losses of biodiversity due to the impacts of a specific development project, so that there is no net reduction overall in the type, amount and condition (or quality) of biodiversity over space and time. A net gain means that biodiversity gains exceed a specific set of losses. The concept of no-net biodiversity loss lies at the heart of biodiversity offsetting. (Business and Biodiversity Offsets Programme)
No-regret measures	'No-regret' measures are activities that yield benefits even in the absence of climate change. In many locations, the implementation of these actions constitutes a very efficient first step in a long-term adaptation strategy. For example, controlling leakages in water pipes or maintaining drainage channels is almost always considered a very good investment from a cost–benefit analysis perspective, even in absence of climate change. (CLIMATE-ADAPT relevant webpage)
Precautionary principle	Principle adopted by the UN Conference on the Environment and Development (1992) that in order to protect the environment, a precautionary approach should be widely applied, meaning that where there are threats of serious or irreversible damage to the environment, lack of full scientific certainty should not be used as a reason for postponing cost-effective measures to prevent environmental degradation. (EEA Glossary)
Proxy indicator	Indirect measure that approximates or represents a phenomenon in the absence of a direct measure.
Residual effects	Effects that remain after mitigation action.
Resilience	The ability of a social or ecological system to absorb disturbances, while retaining the same basic structure and ways of functioning, as well as its capacity to self-organise and adapt to stress and change. There are different ways in which resilience can be framed; the Dutch Climate Changes Spatial Planning research programme provides a list. (Adapted from CLIMATE-ADAPT Glossary). It can be also described as the amount of change a system can undergo without changing state.
SEA Directive	Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment, OJ L 197, 21.7.2001, p.30. It requires the environmental effects of a broad range of plans and programmes to be assessed so they can be considered while plans are actually being developed, and in due course adopted. The public must also be consulted on the draft plans and the environmental assessment, and their views must be taken into account.
Secondary effects	Effects that occur as a consequence of a primary effect or as a result of a complex pathway (see also indirect effects).
Sensitivity	The degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. The effect may be direct (e.g. a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g. damages caused by an increase in the frequency of coastal flooding due to sea level rise).
Significant effects	Effects that are significant in the context of the PP, i.e. a function not just of magnitude or size of effect, but of nature, sensitivity and scale of the receptor.
Synergistic effects	Effects that interact to produce a total effect greater (or less than) than the sum of the individual effects. Cumulative effects that result when the interaction of a number of impacts is greater than the sum of the individual impacts.
Vulnerability	The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity. (CLIMATE-ADAPT Glossary)

Summary

Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment[1] ('Strategic Environmental Assessment' — 'SEA Directive') requires certain public plans and programmes (PPs) to undergo an environmental assessment before they are adopted.

The aim of this *Guidance on Integrating Climate Change and Biodiversity into Strategic Environmental Assessment* is to improve the consideration of these issues in strategic environmental assessments (SEAs) carried out across the EU Member States. This summary gives an overview of the guidance and distils the advice on how to integrate these issues into SEAs.

The guidance is arranged in a way that will encourage users to think about how important climate change and biodiversity — as assessment issues — are likely to be for a specific SEA (see box right).

How important are climate change and biodiversity for your SEA?

- How will PP influence climate change and biodiversity and how it will be influenced by climate change and biodiversity?
- What is it about climate change and biodiversity that poses a challenge to the assessment process?
- How does that affect the information needs — what type of information, what sources and what stakeholders will hold information and specific knowledge in these areas?
- What are the key aspects to cover in the detailed assessment and how important will those issues be in decision making?

Section 1 contains an introduction and detailed user guide, including a navigation aid to help to decide when and how to use the guidance. Sections 2 and 3 explain why climate change and biodiversity are so important for SEAs, including an explanation of the issues and the policy background at the international/EU level. Section 4 helps to scope the climate change and biodiversity issues, and Section 5 explains how to assess climate change and biodiversity throughout the SEA process. The annexes provide sources of further reading and links to other relevant guidance, information, data and tools.

The summary boxes overleaf distil the main points of the guidance on how to integrate climate change and biodiversity into SEAs.

[1] Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment, OJ L 197, 21.7.2001, p.30.

HOW TO ADDRESS BOTH CLIMATE CHANGE AND BIODIVERSITY EFFECTIVELY IN SEAs:

- **Build them into the assessment and PP from the earliest stage** and follow them throughout — start at the screening and scoping stages to build these issues into the mindset of all the key parties: competent authorities and policymakers, planners, SEA practitioners and other stakeholders. The SEA can be used as a creative process to support learning amongst all these parties.
- **The consideration of biodiversity and climate change issues must be tailored to the specific context of the PP.** It is not simply a checklist of issues to tick off. Each SEA can potentially be different.
- **Be practical and use your common sense!** When consulting stakeholders, avoid drawing out the SEA procedure and leave enough time to properly assess complex information.
- Use the SEA as an opportunity to address key issues regarding different types of projects or specific infrastructure projects. At this time, **many options are still open** (e.g. the location of motorways versus Natura 2000 network sites) and you can avoid problematic situations at the EIA/project level.

CRITICAL CHALLENGES FOR ADDRESSING CLIMATE CHANGE AND BIODIVERSITY IN SEAs ARE TO:

- Consider **long-term trends** both with and without the proposed PP and avoid 'snapshot' analyses.
- Assess the PP against the **future baseline** and **key trends and their drivers** taking into account other PPs.
- Consider **the impact that predicted changes in the climate and biodiversity** will have on the proposed PP, potentially over a long timescale, and its resilience and capacity to cope.
- Manage **complexity;** consider whether implementation of part of a PP e.g. climate change mitigation, that might otherwise be positive in its impact, could have a negative impact on climate change adaptation and/or biodiversity.
- Consider what existing climate change and biodiversity **objectives and targets** need to be integrated into the PP.
- Consider the **long-term and cumulative effects** on climate change and biodiversity of PP as these will be potentially significant given the complex nature of these topics.
- Be comfortable with **uncertainty**. Use tools such as **scenarios** to help deal with the uncertainty inherent within complex systems and imperfect data. Think about risks when impacts are too uncertain and factor this into monitoring to manage adverse effects.
- Develop more **resilient alternatives and solutions** based on 'win-win' or 'no regret'/'low regret' approaches to PP development, given the uncertainty inherent in climate change and predicting impacts on biodiversity.
- Prepare for **adaptive management** and monitor to improve adaptive capacity.
- Base your recommendations on the **precautionary principle** and acknowledge assumptions and limitations of current knowledge.

HOW TO IDENTIFY CLIMATE CHANGE AND BIODIVERSITY ISSUES IN SEAs:

- Identify key climate change and biodiversity issues **early in the process**, but be flexible and review them as new issues emerge.
- Identify and bring together all the **stakeholders and environmental authorities** to help identify the key issues.
- Investigate how climate change and biodiversity **interact with each other and with other environmental issues**.
- Remember to consider both the **impacts of the PP on climate and climate change and biodiversity** and the **impact of a changing climate and natural environment on the PP**.
- Investigate how climate change **mitigation and adaptation interact** with each other (e.g. remember that a positive effect on climate change mitigation may lead to negative effects on adaptation, etc.).
- Consider the **national, regional and local context** as appropriate, depending on the scale of the PP. You may also need to consider the European and global context.
- Consider the **objectives, commitments and targets** set in policy and how to integrate them into the PP.
- Use **ecosystem services** to provide a framework for assessing the interactions between biodiversity and climate change.

HOW TO ASSESS THE EFFECTS RELATED TO CLIMATE CHANGE AND BIODIVERSITY IN SEAs:

- **Consider climate change scenarios at the outset**. Include extreme climate situations and 'big surprises' that may either adversely affect implementation of the PP or may worsen its impacts on biodiversity and other environmental factors.
- **Analyse the evolving environmental baseline trends**. Include trends in key issues over time, drivers for change, thresholds and limits, areas that may be particularly adversely affected and the key distributional effects. Use vulnerability assessments to help assess changes to the baseline environment and identify the most resilient alternative(s).
- **Take an integrated, 'ecosystems' approach to planning and examine the thresholds and limits.**
- **Look for opportunities for enhancement**. Ensure that the PPs are consistent with other relevant policy objectives, and priority actions for climate change and biodiversity.
- **Assess alternatives that make a difference in terms of climate change and biodiversity effects** — review the need, the process for its implementation, locations, timings, procedures, etc. and alternatives that enhance ecosystem services.
- First **seek to avoid biodiversity and climate change effects** and then mitigate. Seek 'no-net-loss' of biodiversity.
- **Assess climate change and biodiversity synergistic/cumulative effects**. Causal chains/network analysis may be helpful to understand interactions.
- **Monitor** the effectiveness that adaptive management has been built into the PP and whether it is being delivered.

1. Introduction

This section explains the purpose of the guidance, the approach it adopts, and how to use it to integrate climate change and biodiversity into strategic environmental assessments (SEA). It is assumed that readers will be familiar with the SEA, so it does not introduce the basic SEA process.

1.1 Nature and purpose of this guidance

Climate change and biodiversity loss are among the most important environmental challenges we face today. Both are complex and cross-cutting issues, which impact on nearly all human activity. This *Guidance on Integrating Climate Change and Biodiversity into Strategic Environmental Assessment* ('the guidance') aims to help improve the consideration and assessment of climate change and biodiversity issues into SEAs carried out across the EU Member States, under the *Directive 2001/42/EC*[2] ('Strategic Environmental Assessment' — 'the SEA Directive').

The SEA Directive

The SEA Directive requires certain public PPs to undergo an environmental assessment before they are adopted.

The SEA Directive applies to a wide range of public PPs (e.g. on land use, transport, energy, waste, agriculture, etc.).

PP in the sense of the SEA Directive must be prepared or adopted by an authority (at national, regional or local level) and be required by legislative, regulatory or administrative provisions.

The PPs covered by the Directive are subject to an environmental assessment during their preparation, and before their adoption. This includes the drawing up of an environmental report in which the likely significant effects on the environment and the reasonable alternatives are identified, and the carrying out of consultations (with the public, the environmental authorities, and with other Member States in the case of transboundary effects). The environmental report and the results of the consultations are taken into account before adoption of the proposed PP. Once a PP is adopted, the environmental authorities and the public are informed and relevant information is made available to them. SEA Directive also requires monitoring of significant environmental effects of the PP in order to identify unforeseen adverse effects at an early stage of PP implementation.

As a legally required and specifically defined process, SEAs are an opportunity to systematically integrate climate change and biodiversity in a standardised approach into plans and programmes (PPs) across the EU. This is an opportunity that cannot be missed if Europe is to achieve its environment and development objectives.

This guidance addresses **the specific issues and challenges that climate change and biodiversity bring to SEA**; complementary guidance was prepared on the integration of climate change and biodiversity into environmental impact assessments (EIA). The SEA guidance is designed to be used by competent authorities and policymakers, planners, SEA practitioners and other stakeholders across the Member States and candidate countries.

This guidance highlights how you need to integrate climate change and biodiversity issues effectively into the SEA process. **It is arranged in a way that will encourage users to think about how important climate change and biodiversity — as assessment issues — are likely to be for a specific PP and SEA** processes.

This guidance applies to SEAs carried out for different types of PPs, and their revisions, required under the Directive — it is therefore inevitably generic. It is also intended to apply across all the Member States and their respective legislative and governance structures, and to supplement rather than conflict with any national SEA

[2] Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment, OJ L 197, 21.7.2001, p.30.

guidance.

Since it is the first such type of guidance issued by the European Commission, and climate change and biodiversity scientific base, policies, and SEA practices constantly evolve, it should be considered as a pilot guidance document. Subsequent amended versions are expected as experience with the process is gained. These may include more specific guidance on integrating disaster risk management.

1.2 How to use this guidance

Users can either review the entire document at once, or skip directly to sections of specific interest. It is assumed that readers will already have a reasonable understanding of the SEA process, methodologies and techniques used in SEAs.

Section 2: Climate change and biodiversity in SEA — provides background on the issues and their legal and practical relationship with SEA. It also shows the benefits of early consideration of climate change and biodiversity in SEAs.

Section 3: Understanding climate change and biodiversity — gives users a basic understanding of the climate change and biodiversity issues to enable them to integrate the right issues into the SEA.

Existing guidance documents: SEA and climate change

Several general guidance documents on SEA and climate change have already been issued by Member States or other organisations. While they are tailored for specific users, they can be useful to consult for supplementary information:

- *Opportunities for Integrating Climate Change Concerns into Regional Planning through Strategic Environmental Assessment* (the INTERREG IVC project, Regions for Sustainable Change, 2011)
- *Strategic Environmental Assessment and climate change: Guidance for practitioners* (the Environment Agency for England and Wales, 2011)
- *SEA Topic Guidance for Practitioners* (the Climate Change Countryside Council for Wales, revised 2007)
- *The Consideration of Climactic Factors within Strategic Environmental Assessment* (the Scottish Government, 2010)

Further information: Annex 1

Section 4: What are the key climate change and biodiversity issues? — identifies the key issues on climate change mitigation, adaptation and biodiversity — i.e. how to scope these issues in SEAs.

Section 5: How to assess effects related to climate change and biodiversity in SEA? — practical tips on how to assess climate change and biodiversity related effects in SEAs.

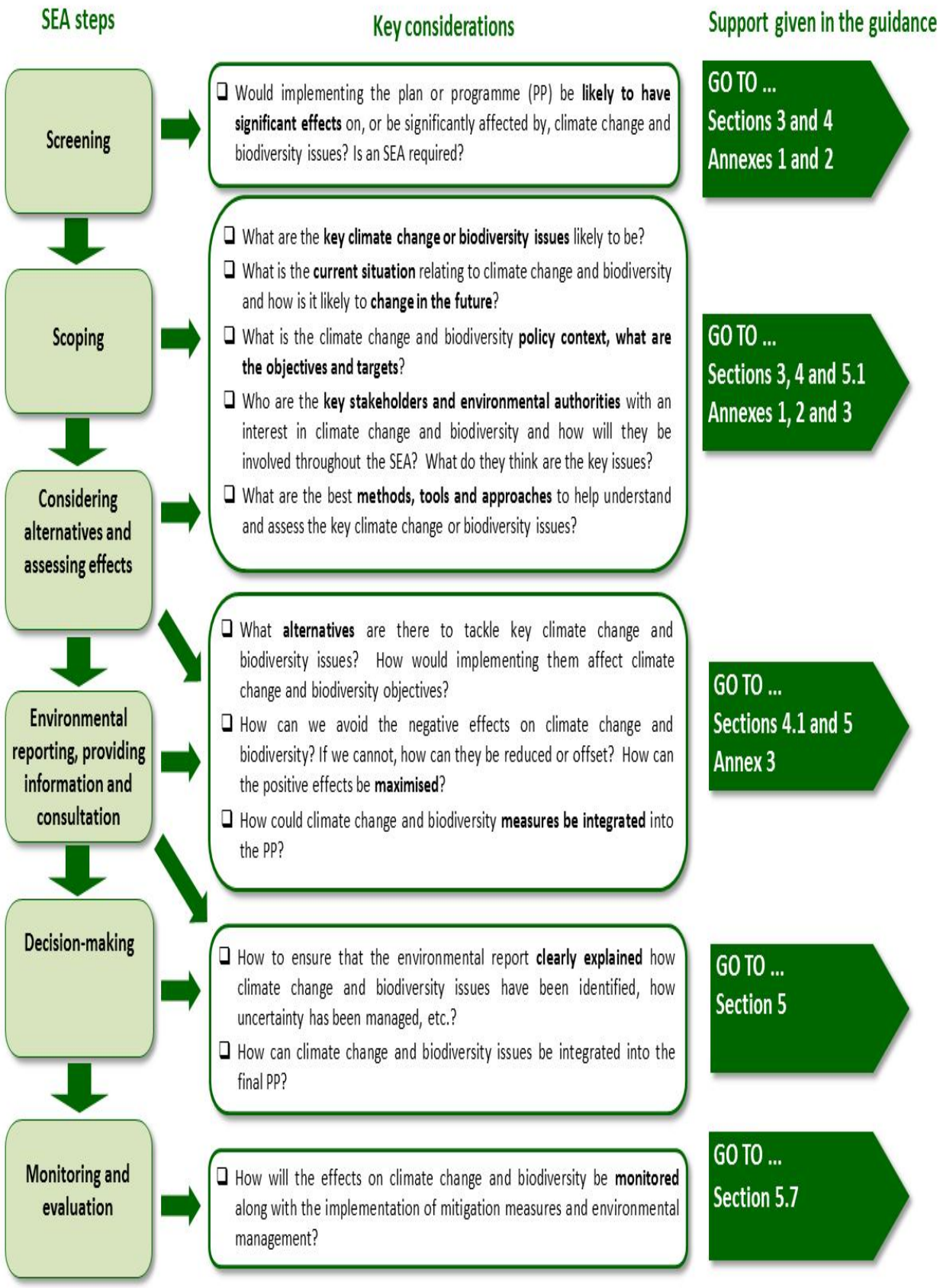
1.2.1 Annexes, tools and other support

Three **Annexes** provide additional sources of information and tools. **Annex 1** and **Annex 2** provide further information and data that could be useful to support the SEA process, and integrating climate change and biodiversity in particular. **Annex 3** summarises key tools and approaches that can be used to support the assessment of climate change and biodiversity as part of the SEA.

1.2.2 Navigating the guidance

The figure overleaf gives an overview of the guidance, and shows how it can be applied throughout the SEA process, as outlined by the SEA Directive.

Figure 1: Overview of the key steps in carrying out an SEA and where to find guidance



2. Climate change and biodiversity in SEA

This section looks at how climate change and biodiversity are currently featured in SEAs. It reviews the requirements of the SEA Directive and discusses the benefits and challenges of integrating climate change and biodiversity into SEAs.

2.1 The legal basis and the 'spirit' of the Directive

The SEA Directive contains a number of starting principles that provide a useful basis for considering climate change and biodiversity in SEA. 'Biodiversity' and 'climatic factors' are specified in the list of factors to be assessed, as well as 'fauna' and 'flora' (see Table 1). The Directive sets out clearly to establish a high level of protection for the environment (Article 1) and to integrate environmental considerations into the preparation of PP likely to have significant effects on the environment, with a view to promoting sustainable development.

Table 1: Direct and indirect references to climate change and biodiversity in the SEA Directive

Issue	Directive reference (direct)	Directive reference (indirect)
Climate Change	• Annex I(f) requires an environmental report to consider the effects on 'climatic factors'.	
Biodiversity	• Annex I(d) requires an environmental report to consider any existing environmental problems which are relevant to the PP including, in particular, those relating to any areas of a particular environmental importance, such as areas designated pursuant to *92/43/EEC*[3] ('Habitats Directive') and the *Directive 2009/147/EC*[4] ('Birds Directive'). • Annex I(f) requires an environmental report to consider the effects on 'biodiversity', 'fauna' and 'flora'.	• The recitals to the Directive refer to the *Convention on Biological Diversity*, the Habitats Directive and the Birds Directive.
Relevant to both climate change and biodiversity	• Annex I(f) requires an environmental report to consider the 'interrelationship' between all listed factors.	• Article 1 sets out the Directive's objective to provide for a high level of protection of the environment and integration of environmental considerations into planning. • Annex I requires an environmental report to consider environmental objectives at international, EU and Member State levels. • Article 10(1) requires monitoring of the effects of implementing PP to identify unforeseen effects at an early stage.

[3] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, as amended, OJ L 206, 22.7.1992, p.7.
[4] Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009, on the conservation of wild birds [codified version], OJ L 20, 26.1.2010, p.7.

2.2 Benefits of considering climate change and biodiversity within SEAs

SEA is not an end in itself. It is the appropriate tool for including environmental considerations when developing a PP. This guidance document seeks to demonstrate the benefits of incorporating climate change and biodiversity from the early stages of developing a PP.

2.2.1 Delivery of climate and biodiversity objectives

For many types of PPs, the SEA is the only legally required tool that requires planners to consider the environment at an early stage of development, when alternatives are still open. For climate change this might include:

- understanding the potential greenhouse gas (GHG) emissions from the implementation of the PP and potential alternatives to avoid or reduce these effects;
- considering flood risk plans/maps in the context of different land uses; and
- exploring any conflicts and synergies between climate change mitigation and adaptation, therefore avoiding maladaptation.

For biodiversity this might include:

- assessing the spatial context of biodiversity (e.g. possible application of ecosystem services mapping/assessment); and
- addressing the objectives of the *EU 2020 Biodiversity Strategy*[5] and the Member States measures put in place to implement that Strategy.

2.2.2 Compliance with EU and national legislation and policies

Clearly, assessing climate change and biodiversity issues in SEAs will facilitate compliance with the SEA Directive and national SEA laws. Moreover, climate change and biodiversity are the subjects of a many pieces of EU legislation, policies and strategies, including binding targets for Member States. Each Member State is also likely to have a suite of legislative instruments relevant to climate change and biodiversity (e.g. building codes to promote energy efficiency, planning polices to minimise the need to travel and avoid development in areas at risk from flooding, species and site protection and management requirements).

Programmes to be funded under the Structural Funds and/or the Cohesion Fund (over the 2014-2020 period) also need to consider the ex-ante conditionalities[6] linked with climate change aspects, which need to be met by the Member States.

The consideration of climate change and biodiversity will also feed into the planning of any projects that result from the implementation of a particular PP, as well as any associated EIAs or Article 6(3) appropriate assessments under the Habitats Directive.

[5] Communication from the Commission to the European Parliament, the Council, the Economic and Social Committee and the Committee of Regions, Our life insurance, our natural capital: an EU biodiversity strategy to 2020, EC, COM(2011) 244 final.

[6] As laid down in the amended proposal for a regulation of the European Parliament and of the Council laying down common provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund, the European Agricultural Fund for Rural Development and the European Maritime and Fisheries Fund covered by the Common Strategic Framework and laying down general provisions on the European Regional Development Fund, the European Social Fund and the Cohesion Fund and repealing Council Regulation (EC) No 1083/2006, COM/2012/0496 final — 2011/0276(COD).

2.2.3 Resilience of a PP to a changing climate

A number of recent studies on the vulnerability of the EU and specific sectors and territories to the changing climate have shown that some of Europe's infrastructure needs to be adjusted to be able to respond to the changing climate. This represents a shift in thinking from the traditional assessment of the effects of a PP on the environment alone, to one where the likely long-term risks associated with climate change are taken into account. Insurance firms, for instance, are already recognising the value of this form of thinking and include such risks in their assessments of risks from natural hazards. SEAs can address these risks within a PP through the concept of resilience.

Building resilience into a PP is increasingly recognised as key to creating an adaptive management response to climate change.[7] In the context of SEAs, this means considering that a PP operates within an evolving environmental baseline — e.g. one that changes over time. The SEA therefore needs to understand the impacts of this changing baseline on the implementation of the PP and how it may respond over time. Adaptation should not be left until the end of the preparation of the PP — resilience needs to be built in from the very beginning as many are likely to experience a significantly changing environment. The SEA process is particularly important in that it has the potential to set the framework for projects — therefore properly building in potential climate change impacts into SEAs has a huge potential to result in more resilient projects (supported by EIAs).

2.2.4 Managing conflicts and potential synergies between climate change, biodiversity and other environmental issues

There are considerable benefits, not to mention cost-effectiveness, of considering climate change mitigation and adaptation, biodiversity, and other environmental issues together. For example, it provides the opportunity for win-wins when applying ecosystem-based approaches to climate mitigation and adaptation, and avoiding mitigation actions that have no adaptive capacity or that reduce the resilience of other factors. One of the roles of SEAs is to seek to manage these conflicts and potential synergies.

2.2.5 Ecosystem services

The ecosystem services provided by biodiversity also need to be considered when developing a PP. Biodiversity can provide a range of ecosystem services that potentially support the objectives of a PP and its implementation. For example, a plan promoting economic and social development could also benefit from the aesthetic and recreational services offered by biodiversity through the creation and protection of green spaces and other natural areas associated with residential or commercial developments. The long-term sustainability of the economic development may be reliant on the climate change adaptation benefits provided by these natural areas, such as, cooling during hot temperature periods and/or the attenuation of flood water.

2.3 Challenges to overcome in addressing climate change and biodiversity in SEAs

A number of characteristics of climate change and biodiversity shape the way in which we need to look at them in the context of a SEA:

[7] Resilience Alliance (2010) in Annex 1 gives examples of environmental limits relevant to climate change and biodiversity.

- long-term and cumulative nature of effects;
- complexity of the issues and cause-effect relationships;
- uncertainty.

These are the main characteristics of climate change and biodiversity that are most likely to pose a significant challenge to SEAs. This section will help users to understand these aspects better and gives some recommendations to help deal with them more effectively throughout the SEA process.

Table 2 below summarises an approach to tackling these challenges. Each challenge is then discussed in more detail in the following sections.

Table 2: Useful tips on tackling the challenges of climate change and biodiversity in SEAs

Key challenges to considering climate change and biodiversity in SEA	Tips on tackling this in SEAs
Long-term and cumulative nature of impacts	• Avoid 'snapshot' analyses and consider trends *with* and *without* the proposed PP
Complexity of the issues and cause-effect relationships	• Analyse impacts of proposed PP on the key climate change and biodiversity trends and their drivers • Work with worst-case and best-case scenarios
Uncertainty	• Acknowledge assumptions and limitations of current knowledge • Base your recommendations on the precautionary principle • Prepare for adaptive management

2.3.1 Long-term and cumulative nature of impacts

Climate change – both mitigation and adaptation – concerns long-term trends and entails changes that are often too gradual to detect over the lifetime of a typical PP. The long-term nature of climate change makes it more difficult to consider within normal (five-to-ten year) planning horizons. However, as many PPs are implemented over the longer-term, and may set a framework for infrastructure and other projects that will have a lifespan of many years, the consideration of climate change and biodiversity will be critical to their viability. This influences the baseline environment against which a PP should be assessed as part of an SEA.

Biodiversity also concerns long-term trends and changes as the effects on biodiversity are cumulative over time. Once species or habitats are completely lost, they cannot be replaced or recovered. This means that we need to avoid impacts wherever possible and take positive action to enhance and better manage biodiversity and maximise ecosystem services.

SEAs should therefore avoid 'snapshot' analyses (i.e. at a single point in time) and consider trends and environmental conditions *with* and *without* the proposed PP (and its alternatives). This is consistent with Annex I(b) to the SEA Directive, which requires the assessment of not only the current state of the environment, but also the 'likely evolution thereof without implementation of the plan or programme.' The cumulative climate change and biodiversity effects are particularly important with regards to the evolving baseline. The need to consider cumulative effects is highlighted in both Annex I and Annex II(2) to the SEA Directive.

2.3.2 Complexity of the issues and cause-effect relationships

Both climate change and biodiversity involve complex systems (see box right) and interactions with other environmental aspects environment and the human environment. Since we cannot fully understand some aspects of complex systems at the required decision point, we need to be able to work with what we have. For example, we are able to analyse trends based on studies, reports and other sources of information. At times, this will require simplified models to give best estimates of emissions and impacts, for example, best-case and worst-case scenarios to illustrate different future states under various assumptions. Conventional assessment approaches can be made more rigorous by asking two basic questions:

Complexity

Impacts that may appear to have positive climate change mitigation benefits (e.g. renewable energy infrastructure) could affect biodiversity, for instance *via* the cumulative effects of several wind turbines on birds, located within or vicinity of Special Protection Areas (SPAs) designated under the Birds Directive. These adverse effects could be exacerbated by additional pressure such as inadequate farming or forestry practices, etc.

1. Is the implementation of the proposed PP likely to have any **significant** direct positive or negative effects on the expected future state of the environment in the study area?
2. Is the implementation of the proposed PP likely to **significantly** alter drivers or trends in the key issues?

The judgment of impact magnitude and significance must be context-specific. For an individual PP — a transport plan, for example — while its contribution to GHGs may be insignificant at the global scale, it may well be very significant at the local or regional scale in terms of its contribution to targets set at those levels for GHG reductions. Biodiversity impacts will also depend on the geographical and temporal scales of impacts and the sensitivity of the habitat or species concerned. For instance, implementing the PP could have negative effects upon a relatively common species at the global level, but at the local level this could be the only viable population of that species. **Both climate change and biodiversity therefore demonstrate the importance of distinguishing between magnitude and significance as you should normally in a SEA. In these cases, temporal and geographical scales may need to be greater.**

2.3.3 Uncertainty

There is a degree of uncertainty in any decision-making system, but it increases with complexity and timescale. It is therefore very likely that there will be uncertainty about the long-term impacts of a PP on biodiversity and climate change (see box overleaf), and how projected changes in the climate will impact the PP. Uncertainty requires taking a more qualitative approach, where actual quantitative data are not available or not sufficiently reliable to predict impacts. Once you recognise uncertainty in the PP and the SEA, consider the following advice for dealing with it.

- Be **comfortable** with uncertainty. When seeking to anticipate the future, you can never be certain.
- Factor uncertainty into **screening**.

- Factor uncertainty into **scoping** by considering what aspects of the PP are susceptible to a changing climate or to long-term biodiversity impacts — and determine what expertise is needed on the SEA team to enable this.
- Gather more information that could be useful up to a point, but only if it is the **appropriate information** and it is feasible to fill an information gap. See Annex 1 on information sources.
- **Scenarios** are an effective way to deal with the uncertainty inherent in complex systems and imperfect data. Use scenarios to present a range of possible outcomes or pathways. For more information on scenarios see Annex 2.
- Use **proxy indicators** if direct indicators are not available, e.g. trends in traffic levels if vehicle GHG emission data are not available.
- Think about **risks** when the impacts are too uncertain. Always acknowledge assumptions behind assessment (i.e. under what circumstances an impact can occur).
- Use the **precautionary principle** to guide the choice of PP alternatives and mitigation measures. Think about building long-term resilience into the PP this way.
- Prepare for **adaptive management** by putting in place monitoring measures to respond to future changes.

Case study:
SEA of the Thames 2100 Flood Risk Management Plan, the United Kingdom — dealing with uncertainty

The Thames Estuary 2100 Plan is a long-term flood risk management strategy for the Thames river area. It was developed by the Environment Agency for England and Wales in response to the gradual deterioration of flood defences in the tidal Thames and the potential for increases in the frequency and severity of flooding due to projected socio-economic change and climate change.

The SEA demonstrates an approach to dealing with long-term horizons and their inherent uncertainties and acknowledges uncertainty directly.

It deals with uncertainty through, for example, the options for future flood risk management and the emphasis placed on monitoring implementation of the plan.

Source: The Environment Agency for England and Wales relevant webpage

3. Understanding climate change and biodiversity

This section provides information on the current status, trends, drivers and policy responses regarding climate change and biodiversity in the EU. The purpose is to highlight the importance and complexity of climate change and biodiversity to those involved in SEAs: competent authorities; planners or programme developers; SEA practitioners; regulators; or other stakeholders. **It should help you at the scoping stage of the SEA process**.

Clearly, an SEA will also need to assess, depending on its scale, the national, regional and local context applicable to the PP concerned. It is not practical to include this level of information in this guidance, therefore the international/EU context provided here is just a starting point.

3.1 Introduction to climate change

Responses to climate change can be divided into two aspects:

Mitigation — the term used to describe the process of reducing GHG emissions that contribute to climate change. It includes strategies to reduce GHG emissions and enhance GHG sinks.

Adaptation — is a process, or set of initiatives and measures, to reduce the vulnerability of natural and human systems against actual or expected climate change effects. Adaptation can also be thought of as learning how to live with the consequences of climate change. The first consequences of climate change can already be seen in Europe and worldwide, and these impacts are predicted to intensify in the coming decades. Temperatures are rising, rainfall patterns are shifting, glaciers are melting, sea levels are getting higher and extreme weather resulting in hazards such as floods and droughts is becoming more common.

Climate change adaptation and mitigation are closely interrelated. While they are often considered as separate topics or policy fields, it is critical to consider the links between them. Certain adaptation responses have clear mitigation benefits, but some actions can result in 'maladaptation' — i.e. instead of reducing vulnerability to climate change, they actually increase it or reduce the adaptive capacity. Some actions can also distribute the benefits of adaptation unequally across society (for example, the prevention of climate-change-induced diseases only for affluent people).[8]

One of the roles of SEAs is to seek to manage these conflicts and potential synergies. To do so, make a comprehensive assessment of the links between climate change mitigation, adaptation and other environmental issues and policy concerns, to avoid the risk of:

- negative synergies and inconsistent policies;
- missed opportunities for exploring and promoting positive synergies; and
- sub-optimal allocation of resources and policy responses.

Some PPs will have as their objectives the promotion of climate change-responsive projects, including mitigation (such as renewable energy licensing regimes, or plans for carbon capture and

[8] Taken from *Guiding principles for adaptation to climate change in Europe ETC/ACC Technical Paper* 2010/6.

storage); adaptation (such as flood management plans); or resource-management such as water (for which energy use, carbon reduction, and adaptation are important, for example, along with the complex interactions between climate change and its impact on supply/demand for water and ecosystem functions and biodiversity). For such PPs, and for PPs with more generic objectives (such as urban development plans), it is important that their SEAs assess these links.

3.1.1 Climate change mitigation — overview of current status, trends and policy responses

Current status, trends and key drivers

Many studies have been carried out into how to assess the current status, trends and key drivers for GHG emissions, and they provide a useful background. See *Mitigating climate change — SOER 2010 thematic assessment* (EEA, 2010)[9] and other documents listed in the Annex 1 to this guidance for an overview.

Policy response

In March 2007,[10] the EU Heads of State and Government endorsed an integrated approach to climate and energy policy that aims to combat climate change and increase the EU's energy security while strengthening its competitiveness. They set a series of demanding climate and energy targets to be met by 2020, known as the '20-20-20' targets (see box left).

'20-20-20' climate and energy targets

- A reduction in **EU GHG emissions** of at least **20%** below 1990 levels;
- **20%** of **EU energy consumption** to come from renewable resources;
- **20%** reduction in **primary energy use** compared with projected levels, to be achieved by improving energy efficiency.

With its *Roadmap for moving to a competitive low-carbon economy in 2050*, the European Commission has looked beyond these short-term objectives and set out a cost-effective pathway for reducing domestic emissions by 80 to 95 % by mid-century. The Roadmap identifies milestones and provides guidance on how to move to a climate-friendly, low carbon economy in the most efficient way.

Table 3 below summarises the key aspects of international and EU climate change mitigation policy.

Table 3: Key aspects of climate change mitigation policy

Policy response	Objectives and targets
United Nation Framework Convention on Climate Change (UNFCCC)	• UNFCCC seeks to reduce international GHG emissions by setting national level targets based on the concept of 'common but differentiated responsibility'. This means that nations which have emitted the majority of GHGs up to now should seek to reduce GHGs at a greater rate.
UNFCCC's Kyoto Protocol	• Under the UNFCCC's Kyoto Protocol, 15 Member States of the EU ('EU-15') decided on a collective target of reducing GHG emissions by 8% relative to 1990 levels between 2008 and 2012 (Member State emission targets are differentiated under an EU burden-sharing decision). The other Member States have similar targets, with the exception of Cyprus and Malta. • The EU-15 are well on track to meeting their target. Preliminary EEA estimates indicate that they reduced their emissions by 14.1% below base-year levels by 2011.[11]

[9] http://www.eea.europa.eu/soer/europe/mitigating-climate-change.
[10] European Council, 8/9 March 2007.
[11] Approximated EU GHG inventory, http://www.eea.europa.eu/publications/approximated-eu-ghg-inventory-2011

EU Climate and Energy Package	• To meet the EU's obligation under international law and in line with European ambition. Member States are required to: • Collectively reduce their combined GHG emissions in 2020 by at least 20% compared to 1990 levels. Note: the EU has offered to take on a 30% target for 2020 if other major emitters contribute adequately to global mitigation efforts. • Produce 20% of their combined energy from renewable sources. • Improve energy efficiency to reduce primary energy use by 20% compared with projected levels. • The collective EU target of reducing emissions by 20% by 2020 is to be achieved by: o The EU Emissions Trading System, the backbone of the EU mitigation effort, which sets a cap on emissions from the most polluting sectors, including over 11000 factories, power plants and other installations, including airlines. By 2020, the cap should result in a 21% reduction relative to 2005 levels. The EU ETS covers about 40% of all EU emissions. o The 'effort sharing decision', which operates outside the EU ETS and establishes annual binding GHG emission targets for individual Member States for the 2013-2020 period. These concern emissions from sectors such as waste, agriculture, buildings, etc. • The '20-20-20' targets are supported by the long-term target of 85-90% reduction in GHG emissions against 1990 levels by 2050.
Roadmap for moving to a low-carbon economy in 2050	• The Roadmap looks beyond the 2020 targets and sets out a plan to meet the long-term target of reducing EU emissions by 80-95% by 2050. The strategy takes a sectoral perspective, looking at how the heavy-emissions sectors such as power generation, transport, buildings and construction, industry and agriculture can make the transition to a low-carbon economy over the coming decades.
Energy Roadmap 2050	• In the *Energy Roadmap 2050*, the EU explores the challenges posed by delivering the EU's decarbonisation objective, while at the same time ensuring security of energy supply and competitiveness.
Flagship initiative for a resource-efficient Europe	• It supports the shift to a resource-efficient, low-carbon economy to achieve sustainable growth. It provides a long-term framework for action to factor in resource efficiency in a balanced manner in many policy areas, including climate change, energy, transport, industry, agriculture, biodiversity and regional development.

3.1.2 Climate change adaptation — overview of current status, trends and policy responses

Current status, trends and key drivers

Regardless of the success of mitigation action, some degree of climate change is already 'locked in' and we are feeling the effects of our changing climate already. Several studies have assessed the current status, trends and key drivers for climate change and provide a useful background. See *Adapting to climate change — SOER 2010 thematic assessment* (EEA, 2010)[12] and the *European Climate Adaptation Platform: CLIMATE-ADAPT,*[13] as well as other documents listed in Annex 1 to this Guidance.

Policy response

Adaptation involves adjusting our behaviour to limit harm and exploiting the beneficial opportunities arising from climate change. However, our level of preparedness, resilience and vulnerability are not easily quantifiable, making it difficult to set hard and fast targets. But climate change mitigation targets are more tangible. In the EU, the focus is on integrating ('mainstreaming') adaptation into all relevant policies and instruments and facilitating effective, consistent adaptation action at national, regional and local levels. For example, the legislative proposals for the EU regional policy (2014-2020) include ex-ante conditionalities linked with climate change aspects, which need to be met by

[12] http://www.eea.europa.eu/soer/europe/adapting-to-climate-change.
[13] http://climate-adapt.eea.europa.eu/

the Member States if they use the EU Structural and Cohesion Funds. Many European countries, as well as some regions and cities, have adopted adaptation strategies. The European Environment Agency (EEA) keeps an overview of adaptation strategies in its 32 member countries.[14] It also hosts the European Climate Adaptation Platform: CLIMATE-ADAPT.

Table 4 below summarises the key international and EU policies on climate change adaptation.

Table 4: Key aspects of climate change adaptation policy

Policy response	Objectives and targets
EU Strategy on Adaptation to Climate Change	• The European Commission adopted a *White Paper on Adapting to Climate Change* in 2009, leading to an EU Adaptation Strategy in 2013. • The *Adaptation Strategy* will: o recognise how important impact assessment is for climate proofing (this guidance supports the Strategy's key objectives and actions) o identify the key priorities for action and how EU policies can encourage effective adaptation action o highlight the issue of adapting infrastructure to climate change and include a separate document on this topic o encourage creating green infrastructure and applying ecosystem-based approaches. • Guidance on how to mainstream adaptation into the Common Agricultural Policy and Cohesion Policy will be developed after the Adaptation Strategy is adopted.
European Climate Adaptation Platform: CLIMATE-ADAPT	• A publicly accessible, web-based platform designed to support policy-makers at EU, national, regional and local levels in the development of climate change adaptation measures and policies. • It has been developed to help users to access, disseminate and integrate information on: o expected climate change in Europe o the vulnerability of regions, countries and sectors now and in the future o information on national, regional and transnational adaptation activities and strategies o case studies of adaptation and potential future adaptation options o online tools that support adaptation planning o adaptation-related research projects, guideline documents, reports information sources, links, news and events.

3.2 Introduction to biodiversity

Biodiversity — or biological diversity — is one of the key terms in conservation, encompassing the richness of life and the diverse patterns it forms. The Convention on Biological Diversity (CBD) defines biological diversity as 'the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems' (Article 2).

The Natura 2000 network of protected areas, created on the basis of the Habitats and the Birds Directives, is the backbone of the EU's biodiversity policy. At present, the network covers almost 18% of the EU's land surface and more than 145 000 km² of its seas. However, it is important to remember that the concept of biodiversity is not limited to the Natura 2000 network, it is much broader:

- The Birds and Habitats Directives also cover species and habitats outside Natura 2000 sites.

[14] Available from: http://www.eea.europa.eu/themes/climate/national- adaptation-strategies.

- Under Article 6(3) of the Habitats Directive, an 'appropriate assessment' – is required for any plan or project likely to have a significant effect on Natura 2000 site, even if it is implemented outside these sites.
- Article 10 of the Habitats Directive recognises the importance of ensuring the ecological coherence of the Natura 2000 sites.
- Finally, the *EU 2020 Biodiversity Strategy*[15] as endorsed by the Council and European Parliament covers the whole territory and emphasises the benefits that ecosystems give us. It provides a package of actions needed to halt the loss of biodiversity and the degradation of ecosystem services by 2020 and to restore them in so far as feasible.

Therefore, SEAs should look at all these aspects of biodiversity and the quality of surroundings (see box below).

Case study: 2000-2007 transport infrastructure development plan, Spain — biodiversity outside designated areas

The Spanish Ornithological Society (Sociedad Española de Ornitología, SEO/Birdlife) has developed a methodology to accurately determine the relevance of territories for biodiversity conservation. This methodology, which has been developed for SEAs for large-scale infrastructure plans, was applied to the Spanish 2000-2007 transport infrastructure plan.

It concluded that SEAs cannot limit themselves to assessing the effects of PPs on protected areas or even networks of protected areas, as the preservation of these depends upon the quality of their surroundings.

SEAs for large-scale infrastructure development plans in particular must contribute to conserving biodiversity not only inside but also outside the system of protected areas and promoting biological connectivity by adopting a scope that is commensurate to the plan's potential impact.

Source: SEO Birdlife relevant webpage

3.2.1 Overview of current status, trends and policy responses

Current status, trends and key drivers

Several studies have assessed the current status, trends and key drivers for biodiversity, and provide a useful background. See *Biodiversity — SOER 2012 thematic assessment* (EEA, 2010),[16] the *EU 2010 Biodiversity Baseline* (EEA, 2010),[17] and the other documents listed in Annex 1 to this guidance for an overview.

These studies have found that the rate of biodiversity loss is accelerating all over Europe. Although there are some positive signs, they recognise five main pressures and drivers of biodiversity loss: (i) habitat loss and fragmentation; (ii) overexploitation and unsustainable use of natural resources; (iii) pollution; (iv) invasive alien species, and (v) climate change.

[15] Communication from the Commission to the European Parliament, the Council, the Economic and Social Committee and the Committee of Regions, Our life insurance, our natural capital: an EU biodiversity strategy to 2020, EC, COM(2011) 244 final.
[16] http://www.eea.europa.eu/soer/europe/biodiversity.
[17] http://www.eea.europa.eu/publications/eu-2010-biodiversity-baseline/.

The aim of the Natura 2000 network and the sites designated under it is to slow down the rate of biodiversity loss, by establishing a system to protect key species and habitats. However, many Natura 2000 sites remain in an unfavourable state and require improved management.

Policy response

Biodiversity has been a core part of EU policy for over 20 years. Nevertheless, the overall trends are still negative and recent policy has been considered ineffective. This is shown by the EU's failure to achieve the target of halting biodiversity loss by 2010.

In 2011, the European Commission adopted a new *EU 2020 Biodiversity Strategy* with its 2020 headline target — 'Halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restoring them in so far as feasible, while stepping up the EU contribution to averting global biodiversity loss.'

Green infrastructure

Green infrastructure can be defined as a strategically planned and delivered network of high quality green spaces and other environmental features. It includes natural and semi-natural areas, features and green spaces in rural and urban, terrestrial, freshwater, coastal and marine areas. Areas protected as Natura 2000 sites are at the core of green infrastructure.

It should be designed and managed as a multifunctional resource capable of delivering a wide range of benefits and services.

The underlying principle is that the same area of land can frequently offer multiple benefits. By enhancing green infrastructure, valuable landscape features can be maintained or created, which are not only valuable for biodiversity but also help deliver ecosystem services such as the provision of clean water, productive soil, attractive recreational areas, and help climate change mitigation and adaptation. It can sometimes be a cost-effective alternative or be complementary to grey infrastructure and intensive land use change.

Source: DG Environment relevant webpage

Target 2 of this Strategy is that 'by 2020, ecosystems and their services are maintained and enhanced by establishing green infrastructure and restoring at least 15% of degraded ecosystem'. This target is broken down into accompanying actions, two of which seek to influence planning practices:

- set priorities to restore and promote the use of green infrastructure (Action 6); and
- ensure 'no-net-loss' of biodiversity and ecosystem services (Action 7).

These provide a good policy basis for preserving ecosystem services and the use of ecosystem-based approaches and green infrastructure (see box left) in SEAs to support PPs. In the climate change context, ecosystem-based approaches can maintain carbon stocks, regulate water flow and storage, maintain and increase resilience, reduce the vulnerability of ecosystems and people, help to adapt to climate change impacts, improve biodiversity conservation and livelihood opportunities and provide health and recreational benefits.[18]

The key aspects of international and EU biodiversity policy are summarised in Table 5 overleaf.

[18] Assessment of the potential of ecosystem-based approaches to climate change adaptation and mitigation in Europe (EC study, Ecologic Institute and Environmental Change Institute, 2011).

Table 5: Key aspects of biodiversity policy

Policy response	Objectives and targets
The Habitats Directive and the Birds Directive	• The Habitats Directive and the Birds Directive seek to protect sites of particular importance for biodiversity— these sites form a network referred to as Natura 2000. • Member States are required to designate and manage Natura 2000 network sites within their borders. This includes habitat and species conservation, and reducing the impact of building new infrastructure and of other human activities. This is achieved in part by applying Article 6(3) on 'appropriate assessments'. • The two directives create provisions for the protection of certain species of flora and fauna when they occur in the wider natural environment. • Article 10 of the Habitats Directive recognises the importance of ensuring the ecological coherence of Natura 2000 sites.
The Convention on Biological Diversity (CBD)	• The CBD is the main international agreement governing biodiversity policy. The EU and its Member States are all parties to the convention. Article 14 of the CBD, on Impact Assessment and Minimising Adverse Impacts, requires that a project's potential adverse impact on biodiversity be taken into account.
Nagoya Protocol	• The *Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilisation to the Convention on Biological Diversity* (adopted in Nagoya, October 2010) is a legally binding agreement that addresses two issues: o How states provide access to genetic resources and/or associated traditional knowledge under their jurisdiction; and o What measures they take to ensure that benefits of using such resources and/or knowledge are shared with provider countries, including indigenous and local communities?
Strategic Plan for Biodiversity 2011-2020 and the Aichi Targets	• The *Strategic Plan for Biodiversity 2011-2020* (adopted in Nagoya, October 2010) aims to inspire action in support of biodiversity by all countries and stakeholders over the next decade. • The *Strategic Plan* includes 20 headline targets, collectively known as the *Aichi Targets*. They are organised under five strategic goals that address the underlying causes of biodiversity loss, reduce the pressures on biodiversity, safeguard biodiversity at all levels, enhance its benefits, and provide for capacity-building.
EU 2020 Biodiversity Strategy	• *Our life insurance, our natural capital: an EU biodiversity strategy to 2020* is in line with the two commitments made by EU Heads of State and Government in March 2010 — halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restoring them in so far as feasible, while stepping up the EU contribution to averting global biodiversity loss. • The long-term goal states that 'by 2050, European Union biodiversity and the ecosystem services it provides — its natural capital — are protected, valued and appropriately restored for biodiversity's intrinsic value and for their essential contribution to human wellbeing and economic prosperity, and so that catastrophic changes caused by the loss of biodiversity are avoided.' • The Strategy is also in line with the global commitments world leaders made in Nagoya in October 2010, when, in the context of the CBD, they adopted a package of measures addressing global biodiversity loss over the next decade (described above). • The emphasis is on the essential contribution of biodiversity and ecosystem services to human wellbeing and economic prosperity, and avoiding catastrophic changes caused by the loss of biodiversity. This represents a significant change in approach for the impact assessment process, from reducing impact to actively improving (restoring) biodiversity as a whole and ensuring 'no-net-loss'. • The main targets of the Strategy cover: o full implementation of EU legislation on protecting biodiversity; o better protection for ecosystems and more use of green infrastructure; o more sustainable agriculture and forestry; o better fish stock management; o tighter controls on invasive alien species, including adopting new legislation to fill existing policy gaps; o a more significant EU contribution to averting global biodiversity loss.

Biodiversity Action Plans (BAPs)	• BAPs provide details on how the Biodiversity Strategy is to be achieved. They are present at European level (for example, the 2006 BAP now superseded by the 2020 Biodiversity Strategy), but also exist across the EU and worldwide under the CBD (as National Biodiversity Strategy and Action Plans, NBSAPs). In Member States, they are sometimes aligned with the EU 2006 BAP. • BAPs form the wider implementation framework for biodiversity, beyond Natura 2000. At Member State level, they list identified species and habitats, assess their status within the ecosystem, create conservation and restoration targets and establish the budgets and timelines needed to achieve said targets. • BAPs can also require the protection of certain species where they occur outside of protected areas.

3.3 Interactions between climate change and biodiversity

The natural environment is intrinsically interlinked. These links are evident among many environmental issues, including climate change and biodiversity. This section does not attempt to fully describe the links between these two aspects, but simply focuses on the key interactions that are directly relevant to SEAs.

Two examples of interactions between biodiversity and climate change are:

Using green infrastructure for flood risk management

The EU Floods Directive establishes a framework for the management of flood risks. It gives the EU Member States the choice of measures to put in place to reduce the adverse consequences related to floods.

Article 7 requires Member States to set their own flood management objectives. The objectives must also focus on 'non-structural' measures (ranging from early-warning to natural water retention measures) and/or on the reduction of the likelihood of flooding.

These are potentially very cost-effective alternatives of achieving flood protection to constructing new or reinforcing dykes and dams. They often deliver multiple benefits in addition to flood protection.

Examples of such measures are:

- restoring natural flows by realignment of coastal areas, or re-connection of rivers with their floodplain;
- restoration of wetlands which can store flood water and help 'slow the flow' of flood waters;
- urban green infrastructure such as green spaces or green roofs.

Source: DG Environment relevant webpage

- Supporting biodiversity delivers clear carbon benefits by enhancing the natural environment's ability to absorb and store carbon via soil and plant matter. Evidence suggests that healthy natural habitats such as soil, wetlands, and forests can sequester significant amounts of carbon. Damaging the biodiversity or physical environment of these areas can release this stored carbon, even indirectly, contributing to climate change and to reducing biodiversity.
- Biodiversity and the natural environment provide services that increase our resilience to the impacts of climate change, such as changes in precipitation and temperature. For example, well-functioning green spaces can regulate storm water flow, reducing the risk of flood events. Ecosystems and their services can be used in many PPs with success as cost-effective alternatives to build infrastructure, for example, to manage flood risks (see box left). Green spaces and vegetation also provide cooling within cities reducing the impact of heat waves and the urban heat island effect and plants stabilise soils, reducing the risk of landslides and erosion. By contrast, deforestation can contribute to mudslides, etc.

The link between biodiversity and climate change is not one-way. The effects of a changing climate are already having an impact on biodiversity and ecosystem service provision. It is predicted that climate change will be the

single biggest cause of biodiversity loss next to land use change.[19] The impacts of climate change on biodiversity stem from the fact that species tend to evolve to a specific range of environmental factors, such as temperature or moisture. As these factors alter due to climate change, species need to migrate to stay in their optimum environment. Some species are more adaptive. For others, this threatens their ability to survive and hence increases extinction rates and reduces biodiversity.

The ability of species to respond to climate-enforced migration is also limited by human activity, which has changed land use and fragmented habitats. When roads, urban areas and agricultural land stand in their way, many species will find it almost impossible to migrate across the landscape. There is therefore a need to facilitate this natural adaptation process by, for example, recognising ecological networks and corridors, and creating new corridors to reduce fragmentation.

[19]Millennium Ecosystem Assessment (2005) Synthesis Report.

4. What are the key climate change and biodiversity issues?

This section looks at the scope of climate change and biodiversity issues in SEAs and how to identify which ones should be addressed in any particular context. It is structured around three key recommendations:

- start identifying the key issues early, using stakeholders to help;
- understand the key climate change issues, and how climate change interacts with the other topics to be assessed in the SEA; and
- understand the key biodiversity issues, and how biodiversity interacts with the other topics to be assessed in the SEA.

This section should support both the screening and scoping stages in the SEA process.

4.1 Start identifying the key issues early using stakeholders to help

It is critical to identify the key issues from a climate change and biodiversity perspective early in the SEA process to ensure that they are assessed effectively throughout the process. When doing this, consider not only the impacts of the PP on climate and climate change and biodiversity but also the impact of a changing climate and natural environment on the PP. For example, quality of life, often associated with the quality of the natural environment rich in biodiversity, can attract investment, workers and tourists. It can be among a region's greatest assets and can translate into future economic success. It should therefore be recognised at the drafting stage of the PP and the associated SEA. On the other hand, a PP covering large areas at high risk of flooding may put restrictions on future developments.

For programmes co-financed by the EU Structural and Cohesion Funds in the 2014 to 2020 period, it is recommended that the SEA also assesses whether relevant ex-ante conditionalities have been fulfilled.

It is also essential to involve the environmental authorities and targeted stakeholder groups, experts, institutions and the wider public at an early stage, to ensure you capture the most important issues and get agreement for establishing a consistent approach to monitoring. Early engagement with stakeholders (see box below) is likely to help improve compliance with certain aspects of the Directive but also make use of environmental authorities and stakeholder knowledge and opinion to highlight potential areas of environmental problems and opportunities for improvement in a timely and effective way. However, you will need to be flexible to address new issues as they emerge through the SEA process.

Case study:
SEA of the Rural Development Plan, Wales, the United Kingdom — early engagement of stakeholders

The Welsh Assembly Government commissioned an SEA to be undertaken alongside their Rural Development Plan 2007-2013. The SEA is notable for the early and effective engagement with stakeholders during the scoping stage. This led to the consideration of climate change and biodiversity across the SEA. The SEA is also a useful example of the use of network analysis and the consideration of cumulative impacts with regard to biodiversity and climate change.

Source: Welsh Government relevant webpage

Engaging proactively with environmental authorities and stakeholders can also help build climate change mitigation and adaptation measures and/or biodiversity enhancement schemes into the proposed PP from the very beginning of planning, into all stages of the SEA process (see box below). Environmental authorities and stakeholders will be in position to give their advice if there are any significant ongoing plans that should be taken into account, but you may not be aware of, e.g. flood risks.

Case study:
River Basin Management Plans, Spain — importance of integrating climate change issues into all stages of the SEA process

Climate change needs to be considered consistently at all stages of the SEA process, particularly in vulnerable areas and sectors.

This case-study recommends that SEA practitioners clearly define mechanisms or instruments to integrate climate change issues into the planning process. Proposed alternative measures need to be designed on the basis of an integrated approach, and explicitly account for climate change-related uncertainty.

Source: IAIA (Paper and presentation: SEA of Spanish river basin plans and climate change: A checklist study)

The breadth of sectors and stakeholders involved in climate change complicates the process of consulting the correct authorities and stakeholders when carrying out SEAs, especially for PPs at the national level. The SEA Directive requires early and effective consultation with authorities with 'specific environmental responsibilities' and the public affected or likely to be affected by, or having an interest in, the decision-making related to the PP in question, including non-governmental organisations, such as those promoting environmental protection and other organisations concerned (Article 6). These authorities are typically defined by the MSs as ministries or specialised environmental agencies at different levels (national/regional/local), but climate change issues typically require a different and often broader perspective, including authorities responsible for energy, transport, water management, health and economic sectors.

Again, SEAs can help PP authorities and experts to better define the range of authorities and stakeholders that need to be part of climate change-related decision making, and to get them involved early in scoping the key issues. SEAs also have a role to play in building consensus over longer-term scenarios and alternatives.

A series of key questions can be used as a starting point to help identify which aspects of climate change and biodiversity are the most relevant — the headline concerns are listed in Table 6 overleaf. The sections below provide sets of questions and issues to help you consider which are the most relevant in any situation. Note that environmental authorities and stakeholders may identify other key concerns, such as the interactions between issues in different columns in Table 6 (e.g. measures to meet low-carbon energy demand and their impacts on habitat fragmentation), and interactions with other environmental issues such as water, waste and air. As discussed in Section 3, it is important to consider the interactions and the potential synergies and conflicts between environmental issues as part of the SEA process.

Table 6: Examples of headline climate change and biodiversity issues to consider as part of SEAs

Climate change mitigation	Climate change adaptation	Biodiversity
• energy demand in industry • energy demand in housing and construction • GHG emissions in agriculture • GHG emissions in waste management • travel patterns and GHG emissions from transport • GHG emissions from energy production • land use, land-use change, forestry and biodiversity	• heat waves (including impact on human health, damage to crops, forest fires, etc.) • droughts (including decreased water availability and quality and increased water demand) • flood management and extreme rainfall events • storms and high wind (including damage to infrastructure, buildings, crops and forests) • landslides • sea level rise, extreme storms, coastal erosion and saline intrusion • cold spells • freeze-thaw damage[20]	• degradation of ecosystem services • loss of habitats, fragmentation (including the extent or quality of the habitat, protected areas, including Natura 2000 sites, habitat fragmentation or isolation, as well as the impacts on the processes which are important for the creation and/or maintenance of ecosystems) • loss of species diversity (including species protected under the Habitats and Birds Directives) • loss of genetic diversity

This is only an indicative list, it is not comprehensive. The issues and impacts that will be relevant to any particular SEA will depend upon the specific circumstances and context of each PP (e.g. the type of PP, the sector covered, its location, scale and the characteristics of the receiving environment, institutional and governance arrangements, etc.). Therefore this section should be used just as a starting point for considering what issues and impacts may be relevant. The level of certainty of the projected changes listed in Table 6 will also vary, and some changes may be more certain than others. Annex 1 and the sources of information in Annex 2, as well as relevant national and local information, should help determine which are the relevant key climate change and biodiversity issues (see also the discussion on the use of scenario, vulnerability assessment, etc. below and in Section 5).

This information can be used during both the scoping and screening stages to help identify which climate change and biodiversity issues and impacts might be most relevant to an SEA of a particular PP. Some key questions are provided to help a reader think through which might be most relevant in a specific situation. It may be useful to explore these questions with stakeholders with an interest or expertise in climate change or biodiversity.

4.2 Identifying the key climate change issues

The starting point is likely to involve considering climate change scenarios, along with socio-economic scenarios, and what the implications of these could be for the PP. Key issues of concern are likely to be around GHG emissions for mitigation, and adaptation measures needed to deal with anticipated impacts resulting from climate change. Note that the mitigation and adaptation concerns will need to be appropriate to the level at which the PP is operating and will have an influence on/be influenced by.

[20] Freeze-thaw weathering is a form of physical weathering, common in mountains and glacial environments, caused by the expansion of water as it freezes. This process also applies to infrastructure materials, e.g. concrete. Climate change is projected to bring more unpredictable winter weather in some parts of the world, increasing the frequency of freeze-thaw cycles. As this happens, roads, railways, water networks, etc. will suffer problems and increased maintenance costs. (adapted from: Talk Talk, and Weathering of building Infrastructure and the changing climate: adaptation options (Auld H., Klaassen J., Comer N., 2007)

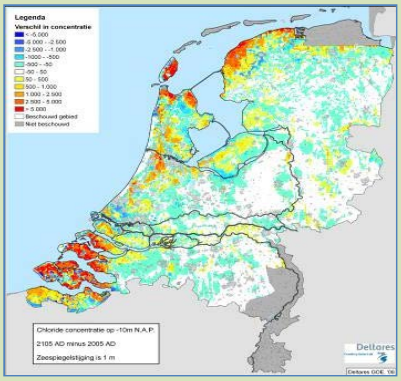
For climate change, in particular, it will be important to consider early in the SEA process not just the impacts of the PP on climate and climate change, but also the impact of a changing climate on the PP and its implementation. The examples of key questions therefore guide you through both of these aspects (see Tables 7 and 8):

- How may the climate be affected by implementing the PP in terms of GHG emissions?
- How may the implementation of the PP be affected by climate change, including the need to adapt to a changing climate and the impact of extreme events? The use of spatial data (see box below) could be very useful to address this question.

Case study:
SEA of Masterplan for Kijkduin, the Netherlands – identifying climate risks

This case illustrates the use of spatial data to identify climate change risk exposure. To obtain a first indication of the degree to which climate effects are important in an area, a mapping tool has been developed in the Netherlands — the Climate Effect Atlas. It is meant to make climate impact data available nationwide in a simple and fast way, via an interactive website, all based on the same assumptions and preconditions.

Source: Climate Effects Atlas (in Dutch), DHV (in Dutch), Climate Impact Atlas promotes the use of climate information in policy making (Climate Research Netherlands — Research Highlights, 2009) (in English)



Example map for salt intrusion

Table 7: Examples of key questions for identifying climate change mitigation issues

Main concerns related to:	Key questions that could be asked at the screening and/or scoping stage of the SEA
Energy demand in industry	• Will the proposed PP increase or decrease demand for energy in industry? • Does the PP encourage or limit opportunities for low carbon businesses and technologies?
Energy demand in housing and construction	• Will the PP increase or decrease demand for construction of housing and for energy use in housing?
GHG emissions in agriculture	• Will the PP increase or decrease generation of methane (CH_4) and nitrous oxide (N_2O) in agriculture? • Will the PP increase or decrease use of nitrogen in fertilising practices? • Will the PP adversely affect or protect carbon rich soils?
GHG emissions in waste management	• Will the PP increase waste generation? • Will the proposed PP influence the waste management system? • How will these changes affect emissions of CO_2 and CH_4 from waste management?
Travel patterns and GHG emissions from transport	• Can the PP increase personal travel — the number and length of journeys and the mode of travel? Will it entail a shift from more-polluting to less-polluting modes of travel (e.g. from personal cars to public transport or from buses to electric trains)? • Can the PP significantly increase or decrease freight transport emissions? • How can the PP enhance or stimulate the provision of sustainable transport infrastructure or technologies — for instance electric vehicle charging points, LPG fuel, hydrogen fuel cells?
GHG emissions from energy production	• Will the PP increase or decrease energy consumption? • How will these changes in energy demand affect the energy supply mix? • What implications will this change in energy supply have on GHG emissions from energy production?
Forestry and biodiversity	• What opportunities could the PP give for carbon sequestration via investment in forestry and biodiversity?

Table 8: Examples of key questions for identifying climate change adaptation issues

Main concerns related to:	Key questions that could be asked at the screening and/or scoping stage of the SEA
Heat waves	• What are the key terrestrial habitats and migration corridors that may be significantly affected by heat waves? How will the proposed PP impact on them? • What urban areas, population groups or economic activities are most vulnerable to heat waves? How will the PP impact on them? • Does the PP reduce or enhance the 'urban heat island' effect? • Will the PP increase or reduce the resilience of landscape/forests to wildlife fires?
Droughts	• What are the key terrestrial habitats and migration corridors that may be significantly affected by droughts? How will the PP impact on them? • Will the PP increase water demand and to what extent? • Are there any significant risks associated with worsening water quality during droughts (increased pollution concentrations due to limited dilution, saline intrusion, etc.)? • Which freshwater bodies will be exposed to excessive water pollution — especially during droughts when the pollution will become less diluted in reduced river volumes?
Flood regimes and extreme rainfall events	• What infrastructure (e.g. existing or planned road segments, water supply, energy, etc.) is at risk due to its location in extreme flood zones? • Is the capacity of drainage networks sufficient to handle potential extreme rainfall? • Does the design of drainage systems prevent channelling drainage water into lower laying areas? • Will the proposed PP reduce or enhance the capacity of ecosystems and flood plains for natural flood management? • Will the proposed PP increase the exposure of the vulnerable (e.g. the elderly, unwell or young people) or sensitive receptors (e.g. critical infrastructure) to floods?
Storms and high winds	• What areas and critical infrastructure will be at risk because of storms and strong winds?
Landslides	• What property, persons or environmental assets are at risk because of landslides and their vulnerability?
Sea level rise, storms surge, coastal erosion, hydrological regimes and saline intrusion	• What are the key aquatic, riverine and coastal habitats and migration corridors that may be significantly adversely affected by sea level rise, coastal erosion, changes in hydrological regimes and salinity levels? How will the proposed PP impact on them? • What are the key infrastructural assets (e.g. road segments and intersections, water supply infrastructure; energy infrastructure; industrial zones and major landfills) at risk due to their location in areas that may be inundated by sea level rise or subject to coastal erosion? Will the proposed PP reduce or increase these risks? • What areas may be affected by saline intrusion? Will the proposed PP reduce or increase these risks?
Cold spells	• What areas and critical infrastructure will be at risk because of short periods of unusually cold weather, blizzards or frost?
Freeze-thaw damage	• What key infrastructure (e.g. roads, water pipes, etc.) is at risk of freeze-thaw damage?

4.3 Identifying the key biodiversity issues

How is biodiversity affected by the implementation of a PP? It may lead, for example, to **habitat loss and degradation** (e.g. the destruction of wetlands, grasslands and forests for housing and industrial development); **habitat fragmentation; loss of species** (e.g. the plants and animals endemic to a particular habitat will not be able to survive if that habitat is destroyed or altered by development); **altering of natural environmental processes** (e.g. river flow, water purification, coastal sediment transport, and erosion control, are altered which can have a long-term impact on habitat and species); **impact on the provisioning of ecosystem services** as a result of loss of species and habitats; **spread of alien invasive species** that can transform natural habitats and disrupt native species; etc.

These sources can help determine which biodiversity impacts to consider in SEA:

- The Convention on Biological Diversity: Voluntary guidelines on biodiversity-inclusive environmental impact assessment
- The IAIA: Biodiversity in Impact Assessment

Note that information in Tables 7 and 10 draw extensively on these sources.

- The Ramsar Handbook 16: Impact Assessment: Guidelines on biodiversity inclusive EIA and SEA.

When scoping the key issues for SEA, you should consider any SEAs carried out at higher decision levels that might have an influence on the scope of the SEA and on climate change and biodiversity aspects of the evolving baseline. Similarly, if Natura 2000 sites could be affected, the requirements of the Article 6(3) of the Habitats Directive have to be taken into account. Article 6(3) requires an 'appropriate assessment' when any plan, either individually or in combination with other PPs and projects, is likely to have a significant effect on a Natura 2000 site/s. The implementation experience[21] shows that Member States use mainly a co-ordinated approach for the SEA and Article 6(3) assessments. This is in line with Article 11(2) of the SEA Directive which allows Member States to provide co-ordinated or joint procedures[22] to avoid duplication and overlapping of assessments.

Combined application of the SEA Directive and the Habitats Directive [Articles 6(3) and 6(4)]

The combined application of the SEA Directive and the Habitats Directive can help in particular to:

- identify projects and/or types of projects likely to have significant negative effects on Natura 2000 sites and the coherence of the network;
- identify and assess likely significant cumulative effects of the PP in combination with other plans or projects;
- propose mitigation measures to avoid and reduce these effects;
- examine alternative solutions (e.g. locations/routes or demand management), when many options are still open at PP level, to avoid significant effects;
- prepare the ground for Article 6(3) assessments at project level; and
- if needed, provide the basis for using the derogation procedure (compensatory measures) under Article 6(4) at project level.

Table 9 overleaf provides examples of questions to help you in identifying key biodiversity issues.

[21] Report from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions on the application and effectiveness of the Directive on Strategic Environmental Assessment (Directive 2001/42/EC), COM(2009) 469 final.

[22] Coordination of the SEA assessment with the other assessment(s) and joint procedure with one single assessment that meets the requirements of both Directives.

Table 9: Examples of key questions for identifying key biodiversity issues

Main concerns related to:	Key questions that could be asked at the screening and/or scoping stage of the SEA
Degradation to ecosystem services (including the impacts on the processes that are important for creating and/or maintaining ecosystems)	• Will the proposed PP, either directly or indirectly, lead to serious damage or total loss of ecosystem, or land-use type thus leading to a loss of ecosystem services of scientific/ecological value, or of cultural value? • Will the PP damage ecosystem processes and services, particularly those on which local communities rely? • Will the PP lead to changes in ecosystem composition, structure or key processes responsible for maintaining ecosystems and their services in areas providing key services? • Is the PP in any way dependent upon ecosystem services? • Can increased supply of ecosystem services contribute towards the PP's objectives? Processes that are important for the creation and/or maintenance of ecosystems: • Will the PP change the food web structure and interactions that shape the flow of energy and the distribution of biomass within the relevant ecosystem? • Would the PP result in significant changes to water level, quantity or quality? Would the PP result in significant changes to air quantity or pollution?
Loss and degradation of habitats (including the extent or quality of the habitat, protected areas including Natura 2000 sites, habitat fragmentation or isolation and green infrastructure)	• Will the PP lead to loss or deterioration of natural or semi-natural habitats, including habitats of Community interest? If so, to what extent; what are the functions performed by this habitat; is the damage temporary or permanent and what can be done to minimise the impact? • If habitats are lost or altered, are alternative habitats available to support associated species? • Are there opportunities to consolidate or connect habitats? • Will the PP adversely affect protected areas; threatened ecosystems outside protected areas; migration corridors identified as being important for ecological or evolutionary processes; areas known to provide important ecosystem services and habitats for threatened species? • Will the PP lead to fragmentation of habitats or areas providing key ecosystem services, e.g. by the creation of linear infrastructure, human settlements, intensive agricultural lands, forest monoculture? • How seriously will this impact on the habitats and corridors, given that they can be also adversely affected by climate change? • Are there opportunities to build or develop green infrastructure as a part of the PP to support its non-environmental goals and its environmental goals (e.g. adaptation to climate change or increasing connectivity of protected sites)?
Loss of species diversity[23] (including species protected under the Habitats and Birds Directives)	• Will the PP have a negative impact, direct or indirect, on the species of Community interest listed in Annex II and/or Annex IV or V, in particular, priority species from Annex II[24] of the Habitats Directive or on the species covered by the Birds Directive? • Will the PP cause a direct or indirect loss of a population of a species identified as priorities in NBSAPs and/or other sub-national biodiversity plans? • Will the PP alter the species-richness or species-composition of habitats in the area? • Will the PP affect the sustainable use of a species population? • Will the PP exceed the maximum sustainable yield, the carrying capacity of a habitat/ecosystem or the maximum allowable disturbance level of populations, or ecosystem? • Would the PP increase the risk of invasion by alien species?
Loss of genetic diversity[25]	• Will the PP result in the extinction of a population of particularly rare or declining species and those with identified as priorities in NBSAPs and/or sub-national biodiversity plans? • Will the PP cause a local loss of varieties of cultivated plants and/or domesticated animals and their relatives, genes or genomes of scientific, ecological, or cultural value? • Will the PP result in the fragmentation of a population leading to (genetic) isolation?

[23] Definition: The number and variety of species found in a given area in a region http://www.cbd.int/cepa/toolkit/2008/doc/CBD-Toolkit-Glossaries.pdf.

[24] Priority species are indicated by an asterisk (*) in Annex II of the Habitats Directive.

[25] The potential loss of natural genetic diversity (genetic erosion) is extremely difficult to determine, and does not provide any practical clues for formal screening/scoping. The issue probably only comes up when dealing with highly threatened, legally protected species which are limited in numbers and/or have highly separated populations, or when complete ecosystems become separated and the risk of genetic erosion applies to many species, COP 6 Decision VI/7, Annex: Guidelines for incorporating biodiversity-related issues into environmental impact assessment legislation and/or process and in strategic environmental impact assessment, http://www.cbd.int/decision/cop/?id=7181.

5. How to assess effects related to climate change and biodiversity in SEA?

This section gives you specific tips, tools and methods for assessing the effects related to climate change and biodiversity throughout the SEA process. It is organised according to the key aspects of SEA where climate change and biodiversity considerations have the greatest impact on the process.

Each sub-section looks at the practical elements of an SEA where climate change and biodiversity considerations are most relevant and provides examples of techniques that are most helpful. Many of the approaches and techniques suggested can be used at various stages of SEA, not only the ones shown here.

This section supports several stages of the SEA process, particularly, the consideration of reasonable alternatives, assessment of significant effects and identification of monitoring measures.

Addressing climate change and biodiversity in the SEA process (see Section 2.3) brings new challenges for the SEA practitioner. There will be situations in which the practitioner will have to make a judgement, preferably in consultation with stakeholders, to avoid unnecessarily extending the EIA procedure or to leave enough time to properly assess complex information. Taking a practical, common sense approach to SEA will sometimes be best.

SEA should be used as an opportunity to address the key issues of climate change and biodiversity at an early stage, when many options are still open. For example, planners should impose restrictions, where appropriate, on developments on flood plains or areas at risk of flooding, or promote land management to increase water retention capacity and avoid or minimise flood risk at project/EIA-level. For linear types of projects, such as motorways or railways, it is important to assess the likely significant effects at corridor level before looking at individual sections (EIA level). This makes it possible to consider a wide range of location alternatives and select the option that avoids or minimises significant environmental effects.

5.1 An overview of tools and approaches to integrate climate change and biodiversity into SEAs

Table 10 overleaf provides an overview of tools and approaches that can be used to help you assess climate change and biodiversity issues during the SEA process. An example of the practical application of one tool — Critical (Decision) Factors — is described in the box below.

Case study:
SEA of Lisbon Metropolitan Area Regional Plan, Portugal — an example of using Critical Decision Factors and close collaboration between plan-makers and SEA practitioners

Incorporating biodiversity and climate change by using a Critical Decision Factors approach led to the effective integration of climate change and biodiversity in the Plan. As a result of this and the SEA and planning teams working together, significant opportunities were recognised and adopted, e.g. protecting natural and agro-forestry areas, limiting the expansion of urban areas and adopting a preliminary regional strategy for climate change.

Source: http://consulta- protaml.inescporto.pt/plano-regional (Plan and SEA in Portuguese)

For more information on the tools and approaches, see Annex 3. This is not an exhaustive list and many other tools may be useful.[26] Some of the tools and approaches listed assess specific aspects of climate change and biodiversity (e.g. GHG emission calculators); others are more generally applicable. They can support different stages of the SEA process, with some being applicable only to specific stages and others to the whole process.

Table 10: Overview of selected tools and approaches that can be used to support the assessment of climate change and biodiversity as part of the SEA process

Tools and approaches	Topics that the tools and approaches are most applicable to		
	Climate change mitigation	Climate change adaptation	Biodiversity
Biodiversity offsetting			
Biodiversity screening map			
CO_2MPARE			
Confidence levels			
Critical Factors			
Ecosystem-based approaches			
Ecosystem services approaches			
Ecosystem services valuation			
GHG emission calculators			
GIS and spatial analysis			
Green infrastructure			
GRIP			
Industry (project) profiles of GHGs			
Life Cycle Assessment (LCA)			
Natural capital approaches/Four-Capitals			
Network analysis			
Regional Economy Environment Input Output (REEIO)			
Resources and Energy Analysis Programme (REAP)			
Risk management			
Scenarios			
Spheres of influence and Ecosystem chains			
SWOT and STEEP analysis			
Vulnerability assessment			

Further information: Annex 3.

[26] The IAIA wiki is a useful resource for more general tools and concepts in the practice of SEA: http://www.iaia.org/iaiawiki/.

5.2 Consider climate change scenarios at the outset of the SEA

SEA practitioners should outline climate scenarios that may either adversely affect implementation of the proposed PP or may worsen its impacts on biodiversity and other environmental factors. These may include 'big surprises' such as extreme droughts, major heat waves and fires, species extinctions, loss of resilience and system collapses. The scenarios to consider will depend on the nature of the PP and issues that emerge at the scoping stage.

In order to put climate change factors as the basis of the assessment, future climatic conditions should be considered upfront — this should include both gradual changes in climate and changes to the frequency of extreme events. Include the following factors:

- changing temperatures (general expected changes, extreme conditions such as heat waves and cold spells);
- changing rainfall patterns and extreme rainfall events (heavy rainfall and droughts);
- windstorms;
- changing sea levels;
- other potential extreme climatic conditions (snowstorms, hail, etc.).

In addition to climate scenarios, it is important to consider socio-economic scenarios as this will help assess future vulnerability to climate change. Most of the direct manifestations of climate change will cause further secondary and indirect effects that can be considered in the analysis of environmental baseline trends (see the section below on analysing evolving baseline trends.)

5.3 Analyse evolving baseline trends

The evolution of the baseline — how the current state of the environment is expected to change in the future *with* or *without* implementation of the PP — is critical to understanding how the proposed PP could impact that changing environment (see box below).

Case study:
SEA of the Offshore Energy Development Plan, Ireland — an example of considering the evolving baseline

This SEA is most interesting as a good example of climate change effects being factored into the assessment of the environmental baseline, particularly with regard to the impacts on biodiversity. The review of the evolving environmental baseline for each category of species considers 'key issues and future trends', with climate change included within each of these species category assessments. This ensures that information on climate effects is based on future trends as per the best available information about what can be expected to happen. This information is used to identify and develop win-win alternatives to the development areas and to apply the precautionary principle.

Source: Sustainable Energy Authority in Ireland

The baseline environment will be a moving baseline, particularly for PPs resulting in large infrastructure projects with a long planning or long-lasting effects (time-scales exceeding 20 years).

It may take many years before they become fully operational, and in that time, biodiversity in the affected areas may have changed, the area may be subject to different climate impacts, such as storm events, increased flood risk, etc. For such PPs, environmental outlooks or scenario studies that analyse the trends and their likely future directions may provide a useful reference.

To be able to understand how the proposed PP could impact on the future environment and how its implementation might be impacted by the changing environmental context, it is critical to understand the likely evolution of the baseline without the proposed PP in light of expected changes in the climate, either positive or negative . You should also consider the result of implementing other PPs. Spatially explicit data and assessments, potentially using the Geographic Information System (GIS), are likely to be important in making this analysis, and to understand the distributional effects. The type and geographical scale of a particular PP is likely to determine what is appropriate for a particular SEA. Several European sources of data, including data repositories and online digital datasets, such as the Biodiversity Information System for Europe (BISE) or the Climate change Data Centre might be useful for analysing the evolving baseline trends. Annex 2 includes a comprehensive overview and links to sources of information on biodiversity and climate change.

It is essential to consider the following aspects when looking at the evolving baseline:

- **Trends in key issues over time:** e.g. water quality and availability during droughts, ecosystem deterioration, vulnerability of infrastructure to extreme climatic events, etc. Are these trends continuing, changing, or levelling out? Are there environmental outlooks or scenario studies available that have assessed the likely future direction of these trends? If data are unavailable for certain indicators, are proxy indicators available, e.g. if air quality monitoring data is not readily available for an urban area, are there data relating to trends in traffic flow/volumes over time?
- **Drivers of change:** e.g. major drivers such as demographic trends and the economic affluence of the society, the legal and policy framework, market forces and economic incentives, major projects that affect the issue, institutional powers and capacities to regulate and manage the issue. The drivers can be broken down into:
    - **Direct drivers**: e.g. changes in land use and land cover; fragmentation and isolation; extraction, harvest or removal of species; external inputs such as emissions, effluents, chemicals; disturbance; introduction of invasive, alien or genetically modified species; restoration.
    - **Indirect drivers:** e.g. demographic, socio-political, economic, cultural, technological processes or interventions.
- **Thresholds/limits:** e.g. have thresholds already been breached (such as air quality thresholds in urban areas, etc.), or are the limits expected to be reached? Have targets been set that need to be met, such as national or regional energy or emissions targets related to the '20-20-20' targets in the EU's *Climate and Energy Package*? Are there tipping points to be avoided in order to prevent serious deterioration or breakdown of relevant ecological and social systems?[27]

[27] See examples of environmental limits relevant to climate change and biodiversity at http://www.resalliance.org/index.php/thresholds_database.

- **Key areas that may be particularly adversely affected by the worsening environmental trends:** focus on areas of particular environmental importance, such as Natura 2000 sites designated under the Birds and Habitats Directives or other zones designated under EU legislation because of their environmental sensitivity or characteristics.
- **Critical interdependencies:** e.g. water supply and sewage treatment systems, flood defences, energy/electricity supply and communication networks.
- **Who benefits and who loses as a result of these trends: a**dverse impacts are not generally proportionally distributed within society — some population groups and economic sectors are more seriously affected than others by these changes in the ecosystems.

When developing the baseline against which the proposed PP is to be assessed, it is also important to acknowledge **uncertainty** — depending on the timescale and spatial scale being considered some uncertainty is inevitable and this will increase over larger scales.

5.3.1 Vulnerability

Assessing vulnerability needs to be built into any assessment of the evolution of the baseline environment, and of alternatives. How will the environment change if the PP is not implemented, or if different alternatives are taken?

'Vulnerability assessment is the analysis of the expected impacts, risks and the adaptive capacity of a region or sector to the effects of climate change. Vulnerability assessment encompasses more than simple measurement of the potential harm caused by events resulting from climate change: it includes an assessment of the region's or sector's ability to adapt. Within the context of climate change, the IPCC defines vulnerability to climate change as the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes.'[28]

Major infrastructure will be particularly vulnerable, and therefore PPs should reflect this (see box right). During flash floods, for example, poorly designed sewage networks can overflow and release contaminated flood waters into other neighbourhoods. PPs that will place future demands on the sewerage system will need to take account of the capacity of the system to cope not just with the expected sewage effluent/disposal requirements of the development resulting from the implementation of a PP, but also its capacity in the long-term and in the face of climate change. Biodiversity

Vulnerability of infrastructure

Major infrastructure projects, in particular, might be vulnerable, e.g. to:

- increased flood risk to fossil fuel and nuclear power sites and electricity substations;
- reduced availability of cooling water for inland power stations;
- reduced quality of wireless service from increased temperatures and intense rainfall;
- increased floods risk to all transport sectors;
- increased scour of bridges from intense rainfall/flooding;
- reduced security of water supply from changing rainfall patterns;
- increased flood risk to wastewater infrastructure.

When assessing vulnerability, it is important to consider critical interdependencies, e.g. in infrastructure they can lead to a 'cascade failure' where the failure of one aspect of infrastructure, such as flood defences, can lead to other failures e.g. flooded power stations leading to power cuts which thereby affect telecommunications networks.

Source: HM Government (UK, 2011) (Climate Resilient Infrastructure: Preparing for a Changing Climate — Summary Document)

[28] Source: CLIMATE-ADAPT.

considerations may also be relevant if, for example, river courses carrying sewage effluent discharge into estuaries designated as being of importance for biodiversity.

5.3.2 Policy consistency and coherence

An important function of SEAs is to assess the consistency and coherence between the proposed PP and the relevant policy objectives and targets for biodiversity protection and climate change. The SEA Directive requires environmental protection objectives to be set at international, Community or Member State level, which are relevant to the PP. These objectives (and any environmental considerations) must be assessed when an SEA is prepared. Section 3 of this guidance outlines the main legislative and policy documents produced at the international and European levels for biodiversity protection and climate change at the time of writing. Additional policy objectives are being set at national and sub-national levels in different Member States. They can provide overall benchmarks for assessing whether the proposed PP moves in a right direction. Climate change objectives can be divided into two sets of objectives: **assessment objectives** (minimal/bottom-line targets or standards that the proposed PP must meet); and **aspirational objectives** (long-term environmental goals that the proposed PP should consider).

The SEA process should identify the policy objectives for biodiversity protection and climate change which may be relevant for the proposed PP and clearly describe whether it facilitates or contradicts their achievement.

Discussing your SEA with other SEA practitioners and those who will prepare or adopt the PP is likely to yield significant benefits. Such discussions can identify broad environmental risks and environmental benefits of the various options and may help consider or develop alternatives or recommend overall changes in the thrust of the proposed PP.

5.4 Assess alternatives that make a difference in terms of climate change and biodiversity impacts

An analysis of alternatives is often viewed to be at the heart of the SEA process, as this provides confidence that the proposed course of action is the best one available. But there must be additional considerations of climate change and biodiversity issues if they are to be addressed effectively in SEAs. This is particularly important if consideration of long-term resilience — of the environment and of the PP — is to be built into the SEA.

Considering alternatives should encourage the planning process to look for better ways to meet human needs without contributing to climate change, and minimise the risks resulting from previous development patterns and the likely expected climate change phenomena.

The analysis of reasonable alternatives should:

- consider the context of different climate change scenarios and climate impacts, and possible reasonable alternative climate change futures (see Annex 3, Scenarios);
- examine alternative ways of achieving the PP's objectives, in particular, if the PP is likely to have adverse impacts (either alone or in combination with other plans or projects) on the integrity of Natura 2000 site/s, and they cannot be addressed via appropriate mitigation measures;

- aim for 'no-net-loss' of biodiversity (see box right) and/or an improvement in biodiversity.

If you use a vulnerability assessment, as outlined above, it can also help when assessing alternatives to help identify and select the most resilient alternative(s).

SEA practitioners may apply the precautionary principle when they are uncertain about the nature of the potential risks and adjust the proposed PP based on a 'no-regret' (see box below) or 'low regret' measures, rather than risk causing major problems during implementation of the proposed PP. This is fully consistent with the requirements of the SEA Directive to 'prevent, reduce and as fully as possible offset any significant adverse effects on the environment of implementing the plan or programme' [Annex I (g)].

'No-net-loss' of biodiversity

No-net-loss, in essence, refers to the point where biodiversity gains from targeted conservation activities match the losses of biodiversity due to the impacts of a specific development project, so that there is no-net reduction overall in the type, amount and condition (or quality) of biodiversity over space and time. Several countries have adopted no-net-loss or net gain as an overarching policy goal, for example, 'no net loss' goal for wetlands, etc.

Source: Business and Biodiversity Offsets Programme; Biodiversity Impact Assessment (IAIA, 2005)

The *CBD Voluntary Guidelines on Biodiversity-inclusive EIA and SEA*[29] recommend the identification and mapping of valued ecosystem services so that these can help influence the type of alternatives and mitigation measures considered.

Tables 11, 12 and 13 provide examples of alternatives and mitigation measures concerning key climate change mitigation, climate change adaptation, and biodiversity concerns. These should be adapted in light of the specificities of each individual case.

'No-regret' measures

'No-regret' measures are activities that yield benefits even in the absence of climate change. In many locations, the implementation of these actions constitutes a very efficient first step in a long-term adaptation strategy. For example, controlling leakages in water pipes or maintaining drainage channels is almost always considered a very good investment from a cost–benefit analysis perspective, even in absence of climate change. Improving building insulation norms and climate-proofing new buildings is another example of a no-regret strategy, since this action increases climate robustness while energy savings can often pay back the additional cost in only a few years.

Once 'no-regret' measures have been identified, it is important to know why they are not implemented yet. Many obstacles explain the current situation, including (i) financial and technology constraints; (ii) lack of information and transaction costs at the micro-level; and (iii) institutional and legal constraints.

Source: CLIMATE-ADAPT

[29] CBD/IAIA (2006), Biodiversity in EIA and SEA — CBD Voluntary Guidelines on Biodiversity-inclusive EIA and SEA, Background document to CBD Decision VIII/2.

Table 11: Examples of alternatives and mitigation measures related to climate change mitigation

Main concerns related to:	Examples of alternatives and/or mitigation measures at the assessment stage
Energy demand in industry	• Reducing demand for energy (electricity or fuel) in industry • Alternative low-carbon sources (onsite or through specific low carbon energy supplier) • Targeted support to businesses engaged in eco-innovations, low-carbon business and low-carbon technologies • Potential synergies between adaptation and GHG reduction
Energy demand in housing and construction	• Improve the energy performance of buildings • Alternative low carbon sources (onsite or through specific low carbon energy supplier) • Potential synergies between adaptation and GHG reduction
GHG emissions in agriculture	• Reducing the use of nitrogen in fertilising practices • Managing methane (enteric and manure) • Protecting natural carbon sinks, such as peat soils • Potential synergies between adaptation and GHG reduction • Harvesting methane emissions for biogas production
GHG emissions in waste management	• Consider ways in which the PP can increase waste prevention, re-use and recycling, particularly to divert waste from landfill • Consider ways of producing energy through waste incineration or producing biogas from wastewater and sludge • Alternative low carbon sources (onsite or through specific low carbon energy supplier) • Potential synergies between adaptation and GHG reduction
Travel patterns and GHG emissions from transport	• Promote PP patterns that reduce the need to travel • Support car-free PP • Encourage walking and cycling • Encourage public transport • Provide transport choices to encourage a modal shift to cleaner modes (e.g. from cars to trains), such as an effective and integrated public transport system • Transport demand management schemes • Encourage car sharing • Prioritise high density urban PPs (smaller housing at higher density) and reuse of brownfie land
GHG emissions from energy production	• Generic recommendations are intentionally not provided as these are context-specific, depending upon the energy production capacity and energy supply sources of the area in question • Potential synergies between adaptation and GHG reduction
Forests and biodiversity	• Investment in wetlands to support carbon sequestration to offset PP's GHG emissions.

Table 12: Examples of alternatives and mitigation measures related to climate change adaptation

Main concerns related to:	Examples of alternatives and/or mitigation measures at the assessment stage
Heat waves	• Avoid development patterns that fragment habitat corridors or, for linear infrastructures, make sure that habitat continuity is restored in the most sensitive areas • Improvements in urban structure — expansion of green areas, open water surfaces and wind paths (along rivers and waterfronts) in urban areas to reduce the possible heat island effect • Encourage greater use of green roofs • Reduce man-made exhausts during heat waves (industries, and car traffic) • Awareness-raising about risks associated with heat waves and action to reduce them • Heat wave early warning systems and response plans • Potential synergies between adaptation and GHG reduction
Droughts	• Encourage water efficiency measures • Explore efficient use/re-use of rainwater and grey water • Restrictions on excessive/non-essential use water use during droughts (depending on their severity) • Minimise low flow withdrawals • Restrictions for effluent discharges into water bodies during droughts • Maintain and improve the resilience of watersheds and aquatic ecosystems by implementing practices that protect, maintain, and restore watershed processes and services

Flood regimes and extreme rainfall events	• Ensure that any existing or planned essential infrastructure is protected from future flood risk • In high risk areas, consider arrangements for supply of goods/services that may be disturbed by floods • Increase resilience to floods through use of sustainable drainage systems • Enhance permeable surfaces and green spaces in new PPs • Avoid decreasing storage volumes in flood plains
Storms and high winds	• Ensure new infrastructure considers the impacts of increased high winds and storms • In high-risk areas, consider arrangements for supply of goods/services that may be disturbed by increased storm events
Landslides	• Avoid new developments in areas at risk from erosion • Protect and expand native woodland cover • In high-risk areas, consider arrangements for supply of goods/services that may be disturbed by landslides
Sea level rise, storms surge, coastal erosion, hydrological regimes and saline intrusion	• Avoid PPs that promote development in coastal areas at risk of rising sea levels, coastal erosion and flooding, except for projects for which this risk is taken into account, such as port development • Move water intakes and any economic activities that depend on the supply of clean water or ground water (agriculture) away from areas that will be affected by saline intrusion • Potential synergies between adaptation and GHG reduction
Cold spells	• Ensure that any existing or planned essential infrastructure is protected from cold spells
Freeze-thaw damage	• Ensure that key infrastructure (e.g. roads, water pipes) is able to resist wind action and to prevent moisture from entering the structure by (e.g. different formulations of materials)

Table 13: Examples of alternatives and mitigation measures related to biodiversity

Main concerns related to:	Examples of alternatives and/or mitigation measures at the assessment stage
Degradation of ecosystem services (including the impacts on the processes which are important for the creation and/or maintenance of ecosystems)	• Restore degraded ecosystems on the site with a view to enhancing ecosystem services
Loss and degradation of habitats (including the extent or quality of the habitat, protected areas including Natura 2000 sites, habitat fragmentation or isolation and green infrastructure)	• Use of ecosystem services approach (see box overleaf) and ecosystem-based approaches and green infrastructure: o green bridges and eco-ducts (elements of green infrastructure) re-connect natural areas divided by linear developments (e.g. roads or railway lines); they reduce accidents involving wild animals and cars; allow animals to move easily and safely from one area to another; give animals more space to find food and shelter, and allow populations of the same species to interact, improving the overall resilience of the species; and help plant species to spread o restoration of flood plains and wetlands as an alternative to dykes
Loss of species diversity (including species protected under the Habitats Directive and Birds Directive)	• Provide recommendations for the project level, e.g. recommend specific design alternatives to avoid adverse effects on bird species (e.g. size, height, spacing, lighting and visibility of wind turbines); or timing of construction conditions • Deliver 'smart conservation' e.g. by promoting properly designed parks, walking paths, green roofs and walls which can contribute to species diversity and to tackle climate change in urban environment
Loss of genetic diversity	• Identify recommendations for the project level, e.g. identify 'no-go-zones' or alternative locations for certain types of investments on grounds of irreversible damage to rare species

Case study:
SEA of the Integrated Coastal Zone Management (ICZM), Portugal — example of an ecosystem services approach

Ecosystem services can be integrated into SEA without the need for extensive technical exercises. An ecosystem services approach is also a useful tool to enable the strategic consideration of biodiversity which would otherwise be difficult in very high level plans.

The SEA did not conduct a detailed analysis and assessment of existing ecosystems and services in the Portuguese coastal zone. Rather, it identified and compared policy options in terms of their risk or benefit to strategic level ecosystem services that were identified through consultation with key policy stakeholders. This required a consideration of strategic ecosystem services that could be affected by policy choices relevant to ICZM: e.g. the management of natural coastal dynamics, especially in vulnerable zones; the maintenance of the productivity of coastal zones; the maintenance and conservation of the availability of natural and cultural heritage and biodiversity.

Source: Including ecosystem services in coastal management by using SEA, Portugal (Partidário M.R., 2011)

5.5 Assess climate change and biodiversity cumulative effects

Cumulative effects — or the combined impact of any number of different effects — are particularly important for climate change and biodiversity. As shown in Section 2, climate change and biodiversity are complex issues with long-term impacts and consequences for PPs. This means that understanding and assessing the cumulative effects is critical.

There are a number of tips and approaches to assessing the cumulative effects of climate change and biodiversity in SEAs.

- **Recognise cumulative effects as early as possible in the SEA process,** if possible in the scoping stage. Talking to the right stakeholders as early as possible can give you a broader overview, which helps you better understand how seemingly insignificant individual effects can have greater consequences when considered together.
- **Pay attention to the evolving baseline** when assessing the cumulative effects of climate change and biodiversity impacts. The current state of the environment will not necessarily be the future state of the environment, even if the proposed PP does not go ahead. Both the climate and the species that make up the natural world are in a constant state of flux.
- **Distinguish between magnitude and significance and use significance criteria.** A high magnitude impact may not be significant if the species affected is common, widely distributed and readily able to recover, but even a small magnitude impact may be very significant to a highly sensitive or rare species or habitat. Significance criteria can be policy and guidance documents, such as: biodiversity strategies; biodiversity action plans for habitats and species; international, national and local designations (e.g. conservation objectives of Natura 2000 sites); legislation and/or using an ecosystems approach by identifying the valued ecosystem services and how they will be affected by drivers of change over time.
- **Gain an understanding of other PPs and projects.** Identify relevant PPs and take them into account when assessing cumulative effects.

- Where possible, use **causal chains** or **network analysis** (see box below) to understand the interactions and associated cumulative effects between specific elements of the PP and aspects of the environment. The point is not to be comprehensive, but to understand what might be the most significant cumulative effects. These may often be best identified through discussions with stakeholders who can help work through potential pathways in causal chains.

Case study:
SEA of the Strategy for Wild Deer in Scotland, the United Kingdom — example of the use of network analysis

The Strategy sought to provide a long term vision for the effective management of wild deer in Scotland. SEA used a network analysis. It is an effective approach for considering complex long-term issues.

SEA explored a suite of alternative approaches to managing wild deer. Each one could enable the Strategy to respond to future changes and unexpected or unforeseen events. The network diagram was based on the relationships between the:

- **driver:** as identified via brainstorming with stakeholders;
- **factors of change:** the possible broader impacts of the driver;
- **sub-influence:** impacts specific to the strategy due to the factors of change (and ultimately the driver);
- **management approach:** what alternatives are available for the strategy to adapt and respond to the sub-influences; and,
- **impacts:** what are the likely final impacts on the ground in relation to the Strategy.

Source: Deer Commission for Scotland relevant webpage

5.5.1 Trend analysis

SEA practitioners may find it useful to use a trend analysis (see box right), not only to analyse the baseline, but also to assess the cumulative effects of multiple actions proposed in the PP on the relevant environmental and climate change issues. This approach allows you to identify the potential changes to the baseline trends likely to be caused by the proposed PP.

A trend analysis can be defined as an interpretation of change over time with and without the proposed PP. It can help to describe past trends and the current situation by tracing any trends or patterns in the relevant territories in time periods covered by the PP. It can also help you predict future baseline trends without the PP, based on information about the changes in their future drivers.[30] Lastly, a trend analysis can be helpful when assessing the cumulative effects of proposed developments in the PP on the identified future baseline trends. Its benefit is that it can combine many different tools and has the capacity to analyse cause-effect relationships even in situations constrained by significant data gaps.

Trend analysis

Trends can be presented through:

- **Storylines** that describe the overall trends, their main drivers, territorial dimensions and key concerns and opportunities arising from these trends;
- **Maps** showing spatial development patterns;
- **Graphs:** from simple graphs that use available data sets to illustrate evolution of key issues and/or their drivers over time to complex graphs that provide comprehensive overview of correlation between evolution of drivers overtime and the corresponding (sometime delayed) changes in the issues addressed by the analysis.

Source: Presentation at the Conference of Regions for Sustainable Change project, INTERREG IVC (Dusik J., 2011)

[30] Oversimplified extrapolation that does not consider how the trend will evolve once it reaches a key breaking point (e.g. when the carrying capacity of the surrounding environment has been reached or exceeded), or once the counter-trends reverse the trend, and therefore may be misleading.

5.6 Seek to avoid adverse effects wherever possible, before considering mitigation

The SEA Directive requires a description of 'measures envisaged to prevent, reduce and as fully as possible offset significant adverse effects on the environment'.

Biodiversity offsetting

Biodiversity offsets can compensate for significant negative biodiversity impacts arising from development plans or projects after appropriate prevention and mitigation measures have been taken. Offsets should:

1. aim for 'no-net-loss';
2. seek additional conservation outcomes;
3. adhere to the mitigation hierarchy;
4. recognise there are limits to what can be offset;
5. be used in a landscape context;
6. achieved through stakeholder participation;
7. seek equity among stakeholders;
8. be based on adaptive management and long-term outcomes;
9. be transparent;
10. be informed by sound science.

Source: Business and Biodiversity Offsets Program relevant webpage

When assessing biodiversity effects, there is a need to aim for avoiding or reducing residual impacts, while maximising opportunities for improvement. SEAs should focus on ensuring 'no-net-loss' of biodiversity and avoiding effects from the start, before considering mitigation and compensation (see box left). Article 6(4) of the Habitats Directive provides a compensation system specifically for Natura 2000 sites.

If required, mitigation and compensation measures for biodiversity can be beneficial for climate change mitigation and adaptation. For example, the creation of new habitats, green spaces, green corridors, green and brown roofs (enhancement) can maintain and enhance biodiversity, aid species in adapting to long-term climate change, and help provide essential ecosystem services such as flood storage capacity, rainfall interception, shade and heat regulation, and air quality regulation as part of adaptation to climate change.

For climate change, an SEA can take a precautionary approach and evaluate whether there is an option to avoid GHG emissions throughout a PP, rather than seek to mitigate them after they have been released. Mitigation measures, such as requiring energy efficiency measures in buildings, may help but are unlikely to fully remediate the harmful effects of emissions.

For climate change adaptation, SEAs should be used to help adjust human activities and the proposed PP to improve adaptive capacity of the system and support human responses to better cope with extreme events.

5.7 Monitoring significant effects and adaptive management

The SEA Directive provides for monitoring a PP's significant environmental effects so that unforeseen adverse effects can be identified at an early stage and remedial action can be taken where needed.

The use of monitoring provisions has consistently been identified as a weakness in SEAs, for example, because of difficulties in identifying monitoring indicators.[31] This is particularly relevant for complex and often uncertain issues like climate change adaptation and biodiversity, as monitoring injects flexibility into PPs and strengthens their adaptive capacity.

[31] (European Commission) Study concerning the report on the application and effectiveness of the SEA Directive (COWI, 2009).

This guidance document emphasises the importance of integrating more adaptive management into SEAs – a systematic process to continually improve management policies and practices by learning from the outcomes of previously employed policies and practices.[32] One way to do this is to develop an effective monitoring system (see box below). In practical terms — given the long timescales often considered — this is best integrated into the regular review process for PPs so that the objectives of the new or revised PP can be adapted to changing circumstances. So, while a PP may have a rolling 20-year horizon, it may be reviewed every five years, providing the opportunity to review and revise the PP in light of changes observed over the preceding five years.

Climate change mitigation and adaption indicators, and key biodiversity indicators, should be identified as part of the monitoring proposals in the SEA. However, many of these are likely to already be indicators monitored for the PP or other purposes and used to ensure that impact mitigation measures are safeguarded, implemented, and focused on the most significant and relevant effects identified by the SEA process. Central to adaptive management will be the ability of the PP, when reviewed, to respond when thresholds or limits are exceeded or negative trends worsen, e.g. a continuing decline in populations of farmland birds or increasing frequency of flood events in the plan area. Adaptive management is therefore more readily integrated into regular plan-making cycles, if these exist. For a one-off PP, e.g. for a linear transport scheme, the adaptive management and mitigation measures need to be fed down the decision-making hierarchy into individual projects (and their EIAs) that arise out of the PP. The monitoring arrangements already identified at strategic level may then be used for EIA.

Mitigation measures may have significant residual environmental effects that need to be taken into account (e.g. renewable energy generation or tree planting may have adverse impacts on biodiversity). Hence, there is a need to monitor the PP regularly and assess the mitigation measures against identified effects on the ground.

The IMPEL Project's Report[33] provides useful generic information on monitoring in SEA.

Case study:
SEA of the Thames Estuary 2100 Plan for Flood Risk Management — monitoring adaptive capacity

This SEA highlights the importance of monitoring the plan, given its long-term focus and the inherent uncertainty. The SEA report states that monitoring will help to achieve 'timely adaptation of the plan in response to changes in how the Estuary responds to both climate change and the flood risk management approaches.' Among the aspects that the SEA expects to monitor are: impacts of flood risk management measures and sea level rise (which will provide an indication of the biodiversity effects and help determine whether habitat replacement measures are correctly aligned with the rate and scale of habitat loss); health and stability of the intertidal habitat; and 'climatic factors' as measured by mean sea level rise, peak surge tide level and peak river flood flows.

Source: The Environment Agency for England and Wales relevant webpage

[32] Further guidance on adaptive management can be found at http://www.for.gov.bc.ca/hfp/amhome/Admin/index.htm.
[33] IMPEL Project: Implementing Article 10 of the SEA Directive 2001/42/EC, Final Report (Impel, 2002).

Annexes

Annex 1: Further reading

The policy documents, reports and guidelines described below include both documents referred to within this guidance and also other potentially useful sources of information to support the SEA process. This section includes only reference documents publicly available on the Internet. The table below provides the title, hyperlink and short description of each source. The icons below are used to distinguish the different topics covered in the table.

Key:

 Climate change

 Mitigation

 Adaptation

 Biodiversity

Environmental Impact Assessment

Strategic Environmental Assessment

Reference/further reading (links active as of March 2013)	Comments on relevance
Climate change — general	
Impacts of Europe's changing climate 2008 — indicator-based assessment (EEA, 2008)	• The main part of this report summarises the relevance, past trends and future projections for about 40 indicators covering all aspects of climate change and impacted sectors. The report also addresses adaptation and the economics of climate change impacts and adaptation strategies.
Stern Review on the Economics of Climate Change (Cabinet Office - HM Treasury, 2006)	• This review provides a contribution to assessing the evidence and building understanding of the economics of climate change. It first examines the evidence on the economic impacts of climate change itself, and explores the economics of stabilising GHGs in the atmosphere. The second half of the document considers the complex policy challenges involved in managing the transition to a low-carbon economy and in ensuring that societies can adapt to the consequences of climate change that can no longer be avoided.
Understanding Climate Change, SOER thematic assessment (EEA, 2010)	• The report which provides an introduction to climate change, including scientific background, policy context, possible risks and impacts, policy actions and current targets and goals.
UN Framework Convention on Climate Change (UNFCCC)	• It provides information regarding the latest developments through the United Nations Conference of Parties (COP) process. • It includes links detailing international requirements (such as Kyoto, Bali Action Plan, Copenhagen Accord and Cancun Agreement) including likely developments. • Good source of supra-national GHGs data.
Climate change — mitigation	
Mitigating climate change, SOER thematic assessment (EEA, 2010)	• The report summarising the EU's progress towards GHG reduction targets. • It considers global and European trends in GHG and associated challenges.
Climate change — adaptation	
Adapting to Climate Change, SOER thematic assessment (EEA, 2010)	• This report is a good source of European climate change impact analysis; description and analysis of current and possible future policy actions.

Climate Change: Working Group II: Impacts, Adaption and Vulnerability (IPCC, 2007)	• IPPC Chapter on impacts of climate change across Europe. It considers key vulnerabilities and possible policy responses.
Forest, health and climate change: Urban green spaces, forests for cooler cities and healthier people (EEA, 2011)	• A leaflet describing the benefits of forests (parks and green spaces) in urban environment as an adaptation approach to climate change.
Fourth Assessment Report: Climate Change (IPCC, 2007)	• The information regarding global climate change science, split into a range of working groups and sectoral reports.
Guiding principles for adaptation to climate change in Europe ETC/ACC Technical Paper 2010/6 (ETC, 2010)	• Technical consideration of the higher level principles for adapting to climate change.
Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (IPCC, 2012)	• Extreme weather and climate events, interacting with exposed and vulnerable human and natural systems, can lead to disasters. This report explores the challenge of understanding and managing the risks of climate extremes to advance climate change adaptation.
Mapping the impacts of natural hazards and technological accidents in Europe (EEA, 2010)	• The report assesses the occurrence and impacts of disasters and the underlying hazards such as storms, extreme temperature events, forest fires, water scarcity and droughts, floods, snow avalanches, landslides, earthquakes, volcanoes and technological accidents in Europe for the period 1998-2009. Useful for scoping potential vulnerability.
Vulnerability and adaptation to climate change (EEA, 2005)	• The technical report by the EEA that assesses European vulnerability to climate change impacts and adaptation measures being undertaken as of 2010.
White paper - Adapting to climate change: towards a European framework for action (EC, 2009)	• The white paper setting out the EU's approach to adapting to climate change, based on the concept of mainstreaming. • It refers to resilience of biodiversity and natural systems.
Biodiversity	
General	
Assessing biodiversity in Europe — the 2010 report (EEA, 2010)	• This report provides information on the status of European biodiversity with a focus on designated areas and progress towards the EU's biodiversity targets.
Biodiversity Baseline Flyer (EEA, 2010)	• The report summarising the EEA's biodiversity assessments as part of the State of the Environment Report 2010 reports.
Biodiversity — SOER 2010 thematic assessment (EEA, 2010)	• This report provides comprehensive assessment of the state and trends of Europe's biodiversity.
Biodiversity — 10 messages for 2010 (EEA, 2010)	• This report provides a range of specific assessments based on Europe's bio-geographic regions and the interrelationship between climate change and biodiversity.
EU 2010 Biodiversity Baseline (EEA, 2010)	• The detailed report providing an assessment of the status and trends of Europe's biodiversity.
EU Biodiversity Strategy to 2020 (EC, COM(2011) 244 final)	• The new Biodiversity Strategy aims to halt the loss of biodiversity and ecosystem services in the EU by 2020. There are six main targets, and 20 actions to help Europe reach its goal.
Landscape fragmentation in Europe (EEA, 2011)	• This report provides a foundation for environmental monitoring and protective measures for those landscapes that are not yet fragmented. It also makes it clear that fragmentation analysis must be integrated into transport and regional planning so that cumulative effects are considered more effectively in the future.
Millennium Ecosystem Assessment (2005)	• This seminal report considers the status and trends of global biodiversity and the services it provides.
PIANC — Working with Nature (PIANC, revised 2011)	• The document that sets out the World Association for Waterborne Transport (PIANC) management plans to integrate ecosystem services into its activities. It provides a general principle of integrated planning.

Resource Paper: No Net Loss and Loss-Gain Calculations in Biodiversity Offsets (2012)	• This resource paper has been prepared by the Business and Biodiversity Offsets Programme to help auditors, developers, conservation groups, communities, governments and financial institutions that wish to consider and develop best practice related to biodiversity offsets.
The Economics of Ecosystems and Biodiversity (TEEB, 2010)	• The report on the current provision of ecosystem services and the economic and decision support tools that can support its integration into policy and decision making.
The Use of Environmental Limits in Regulating Environmental Systems - How Could the Concept Be Applied in Environmental Agencies? (SNIFFER, 2010)	• The report considering the concept of environmental limits and how it may usefully applied within environmental agencies.
Green infrastructure	
Green infrastructure implementation and efficiency (EC study, 2012)	• The study assessing the effectiveness and efficiency of policy initiatives to support green infrastructure across Europe. • It identified the main existing policy measures that can help to support Green Infrastructure initiatives and their implementation, including, seven in-depth case studies on thematic issues.
Green infrastructure and territorial cohesion (EEA, 2011)	• The report exploring the concept of green infrastructure, with illustrative examples of green infrastructure initiatives on the ground and further analyses of the integration of green infrastructure into policy sectors.
Green infrastructure — Sustainable investments for the benefit of both people and nature (SURF-nature project, 2011)	• The booklet explaining the basics of green infrastructure and presenting some approaches.
Article 6 of the Habitats Directive guidance documents	
Commission Staff Working Document: Integrating biodiversity and nature protection into port development (EC, 2011)	• The Commission Staff Working Document includes the policy context for reconciling environmental requirements with port development.
EC Guidance: Non-mineral extraction and Natura 2000 (EU, 2011)	• These guidelines show how the needs of extractive industry can be met while avoiding adverse effects on wildlife and nature. • They examine how the potential impacts of extraction activities on nature and biodiversity can be minimised or avoided altogether.
EC Guidance: The implementation of the Birds and Habitats Directives in estuaries and coastal zones with particular attention to port developments and dredging (EU, 2011)	• This guidance document aims to explain the protection regime, defined under Article 6 of the Habitats Directive that applies to Natura 2000 sites in the specific context of estuaries and overlapping with, fairway channels and coastal zones, with particular attention to port-related activities, including dredging and industry (e.g. shipyards).
EC Guidance: Wind energy development and Natura 2000 (EC, 2010)	• The purpose of this document is to provide guidance on how best to ensure that wind energy developments are compatible with the provisions of the Habitats and Birds Directives.
Guidance document on Article 6(4) of the Habitats Directive 92/43/EEC (EC, 2007/updated in 2012)	• The clarification of the concepts of: alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence, Opinion of the Commission.
Guidance document on the assessment of plans and projects significantly affecting Natura 2000 sites (EC, 2001)	• The methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive.
Managing Natura 2000 sites. The provisions of Article 6 of the Habitats Directive 92/43/EEC (EC, 2000)	• This document aims at providing guidelines to the Member States on the interpretation of certain key concepts used in Article 6 of the Habitats Directive.

Biodiversity and climate change	
Adapting through natural interventions (Climate North West, 2011)	• The detailed description and analysis of environment based interventions that increase adaptive capacity with regard to climate change.
Assessment of the potential of ecosystem-based approaches to climate change adaptation and mitigation in Europe (EC study, 2011)	• The study aimed to address current knowledge gaps regarding the uptake and implementation of ecosystem-based approaches and thereby gain a better understanding of their role and potential in climate change adaptation and mitigation in Europe.
Biodiversity and Climate Change: Achieving the 2020 targets (CBD, 2010)	• The technical note on how the 2020 targets as set down in the CBD will be achieved considering the stresses presented by climate change and biodiversity loss
Climate change and biodiversity. 10 messages for 2010 (EEA, 2010)	• The summary report exploring and describing the main issues surrounding climate change and biodiversity in Europe.
Climate change and biodiversity. The role of the European regions (European Centre for Nature Conservation, Jones W.L. and Nieto, A. (Eds.), 2007)	• This report discusses the role of the European regions in responding to climate change-related issues, including adaptation and mitigation.
Draft guidelines on dealing with the impact of climate change (2012)	• The purpose of these guidelines is to underline benefits from Natura 2000 sites in mitigating the impacts of climate change, reducing vulnerability and increasing resilience, and how adaptation of management for species and habitats protected by Natura 2000 can be used to tackle the effects of climate change.
Examples of environmental limits relevant climate change and biodiversity (Resilience Alliance, 2010)	• The database of a wide range of examples and case studies of environmental limits research, experience and analysis.
Impacts of climate change and selected renewable energy infrastructures on EU biodiversity and the Natura 2000 network: Summary report (EC study, 2011)	• This summary report provides an overview of the likely impact of climate change on biodiversity in the EU and indications as to how the design and implementation of current policy might need to be adapted in order to ensure that the EU respects its commitment to reduce biodiversity loss.
Nature's Role in Climate Change (EC, 2009)	• The analysis report on the potential role of nature and ecosystem services in mitigating and responding to climate change.
SEA	
Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment	• Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment, OJ L 197, 21.7.2001, p.30. It requires the environmental effects of a broad range of plans and programmes to be assessed so they can be considered while plans are actually being developed, and in due course adopted. The public must also be consulted on the draft plans and on the environmental assessment and their views must be taken into account.
Guidance on the implementation of Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment (EC, 2003)	• The guidance aims to provide MSs with a clear understanding of the Directive's requirements, so that it is implemented consistently throughout the EU.
Handbook on SEA for Cohesion Policy 2007-2013 (GRDP Project, 2006)	• The step-by-step guidance specifically tailored for SEAs of Cohesion Policy Operational Programmes for the programming period 2007-2013.
Implementation of the SEA Directive (2001/42/EC)- Ireland	• The report describing the implementation requirements of the SEA Directive in Ireland. The report refers to climatic factors and biodiversity at certain stages of the SEA procedure.
Report on the application and effectiveness of the Directive on Strategic Environmental Assessment (COM (2009) 469 final)	• This report assesses the application and the effectiveness of the SEA Directive and includes proposals for its amendment (in particular the amendment of its scope).

Resource Manual to Support Application of the UNECE Protocol on Strategic Environmental Assessment (UNECE and REC, 2011)	• It provides guidance to those applying the Protocol or supporting others in doing so, including: the main requirements of Protocol; an outline of the key issues for applying Protocol in practice; and materials for training & capacity-development programmes supporting Protocol application
Strategic Environmental Assessment good practice guide (Portuguese Environment Agency, 2007)	• The Portuguese SEA guide which promotes an integrated approach to assessments.
SEA and biodiversity	
Biodiversity, Ecology, and Ecosystem Services - Impact Assessment Considerations/Approaches. (International Association of Impact Assessment, 2006)	• The meta-study pulling together work and synthesising. • The range of overarching principles, supported by case studies and possible tools.
Biodiversity in Impact Assessment (IAIA, 2005)	• The short special publication, user-friendly structure reviewing key strategic and operational issues concerning the integration of biodiversity-related considerations into impact assessment practices.
Guidelines for ecological impact assessment in the United Kingdom (Institute of Ecology and Environmental Management, 2006)	• The guidelines including examples of how biodiversity could be included into assessment methodologies.
Impact assessment: Voluntary guidelines on biodiversity-inclusive impact assessment (Convention on Biological Diversity, 2006)	• The assessment guidelines that seek to incorporate the requirements of the CBD into PPs (via SEA) and projects (via EIA). • They consider higher level principles and provide relevant case studies.
Position paper on environmental assessment in the European Union (Birdlife, 2010)	• The incorporation of advocacy into guidance. It includes higher level principles supported by a process based approach that highlights common problems with each stage of assessment. • It sets out 'dos and don'ts' for practitioners and reviewers.
Principles for the use of Strategic Environmental Assessment as a tool for promoting the conservation and sustainable use of biodiversity. Treweek, J., Therivel, R., Thompson, S. and Slater, M. (2005). Journal of Environmental Assessment, Policy & Management, 7, 173 - 199	• The paper contextualising the potential of SEA to promote biological conservation, including the overarching principles. • It identifies 'insertion points' for biodiversity along the SEA process.
Resolution X.17 - Environmental Impact Assessment and Strategic Environmental Assessment: updated scientific and technical guidance (RAMSAR Convention, 2010)	• The technical guidance based on the CBD guidelines described above. Includes RAMSAR-specific additions that seek to include consideration of wetlands.
SEA and Ecosystem Services (OECD, 2010)	• The advisory note on the inclusion of biodiversity within SEA.
SEA Topic guidance for Practitioners. SEA topic: biodiversity (Countryside Council for Wales, 2007)	• This guidance introduces biodiversity and SEA for responsible authorities; it provides source information and examples for the various stages of SEA.
TEEB for local and regional policy makers (TEEB, 2010)	• The report that considers how SEA (and EIA) could seek to include ecosystem services.
SEA and climate change	
Climate change and impact assessment symposium (International Association of Impact Assessment, 2010)	• This online resource which provides links to a range of presentations on various aspects of climate change.

Guidelines on the Integration of Environment and Climate Change in Development Cooperation, Guidelines No. 4 (EuropeAid 2009)	• The guidelines cover EIA and SEA with specific reference to climate change issue, adaptation and risk management in international development funding and projects.
Improving the Climate Resilience of Cohesion Policy Funding Programmes. An overview of member states' measures and tools for climate proofing Cohesion Policy funds. (ENEA Working Group on Climate Change and Cohesion Policy, 2009).	• It presents MS' strategies for integrating climate change to Cohesion Policy programmes.
Incorporating climate change impact and adaptation in environmental impact assessments opportunities and challenges. (OECD, 2010)	• This multi-purpose guidance type document assesses the current state of the inclusion of adaptation into EIA with examples of current approaches — Canada and CARICOM.
OECD/DAC Advisory note: Strategic Environmental Assessment and Adaptation to Climate Change (OECD, 2008)	• This note setting out advice and links to additional resources (an OECD/DAC document 'Good Practice Guidance on SEA' exists since 2006). • It uses a question-based approach to consider climate change adaptation in SEA, supported by information and case studies. • It illustrates how SEA can provide a framework for integrating climate change, adaptation-related considerations (risks and opportunities) into strategic planning. • Key questions to ask during each step of SEA (Setting context, Implementation, Informing/Influencing Decision Makers, Monitoring/Evaluation).
Opportunities for Integrating Climate Change Concerns into Regional Planning through Strategic Environmental Assessment. Regions for Sustainable Change project, INTERREG IVC (RSC Project, 2011)	• It investigates critical issues for using SEA as a tool to help integrate climate change into regional-level planning in the EU • It reviews actual practice of regional authorities in integrating climate change into SEA • It provides guidance and recommendations on how to mainstream climate and low-carbon issues into planning processes using SEA
Resilience thinking improves SEA: a discussion paper (Slootweg, R. and Jones, M., 2011)	• The discussion paper drawn from a workshop on resilience thinking and SEA at the 2010 IAIA conference in Geneva. It introduces the basic concepts of resilience thinking, and develops ideas for its integration within SEA practice.
SEA and Adapting to Climate Change (OECD, 2010)	• The advisory note on the inclusion of adaptation within SEA.
Strategic Environmental Assessment and climate change: Guidance for practitioners (Environment Agency for England and Wales, revised 2011)	• The UK guide that provides useful, concise information on how climate change should be considered in each stage of the SEA process and examples of objectives and climate impacts relevant to a range of sectors. • Possible climate change indicators and information sources.
SEA Guidance for Practitioners, SEA Topic - Climate Change (Countryside Council for Wales, revised 2007)	• The guidance on potential plans, programmes, objectives, policies and legislation to be taken into consideration for the Climate Change Topic (international, national and regional). • Potential climate change-related environmental issues and opportunities. • The examples of SEA Objectives/Sub-Objectives and Indicators for Climate Change. • Interrelationships with other SEA topics (including biodiversity).
The Consideration of Climactic Factors within Strategic Environmental Assessment (Scottish Government Environmental Assessment Team, 2010)	• The report providing key screening questions for mitigation/adaptation. • The baseline information sources (Scottish) for scoping. • The tables showing typical influences on climactic factors from different types of plans, which could be referred to in the guidance sections on alternatives assessment and impacts. • Useful examples of SEA objectives, cumulative effects, indicators, data sources, etc.

Annex 2: Sources of information on biodiversity and climate change

This annex lists the information that can be used to support an SEA. It outlines the different types and sources of information that may be available. This is likely to be particularly relevant to the SEA screening, scoping and assessment stages, and then monitoring/follow-up.

Types of information

Examples of the types of quantitative datasets relevant to climate change and biodiversity include:

- species distribution;
- trend data, e.g. loss of species/habitats;
- protected area status: Natura 2000 sites, national designations, etc.;
- GHGs emission inventories etc.;
- climate projections: IPCC , etc.;
- future climate and socio-economic scenarios.

These datasets may already exist, depending upon the location and scale required.

Sources of information

A starting point for sources of information on climate change and biodiversity will be other strategic documents that provide the context in which a plan or programme must be considered. These may include, for example, municipal/local authority spatial plans and policies/strategies on biodiversity protection (e.g. biodiversity action plans for species and habitats) and climate change mitigation and adaptation plans, strategies or vulnerability assessment studies.

Other forms of assessment may also be relevant, such as EIAs carried out under the EIA Directive or assessments carried out under the Habitats Directive.

For biodiversity — potential specialist sources are likely to include:

- environmental authorities with responsibility for nature conservation;
- environmental NGOs;
- stakeholders dependent or influential on biodiversity derived ecosystem services, e.g. foresters, fisheries, water companies/authorities.

For climate change — potential specialist sources are likely to include:

- environmental authorities with responsibility for climate change mitigation and adaptation;
- local authorities/municipalities;
- environmental NGOs;
- health services;
- social well-being organisations;
- infrastructure providers, e.g. transport authorities, utilities.

Key European sources of data

The table below summarises some of the key sources of data available at the European level, including data repositories and datasets, online tools and key reports and documents. The table is organised into different topics and types of data using the icons below.

Key:

 Climate change

 Biodiversity

 Mitigation

 Adaptation

 Databases, data repositories and online tools

 Organisations and research projects

 Reports and other documents

Key European sources of data, including data repositories and online digital datasets

	Source	Description	Link (March 2013)
	**Climate change**		
	**Climate Change Data Centre (EEA)**	Repository of a wide range of climate change relevant data and information. This includes all the latest climate change relevant developments within the EEA. Good meta-source of developments across European climate policy and reporting.	http://www.eea.europa.eu/themes/climate/dc
	**Climate Change Knowledge Portal, CCKP (the World Bank Group)**	The Portal provides an online tool for access to comprehensive global, regional, and country data related to climate change and development. The aim of the portal is to help provide development practitioners with a resource to explore, evaluate, synthesise, and learn about climate related vulnerabilities and risks at multiple levels of details.	http://sdwebx.worldbank.org/climateportal/index.cfm
	**Intergovernmental Panel on Climate Change (IPPC)**	IPCC is the leading international body for the assessment of climate change. Its website includes, *inter alia*, the Fourth assessment report: climate change (2007) and other releases of global climate change science, split into a range of working groups and sectoral reports.	http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml
	**Climate change — mitigation**		
	**European Topic Centre for Air Pollution and Climate Change Mitigation (ETC/ACM) (EEA)**	The ETC/ACM assists the EEA in its support to EU policy in the field of air pollution and climate change mitigation. The ETC/ACM provides reports and databases relevant to climate change mitigation.	http://acm.eionet.europa.eu/
	**Greenhouse Gas Emission Viewer (EEA)**	The EEA GHG viewer provides easy access and analysis of the data contained in the Annual EU greenhouse gas inventories. The EEA GHG data viewer can show emission trends for the main sectors and allows for comparisons of emissions between different countries and activities.	http://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer
	**Climate change — adaptation**		
	**CLIMATE-ADAPT: European Climate Adaptation Platform (EEA)**	CLIMATE-ADAPT is an interactive, publicly accessible web-based tool on adaptation to climate change. It is designed to support policy-makers at EU, national, regional and local levels in the development of climate change adaptation measures and policies.	http://climate-adapt.eea.europa.eu/
	**CLIMSAVE**	CLIMSAVE is a research project that is developing a user-friendly, interactive web-based tool that will allow stakeholders to assess climate change impacts and vulnerabilities for a range of sectors, including agriculture, forests, biodiversity, coasts, water resources and urban development. The linking of models for the different sectors will enable stakeholders to see how their interactions could affect European landscape change.	http://www.climsave.eu/climsave/index.html

	**EmDAT**	International disaster database that seeks to inform preparedness and decision making to natural disasters. It can be useful for scoping vulnerability to climate change.	http://www.emdat.be/
	**ERA-NET ROAD — Coordination and Implementation of Road Research in Europe**	ERA-NET ROAD was a Coordination Action funded by the *EU Sixth Framework Programme for European Research and Technological Development*. 11 National Road Administrations participated in the programme. Within the framework of this action, the call Road owners getting to grips with climate change was launched. Four projects relevant for climate change adaptation were funded within this call: IRWIN — Improved local winter index to assess maintenance needs and adaptation costs in climate change scenarios; P2R2C2 — Pavement Performance and Remediation Requirements following Climate Change; RIMAROCC — Risk Management for Roads in a Changing Climate; SWAMP — Storm Water prevention — Methods to predict damage from water stream in and near road pavements in lowland areas. The project is being continued as ERA-NET Road II within an enlarged consortium and the funding from the *EU Seventh Framework Programme for Research and Technological Development*.	http://www.eranetroad.org/
	**European Severe Weather Database**	Database of severe weather events across Europe. It is useful for indicating general vulnerability of projects.	http://www.essl.org/ESWD/
	**Green and Blue Space for Adaptation (GRaBS) Adaptation Risk and Vulnerability Toolkit**	Online toolkit that presents spatially various aspects of climate change adaptation. It includes physical risks and aspects of social vulnerability.	http://www.ppgis.manchester.ac.uk/grabs/start.html
	**NatCatSERVICE**	Insurance based database analysing approximately 1000 events every year. The information collated can be used to document and perform risk and trend analyses on the extent and intensity of individual natural hazard events in various parts of the world.	http://www.munichre.com/en/reinsurance/business/non-life/georisks/natcatservice/default.aspx
	**National Adaptation Strategies (EEA)**	Up-to-date database of EU MSs progress under the EU's Adaptation White Paper. It is a good source for country specific actions.	http://www.eea.europa.eu/themes/climate/national-adaptation-strategies
	**National Climate Research The Netherlands**	The joint website of the Dutch Climate changes Spatial Planning Programme and the Knowledge for Climate Research Programme. The Climate changes Spatial Planning Programme enhances joint-learning between communities and people in practice within spatial planning, with the themes climate scenarios, mitigation, adaptation, integration and communication. The Knowledge for Climate Research Programme develops knowledge and services, focusing on eight Hotspots, enabling the climate proofing of the Netherlands.	http://www.climateresearchnetherlands.nl/
	**Urban adaptation to climate change in Europe and Interactive maps from the Report on Eye on Earth (EEA)**	This Report provides information regarding challenges and opportunities for cities together with supportive national and European policies to facilitate. It is accompanied by a range of interactive maps from the report on Eye on Earth, including, heat wave risk to European cities; coastal flooding; share of green and blue areas, etc.	http://www.eea.europa.eu/publications/urban-adaptation-to-climate-change http://eea.maps.arcgis.com/apps/PublicGallery/index.html?appid=1573f2f083824a34a5640bd04e098248&group=b9052eb339264f64b1eb75f6244eccdf

	Biodiversity		
	ALARM	ALARM (**A**ssessing **LA**rge Scale **R**isks for Biodiversity with Tested **M**ethods) is a research project which developed and tested methods and protocols for the assessment of large-scale environmental risks in order to minimise negative direct and indirect human impacts.	http://www.alarmproject.net/alarm/
	Biodiversity Action Plans (EC)	Inventory of European Biodiversity Action Plans and assessments of Member States.	http://ec.europa.eu/environment/nature/biodiversity/comm2006/bap_2010.htm
	Biodiversity Data Centre (EEA)	Repository of a wide range of biodiversity relevant data and information. This includes all the latest biodiversity relevant developments within the EEA. It is a good meta-source of developments across European biodiversity policy and reporting.	http://www.eea.europa.eu/themes/biodiversity/dc
	Biodiversity Information System for Europe, BISE (EEA)	Database of all relevant European biodiversity data sources. It is a good source of indicators and maps collated from across European institutions.	http://biodiversity.europa.eu/data
	Birdlife Datazone	Updated site that provides species and habitat specific information for sites across the EU (and beyond).	http://www.birdlife.org/datazone/
	European Topic Centre for Biological Diversity (ETC/BC) (EEA)	The ETC/BD is an international consortium working with the EEA under a framework partnership agreement. The ETC/BD presents expert knowledge and reporting in a range of reports and databases.	http://bd.eionet.europa.eu/
	Global Biodiversity Information Service	Publicly accessible biodiversity data including species occurrence and taxonomic information. Very detailed species specific data source. Good indicator of potential species presence across Europe for use in scoping. It is likely to require site investigation to confirm occurrences.	http://data.gbif.org/welcome.htm
	Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES)	IPBES goal is to be an interface between the scientific community and policy makers that aims to build capacity for and strengthen the use of science in policy making. It sets a mechanism to address the gaps in the science policy interface on biodiversity and ecosystem services.	http://www.ipbes.net/
	MACIS	MACIS (**M**inimisation of and **A**daptation to **Cl**imate Change **I**mpacts on Biodiver**S**ity) is a research project which summarised what is already know about the impacts of climate change on biodiversity and developed methods to assess the potential impacts in the future.	http://macis-project.net/index.html
	Natura2000 Viewer (EEA)	Information on the Natura 2000 network across the EU Member States.	http://natura2000.eea.europa.eu/
	RESPONSES	The objective of the RESPONSES research project is to identify and assess integrated EU climate-change policy responses that achieve ambitious mitigation and environmental targets and, at the same time, reduce the Union's vulnerability to inevitable climate-change impacts.	http://www.responsesproject.eu/

	General		
	**Data and Maps (EEA)**	Access the EEA's maps, indicators, databases and graphs.	http://www.eea.europa.eu/data-and-maps
	**EUROSTAT**	Database holding a huge range of environmental, economic and social data.	http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home
	**EUROSTAT Sustainable development indicators**	The Sustainable Development Indicators are used to monitor the EU Sustainable Development Strategy in a report published by Eurostat every two years. They are presented in ten themes including climate change and natural resources down to Member State levels.	http://epp.eurostat.ec.europa.eu/portal/page/portal/sdi/indicators
	**EUROSTAT Country profiles**	Country specific data on a range of issues including climate change emissions and sectoral activity.	http://epp.eurostat.ec.europa.eu/guip/introAction.do
	**Group on Earth Observatories (GEO)**	Database of global data components on a range of environmental aspects, including climate change and biodiversity.	http://geossregistries.info/holdings.htm
	**Indicators (EEA)**	Indicators and factsheets about Europe's environment.	http://www.eea.europa.eu/data-and-maps/indicators#c7=all&c5=&c0=10&b_start=0

Annex 3: Tools for assessing climate change and biodiversity within SEA

The table below provides an overview of tools and approaches that can be used to support the assessment of climate change and biodiversity as part of the SEA process. See Section 5 for a summary of these tools and approaches and hints on determining when they may be applicable.

Description of tools and approaches that can be used to support the assessment of climate change and biodiversity as part of the SEA process

Name	Description	Application Comments	Source of further Information
Biodiversity offsetting	Biodiversity offsetting is an approach which seeks to compensate for unavoidable loss of habitats and species due to development. Though not formalised in every Member State there are allowances for offsetting within the Environmental Liability Directive and Habitats Directive — Article 6.4.	This practice is developing across Europe and examples include the EU Biodiversity Strategy making reference to the Commission developing practice in line with previous studies. It is likely that, within the context of European policy, Member States will develop this area as they see fit.	Business- led offsetting programme: http://bbop.forest-trends.org/index.php BirdLife International position on offsetting: http://www.birdlife.org/eu/pdfs/2010_BHDTF_position_Biodiversity_offsets.pdf EC feasibility study: http://ec.europa.eu/environment/enveco/pdf/eftec_habitat_technical_report.pdf A source of news, data, and analytics on markets and payments for ecosystem services: http://www.ecosystemmarketplace.com/
Biodiversity screening map	Screening maps are a form of spatial analysis that requires the identification of the habitats sited around a particular project. Based on these, habitats should be assessed for their relative worth considering wider trends and likely impacts of the project. If there is considered to be some potentially significant effects, this should inform the screening decision.	Useful for screening and scoping stages and to identify areas of potential higher value biodiversity that may be used within the consideration of the alternatives.	It can be supported by some of the information sources presented in Annex 2, but will more normally be based on expert judgment and the experience of other stakeholders.
CO_2MPARE	Model to assess CO_2 emissions of Regional Policy Operational Programmes (2014-2020) — under development (status as of February 2013).	This voluntary tool should (i) enable evaluation of the GHG impact of investments resulting from the Operational Programmes; (ii) be so generic that it can potentially be applied in all European regions and for all relevant spending categories, and (iii) be freely available.	http://ted.europa.eu/udl?uri=TED:NOTICE:179076-2011:TEXT:EN:HTML&tabId=1 http://www.bartlett.ucl.ac.uk/energy/research/themes/energy-systems/co2_emissions_model
Confidence levels	Confidence levels are an effective approach to communicating uncertainty; this may be useful when considering potential climate change impacts.	Increasingly climate change impacts are being presented in probabilistic scenarios which can be presented in terms of confidence levels.	The provision of confidence levels varies within different climate scenarios — e.g. the IPPC provides information as to specific confidence levels within different assessments.
Critical	An alternative approach to consider is one based on	This is a structured approach to the **scoping** stage of SEA. The	Strategic Environmental Assessment Good Practices

factors	'critical factors for decision-making.' These constitute the fundamental decision-making factors that should be underlying the focus of the SEA. These critical factors identify the aspects regarding design and implementation of the PP that must be considered in the decision process. The resulting critical factors for decision-making will provide the structure to the analysis and assessment of opportunities and risks across the SEA, defining the technical studies that need to be performed under the SEA in order to gather the information required for a decision. The critical factors should be derived through wider public participation and consultation with key stakeholders.	critical factors are generated out of an integrated analysis of the following elements: • *Strategic reference framework* — which constitutes an assessment benchmark and gathers the relevant policy objectives established at international, European, national and local levels and also other relevant PPs. • *Strategic issues* — the strategic objectives and core principles of the strategy being assessed. • *Environmental/sustainability/ health/equality/etc. factors* — defines the relevant scope of the SEA which must be adjusted to each specific case according to the strategic focus, the assessment scale and, as a result, their relevance.	Guide. Methodological Guidance. Portuguese Environment Agency http://www.sea-info.net//files/events/SEA_guide_Portugal.pdf
Ecosystem-based approaches	Managing, restoring and protecting biodiversity and ecosystem services provide multiple benefits to human society. These ecosystem-based approaches contribute to protecting and restoring natural ecosystems by conserving or enhancing carbon stocks, reducing emissions caused by ecosystem degradation and loss, and providing cost-effective protection against some of the threats that result from climate change.	They can be used as cost-effective alternatives to infrastructure solutions. For example, coastal ecosystems such as saltmarsh and barrier beaches provide natural shoreline protection from storms and flooding and urban green spaces cool cities (reducing the urban-heat island effect), minimise flooding and improve air quality.	Relevant information from the DG Environment website, including the following reports: Towards a Strategy on Climate Change, Ecosystem Services and Biodiversity http://ec.europa.eu/environment/nature/pdf/discussion_paper_climate_change.pdf Assessment of the potential of ecosystem-based approaches to climate change adaptation and mitigation in Europe http://ec.europa.eu/environment/nature/climatechange/pdf/EbA_EBM_CC_FinalReport.pdf Relevant information from the CBD website: http://www.cbd.int/climate/
Ecosystem services approaches	Ecosystems provide a number of basic functions that are essential for using the Earth's resources sustainably. The Economics of Ecosystem Services and Biodiversity (TEEB) study defines ecosystem services as 'the benefits people receive from ecosystems'. Ecosystem services offer potentially a new tool to use in SEA, using the concepts developed by the Millennium Ecosystem Assessment.	In practice ecosystem services could be could be used in a number of ways in SEA: **Baseline** — ecosystem services could help make baseline data much more relevant to the assessment process by combining datasets in a useful way for planners and decision-making. **Scoping and engagement with stakeholders** — using network analysis for example to understand the range of ecosystem services provided by an area and as a means to identify key issues/areas.	Millennium Ecosystem Assessment (MEA) (2005) Ecosystems and Human Well-Being: Synthesis. Island Press, Washington. http://www.maweb.org/en/index.aspx OECD (2008) Strategic Environmental Assessment and Ecosystem Services http://www.oecd.org/dataoecd/24/54/41882953.pdf World Resources Institute (2008) Ecosystem Services: A Guide for Decision Makers

	Ecosystem services can be used as additional or alternative assessment criteria within SEA, even at a generic/strategic level e.g. what will be the effects on i) supporting services; ii) provisioning services; iii) regulating services; and iv) cultural services. See also ecosystem services valuation below.	**Assessment and consideration of alternatives** — ecosystem services can provide important information on the potential for multi-functionality of an area when considering alternatives. They can be supplementary or an alternative to the typical assessment objectives or criteria — e.g. an objective *'To protect and enhance biodiversity'* might be re-cast in ecosystem service terms *'What will be the effect on biodiversity provisioning services?'* However, 'ecosystem services thinking' could also provide an important perspective in the same way that life cycle thinking provides wider benefits to sustainable product and service provision beyond heavily data dependent life cycle analysis/assessment.	http://www.wri.org/publication/ecosystem-services-a-guide-for-decision-makers Sheate W, Eales R, Daly E, Murdoch A, and Hill C (2008), Case study to develop tools and methodologies to deliver an ecosystem-based approach: Thames Gateway Green Grids, Project report NR0109, London, Defra, 2008, available at http://randd.defra.gov.uk/Document.aspx?Document=NR0109_7429_FRP.pdf
Ecosystem services valuation	The economic valuation of ecosystem services has developed significantly as a potential tool within impact assessment. Recent analysis within the TEEB and various Member States indicate this approach has some potential for making clear the economic value of biodiversity. This in theory would allow a more informed understanding of the societal impact of a project. Valuation is a useful tool but the most efficient use of the concept of ecosystem services within impact assessment may be in demonstrating that the environment is important to us rather than in quantifying the cost equivalence of this importance.	The time and resource requirements for ecosystem valuation are significant and may undermine its potential to support impact assessment practice where resources are often limited. This is particularly true at the strategic scale. It is possible to relate existing valuation studies to a different area this can be useful at the strategic scale but its effectiveness is limited at more local levels due to the contextual nature of value. However certain ecosystem services (i.e. provisioning services) can be relatively simply valued and may add value to some assessments. Within SEA the focus should be on the value of services and areas broadly rather than specifically, this can be based on linking land or habitat types to services using existing studies or stakeholder and expert engagement.	Chapter 6 of TEEB for Local and Regional Policy makers considers economic valuation as part of EIA and SEA practice: http://www.teebweb.org/local-and-regional-policy-makers-report/ Guide to valuing ecosystem services: http://www.defra.gov.uk/environment/natural/ecosystems-services/valuing-ecosystem-services/
GHG emission calculators	Emission calculators seek to quantify the total GHG (or often carbon alone) emissions from an activity or project as a whole. Emissions can be calculated for operation or the construction of a project. A range of calculators exist and are generally based on GHG equivalents for certain indicators such as energy consumption.	Depending on the level of detail contained within your PP, it may be possible to quantify possible GHG emissions. This can be undertaken by consultants or via online tools where available. A number of consultancies operate GHG emissions calculators that can be undertaken for individual projects. Calculators can be found online though the accuracy and assumptions (such as the type of fuel used to generate power, etc.) will vary and may not be relevant	Resources and Energy Analysis Programme (REAP) (see below) is a potentially useful strategic level emission calculator. The World Resource Institute and World Business Council for Sustainable Development have developed and maintain the http://www.ghgprotocol.org/ which includes a wide range of sectoral GHG calculators and related tools and case studies. The Scottish Government is developing a *Quantitative*

		to your PP area.	*Greenhouse Gas Impact Assessment: A Tool For Spatial Planning Policy Development* http://www.scotland.gov.uk/Resource/Doc/341338/0113478.pdf
GIS and spatial analysis	Geographic Information System (GIS) and its use as a form of spatial analysis has proven value in communicating and identifying environmental impacts of PPs. There is a huge spectrum of possible GIS methods and uses and these can be tailored depending on the required scales and available resources.	The nature of the GIS required will vary depending on the scale of PP and the intended purpose of the GIS. GIS is a broad technique and can be used to undertake analysis of various morphological or technical factors or to support consultation exercises via visualisation.	GIS is largely dependent upon the available data. Potentially useful sources of pan-European information and data are presented in Annex 2.
Green infrastructure	Green infrastructure is a concept addressing the connectivity of ecosystems, their protection and the provision of ecosystem services, while also addressing mitigation and adaptation to climate change. It contributes to minimising natural disaster risks, by using ecosystem-based approaches for coastal protection through marshes/flood plain restoration rather than constructing dikes.	Useful for consideration of alternatives and mitigation measures.	http://ec.europa.eu/environment/nature/ecosystems/index_en.htm
Greenhouse Gas Region Inventory Protocol (GRIP)	The protocol allows the formation of a GHG emissions inventory. The GRIP approach enables regions across the world to compare their releases using a consistent approach.	GRIP also contains a Scenario Tool devised to bring together discussions on energy futures. It enables coherent discussions across the energy system, so that (for example) debates on transport can take place in combination with those on electricity generation and domestic heating. Subscription required.	For general information http://www.grip.org.uk/
Industry (project) profiles of GHGs	SEAs should, where possible, make use of existing information — one potential source of useful information may be sectoral or technology profiles of the energy requirements of various elements of a project during operation and construction.	This information will be useful during the scoping and screening stages of the SEA and to understand the relative profiles of different sectors.	Industry profiles may often be based on the experience of various stakeholders and looking to see examples of previous PPs (or EIAs where appropriate). In certain Member States specific industry profiles may exist.

Life Cycle Assessment (LCA)	LCA is a technique that seeks to consider all the environmental impacts of particular actions — over their lifetime. This is particularly relevant to climate change as the GHG emissions are often released during the construction stage. LCA can include a full assessment of all impacts in detail or be a less quantitative and detailed consideration of the materials in use and their probable environmental impacts. For example responsibly sourced wood has a lower carbon footprint that steel and responsibly sourced (certified) wood has a generally lower impact on biodiversity than un-certified wood. LCAs can be undertaken by consultants or in-house.	Undertaking full LCA can be a very costly and timely process, however certain elements of a project may already be subject to LCA, there is therefore the potential for the EIA to use this information where available. It may also be possible to undertake a qualitative assessment of possible LCA impacts based on readily available information such as material types. LCA is particularly useful during the impact assessment stage of the EIA and can inform the consideration of alternatives buy identify the most significant elements of a project in terms of biodiversity and climate change. But for **SEA**, LCA is more likely to be relevant for providing a way of thinking about strategic options rather than being applied more formally.	Online repository of LCA tools: http://www.dantes.info/Tools&Methods/Software/enviro_soft_SW.html Regional Economy Environment Input Output (REEIO) is a potentially useful LCA type tool (see below)
Natural capital approaches **Four-Capitals**	Various similar approaches that use the concept of 'capital' as derived from economics and describe benefits through the services and outputs provided by natural and other capital. The Four Capitals Model considers development (and the meeting of needs and aspirations) to take place through the services provided by economic, human, social and environmental assets. Development is then considered to be sustainable if and only if the stock of all assets or capital (wealth) per capita remains constant or rises over time. The four types of capital are: manufactured capital (infrastructure); natural capital (natural resources); human capital (health, well-being and productive potential of individuals); and social capital (human well-being on a societal level).	The four-capitals model, and other similar approaches, provide an alternative framework for defining and assessing sustainable development and can provide an alternative assessment framework to use as part of an SEA ensuring that that all three of the pillars of sustainable development — economic, social and environmental — are included in the analysis and that the focus is on the evaluation is not just on stocks, but on the flows of benefits to which they give rise to. It can also provide a good means of engaging stakeholders with the concerns of sustainable development.	The SDRTOOLS programme design evaluation methods to assess sustainable development, using the Four Capitals Model as a starting point. http://www.srdtools.info/index.htm
Network analysis	Network analysis is an effective way to consider complex systems by linking causes and impacts via a chain of causation. The concept is based on the idea that there are links and impact pathways between	This approach can be used to ascertain the probable impacts and benefits on climate change and biodiversity of various elements of a project by identifying their outcomes via the development of a chain of causation. It is best undertaken during the scoping	Network analysis is generally dependent upon the use of expert knowledge and judgment and the accurate identification and linking of drivers and impacts. Examples of the application of this approach can be seen in

	elements of a project and environmental outcomes, and that these can be identified. This enables the identification of actions that may achieve desired objectives, such as reduced impact or enhancement. Within **SEA** it is particularly useful in relating non material elements of a PP (such as funding or management options) to specific environmental impact.	stage, but may be extended into the following stages of assessment.	case studies in Annex 4 of the guidance.
Regional Economy Environment Input Output (REEIO)	The Regional Economy Environment Input Output Model is a powerful decision support tool used to assess the environmental implications of production within a region. The model was the main output from the REWARD project and is now maintained by Cambridge Econometrics	REEIO links economic activity in 42 industrial sectors to environmental component. Using either Cambridge Econometrics regional economic forecasts or a user defined scenario, it allows the user to measure and compare the environmental impact of economic development. The model provides annual comprehensive projections to 2020 for a wide range of indicators.	http://www.camecon.com/AnalysisTraining/suite_economic_models/Reeio/ReeioOverview.aspx
Resources and Energy Analysis Programme (REAP)	REAP is a software tool developed by the Stockholm Environment Institute. In addition to managing data to quantify GHG emissions and other indicators of resource use REAP can be used as a scenario development tool. Subscription is required.	REAP can be used to answer certain questions related to understanding the environmental consequences of economic activity. These include: • How do we account for the resource use associated with everything people buy and use? • How do we track complex product supply chains? • How do we calculate, attribute and report results in a consistent fashion? • How do we relate this to populations at different spatial scales and over time? • How do we explore where resource savings can be made both in production efficiency and consumption patterns?	Tool website: http://www.resource-accounting.org.uk/
Risk management	When considering climate change it is particularly useful to frame potential impacts in terms of the probability and magnitude of impacts. These two components make up risk. This can be achieved by considering the probability of impact (e.g. how likely is it that sea level rise will impact on a PP) in relation to the magnitude of the impact (what would be the likely	Thinking in terms of probability and magnitude within an SEA can inform the stakeholders as to the vulnerability of a PP and therefore the necessity of adaptation measures (what alternatives are available) and what monitoring is required to enable adaptive management.	Vulnerability and climate change: http://www.metrovancouver.org/planning/ClimateChange/ClimateChangeDocs/Vulnerability_climate_change.pdf IAIA's risk management advice: http://www.iaia.org/iaiawiki/ra.ashx

	impact of sea level rise on a PP). Understanding these two elements is essential to reducing vulnerability and increasing resilience.		
Scenarios	Scenarios relate to climate change scenarios (e.g. IPCC scenarios) and socio-economic/alternative futures scenarios for considering the resilience of projects and the environment into the long term future. The use of scenarios is a response to uncertainty.	Scenarios are effective ways of considering the evolution of the baseline — both in terms of the potential impacts of the climate on a project and the changes to wider socio-economic context that the project operates in. The scenarios can also support the consideration of alternatives.	Potential European resources include the information on the European Environment Agency's website: http://www.eea.europa.eu/themes/scenarios/scenarios-and-forward-studies-eea-activities http://scenarios.ew.eea.europa.eu/
Spheres of influence and Ecosystem chains	Spheres of influence are based on using spatial tools to assess the potential effects of a project beyond the specific project boundaries; as such these concepts use tools such as network analysis but apply them spatially. This entails looking at the indirect impact on downstream or related ecosystems, for instance how will changing water abstraction impact downstream systems, how will increased dust impact on the turbidity of downstream environments, how will removing one habitat type impact on neighbouring habitats?	This concept is particularly useful for the screening and scoping stages and for identifying indirect and secondary effects. It requires an understanding of possible impacts and causal chains, as such network analysis is a related tool. This may also be a useful tool when considering alternatives and their impacts.	It can be supported by some of the information sources presented in Annex 2, but will more normally be based on expert judgment and the experience of other stakeholders.
SWOT and STEEP analysis	SWOT (**S**trengths, **W**eaknesses, **O**pportunities and **T**hreats) and STEEP (**S**ocio-cultural, **T**echnological, **E**conomic, **E**nvironmental and **P**olitical) analysis are strategic planning methods used to evaluate a project, plan or a business venture for example. They involve identifying the internal and external factors that are favourable and unfavourable to achieve an objective of the activity.	SWOT analysis and STEEP analysis may be appropriate to use within an SEA, particularly as part of identifying effects. SWOT analysis, for example, could be used to summarise the main strengths, weaknesses, opportunities and threats presented by a draft PP, and as a result what could be addressed in the final plan or programme to improve its overall performance. STEEP analysis could similarly be used, for example it could offer an opportunity to help take account of environmental equality in assessments: Social: use the idea of community and wellbeing; Technical: look at soft and hard solutions for social and environmental benefits for all; Environment: use simple language about the environment in the context of wellbeing and sharing it equally with others; Economic: explore models that work to provide equitable economic	http://www.gcvcore.gov.uk/downloads/futures/STEEPanalysisOutputs.pdf http://www.mindtools.com/pages/article/newTMC_05.htm

		benefits for all; Political: discuss good stewardship of environmental, community and financial resources.	
Vulnerability assessment	A vulnerability assessment is the process of identifying, quantifying, and prioritising (or ranking) the vulnerabilities in a system. Vulnerability assessment has many things in common with risk assessment. Assessments are typically performed according to the following steps: • cataloguing assets and capabilities (resources) in a system; • assigning quantifiable value (or at least rank order) and importance to those resources; • identifying the vulnerabilities or potential threats to each resource; • mitigating or eliminating the most serious vulnerabilities for the most valuable resources.	Vulnerability assessment is helpful when taking resilience approach to climate change and needs to be built into any effective assessment of the evolution of the baseline environment and of alternatives to investigate how will the environment change without implementation of a PP, and in relation to different alternatives. It can therefore be used to evaluate alternatives in order to help identify and select the most resilient alternative(s).	Climate change Clearing House. Technical Briefings(5) Climate Vulnerability Assessment. http://www.theclimatechangeclearinghouse.org/Resources/TechBrief/default.aspx A Guide to Climate Change Vulnerability Assessment. National Wildlife Federation, Washington, D.C. www.nwf.org/vulnerabilityguide

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