

Introduction: Context and Methodology

Purpose of the report

The purpose of the *OECD Environmental Outlook* is to help government policy-makers to identify the key environmental challenges they face, and to understand the economic and environmental implications of the policies that could be used to address those challenges.

The *Outlook* provides a baseline projection of environmental change to 2030 (referred to as “the Baseline”), based on projected developments in the underlying economic and social factors that drive these changes. The projections are based on a robust general equilibrium economic modelling framework, linked to a comprehensive environmental modelling framework (see below, and Annex B, for more details). Simulations were also run of specific policies and policy packages that could be used to address the main environmental challenges identified, and their economic costs and environmental benefits compared with the Baseline.

This is the second *Environmental Outlook* produced by the OECD. The first *OECD Environmental Outlook* was released in 2001, and provided the analytical basis on which ministers adopted an *OECD Environmental Strategy for the First Decade of the 21st Century*. This second *Outlook*:

- extends the projected baseline used in the first *Outlook* from 2020 to 2030, and even 2050 for some important areas;
- is based on a stronger and more robust modelling framework;
- focuses on the policies that can be used to tackle the main challenges;
- expands the country focus to reflect developments in both OECD and non-OECD regions and their interactions.

Many of the priority issues and sectors identified in this *Outlook* are the same as those highlighted as needing most urgent policy action in the first *OECD Environmental Outlook* (2001) and in the *OECD Environmental Strategy for the First Decade of the 21st Century*. These include the priority issues of climate change, biodiversity loss and water scarcity, and the key sectors exerting pressure on the environment (agriculture, energy and transport). Added to these is a new priority issue: the need to address the health impacts of the build-up of chemicals in the environment. The 2001 *Outlook* indicated the environmental challenges expected in the next couple of decades; this *Outlook* not only deepens and extends this analysis, it also focuses on the policy responses for addressing these challenges. It finds that the solutions are affordable and available if ambitious policy action is implemented today, and if countries work together in partnership to ensure comprehensive action, avoid competitiveness concerns and share the responsibility and costs of action fairly and equitably. This latest *Outlook* analyses the policies that can be used to achieve the *OECD Environmental Strategy*. It will provide the main analytical material to support discussions on further implementation of the *OECD Environmental Strategy* at the OECD Meeting of Environment Ministers planned for early 2008.

Policy context

Why develop an environmental outlook? Many of the economic or social choices that are being made today – for example, investments in transport infrastructure and building construction, fishing fleets, purchase of solar heating panels – will have a direct and lasting affect on the environment in the future. For many of these, the full environmental impacts will not be felt until long after the decisions have been taken. These factors make policy decisions difficult: the costs of policy action to prevent these impacts will hit societies today, but the benefits in terms of improved environmental quality or damage avoided may only be realised in the future. For example, the greenhouse gases released today continue to build up in the atmosphere and will change the future climate, with serious impacts for the environment, the economy and social welfare.

But politicians tend to reflect the short-term interests of the voting public, not the long-term needs of future generations. They also tend to focus on the immediate costs and benefits to their own populations of a given policy approach, rather than on the global impacts. But many of the main environmental challenges countries face in the early 21st century are global or transboundary in nature, including global climate change, biodiversity loss, management of shared water resources and seas, transboundary air pollution, trade in endangered species, desertification, deforestation, etc. Building public understanding and acceptance of the policies that are needed to address these challenges is essential for policy reform.

These political challenges are exacerbated by uncertainty about the future. Often the exact environmental impacts of social and economic developments are poorly understood or disputed. In some cases, scientific uncertainty about environmental or health impacts is a main cause of policy inaction, while in others it is used as a justification for precautionary action. Scientific understanding and consensus about environmental change has been developing rapidly in a number of areas in recent years, for example through the 2005 Millennium Ecosystem Assessment and the 2007 IPCC Fourth Assessment Report on the Science of Climate Change. Despite the improvements in the scientific understanding of such issues, a gap remains in the development and implementation of effective environmental policies based on this scientific understanding.

This *Environmental Outlook* examines the medium to long-term environmental impacts of current economic and social trends, and compares these against the costs of specific policies that could be implemented today to tackle some of the main environmental challenges. The purpose is to provide more rigorous analysis of the costs and benefits of environmental policies to help policy-makers take better, more informed policy decisions now.

Many environmental problems are complex and inter-connected. For example, species loss is often the result of multiple pressures – including hunting, fishing or plant harvesting, loss of habitat through land use change or habitat fragmentation, impacts of pollutants – and thus a mix of policy instruments is needed to tackle the various causes of this loss. These policy packages need to be carefully designed in order to achieve the desired environmental benefits at the lowest economic cost. This *Outlook* examines the policy packages that could be used to tackle some of the key environmental challenges, and the framework conditions needed to ensure their success.

The transboundary or global nature of many of the most pressing environmental challenges identified in this *Outlook* require countries to increasingly work together in partnership to address them. The ways in which OECD environment ministries can work together in partnership with other ministries, stakeholder partners and other countries are explored in this *Outlook*.

A special focus on the emerging economies in the Outlook

This Outlook identifies the main emerging economies as the most significant partners for OECD countries to work with in the coming decades to tackle global or shared environmental problems. This is because these countries are responsible for an increasingly large share of the global economy and trade, and thus have an increasing capacity to address these challenges, in part because their economies are so dynamic. Moreover, the pressures that they exert on the environment are also growing rapidly.

In some chapters, where data are available and relevant, the BRIICS countries (Brazil, Russia, India, Indonesia, China and South Africa) are highlighted for attention as a country grouping. In other chapters, the smaller country grouping of BRIC (Brazil, Russia, India and China) is examined, or even further disaggregated to each of these four countries individually. The BRIC grouping is used for most of the modelling projections and simulations in the Outlook.

Modelling methodology and sources of information

The analysis presented in this *Environmental Outlook* was supported by model-based quantification. On the economic side, the modelling tool used is a new version of the OECD/World Bank JOBS/Linkages model, operated by a team in the OECD Environment Directorate and called ENV-Linkages. It is a global general equilibrium model containing 26 sectors and 34 world regions and provides economic projections for multiple time periods. It was used to project changes in sector outputs and inputs of each country or region examined to develop the economic baseline to 2030. This was extended to 2050 to examine the impacts of policy simulations in specific areas, such as biodiversity loss and climate change impacts. The economic baseline was developed with expert inputs from, and in co-operation with, other relevant parts of the OECD, such as the Economics Department, the International Energy Agency and the Directorate for Food, Agriculture and Fisheries.

The Integrated Model to Assess the Global Environment (IMAGE) of the Netherlands Environmental Assessment Agency (MNP) was further developed and adjusted to link it to the ENV-Linkages baseline in order to provide the detailed environmental baseline. IMAGE is a dynamic integrated assessment framework to model global change, with the objective of supporting decision-making by quantifying the relative importance of major processes and interactions in the society-biosphere-climate system. The IMAGE suite of models used for the Outlook comprises models that also appear in the literature as models in their own right, such as FAIR (specialised to examine burden sharing issues), TIMER (to examine energy), and GLOBIO3 (to examine biodiversity). Moreover, for the Outlook the IMAGE suite included the LEITAP model of LEI at Wageningen and the WaterGap model of the Center for Environmental Systems Research at Kassel University. IMAGE and associated models provided the projections of impacts on important environmental endpoints to 2030, such as climate, biodiversity, water stress, nutrient loading of surface water, and air quality. Annex B provides a more detailed description of the modelling framework and main assumptions used for the Outlook report.

The Baseline Reference Scenario presents a projection of historical and current trends into the future. This Baseline indicates what the world would be like to 2030 if currently existing policies were maintained, but *no new policies* were introduced to protect the environment. It is an extension of current trends and developments into the future, and as

such it does not reflect major new or different developments in either the drivers of environmental change or environmental pressures. A number of major changes are possible in the future, however, that would significantly alter these projections. A few of these were examined as “variations” to the Baseline, and their impacts are described in Chapter 6 to show how these changes might affect the projections presented here.

Because the Baseline reflects no new policies, or in other words it is “policy neutral”, it is a reference scenario against which simulations of new policies can be introduced and compared. Simulations of specific policy actions to address key environmental challenges were run in the modelling framework. The differences between the Baseline projections and these policy simulations were analysed to shed light on their economic and environmental impacts.

The simulations undertaken for the *Environmental Outlook* exercise are illustrative rather than prescriptive. They indicate the type and magnitude of the responses that might be expected from the policies examined, rather than representing recommendations to undertake the simulated policy actions. As relevant, some of the policy simulation results are reflected in more than one chapter. The table below summarises the policy simulation analyses and lists the different chapters containing the results.

Sensitivity analysis was undertaken to test the robustness of key assumptions in ENV-Linkages, and some of the results of this analysis are presented in Annex B. This, in conjunction with the Baseline variations described in Chapter 6, provides a clearer picture for the reader of the robustness of the assumptions in the Baseline.

Throughout the *Outlook*, the analysis from the modelling exercise is complemented by extensive data and environmental policy analysis developed at the OECD. Where evidence is available, specific country examples are used to illustrate the potential effects of the policies discussed. Many of the chapters in this *Outlook* have been reviewed by the relevant Committees and Expert Groups of the OECD, and their input has strengthened the analysis.

The *Outlook* is released at about the same time as a number of other forward-looking environmental analyses, such as UNEP’s Fourth Global Environment Outlook (GEO-4); the IPCC Fourth Assessment Report (AR-4); the International Assessment of Agricultural Science and Technology for Development supported by the World Bank, FAO and UNEP; and the CGIAR Comprehensive Assessment of Water Use in Agriculture. Through regular meetings and contacts, efforts have been made by the organisations working on these reports to ensure co-ordination and complementarity in the studies, and to avoid overlap. The *OECD Environmental Outlook* differs from most of the others in its emphasis on a single baseline reference scenario against which specific policy simulations are compared for the purpose of policy analysis. Most of the others explore a range of possible “scenarios”, which provide a useful communication tool to illustrate the range of possible futures available, but are less amenable to the analysis of specific policy options. The *OECD Environmental Outlook* also looks at developments across the full range of environmental challenges, based strongly on projected developments in the economic and social drivers of environmental change, while many of the other forward-looking analyses focus on a single environmental challenge.

Table I.1. **Mapping of the OECD Environmental Outlook policy simulations by chapter**

Simulation title	Simulation description	Chapters in which the results are reflected	Models used
Baseline	The “no new policies” Baseline used throughout the <i>OECD Environmental Outlook</i> .	All chapters	ENV-Linkages; IMAGE suite
Globalisation variation	Assumes that past trends towards increasing globalisation continue, including increasing trade margins (increasing demand by lowering prices in importing countries) and reductions in invisible costs (<i>i.e.</i> the difference between the price at which an exporter sells a good and the price that an importer pays).	4. Globalisation 6. Key variations to the standard expectation	ENV-Linkages; IMAGE suite
High and low growth scenarios	Variation 1: High economic growth – examines impacts if recent high growth in some countries (<i>e.g.</i> China) continues, by extrapolating from trends from the last 5 years of growth rather than the last 20 years. Variation 2: Low productivity growth – assumes productivity growth rates in countries converge towards an annual rate of 1.25% over the long-term, rather than 1.75% as in the Baseline. Variation 3: High productivity growth – assumes productivity growth rates in countries converge towards an annual rate of 2.25% over the long-term.	6. Key variations to the standard expectation	ENV-Linkages
Greenhouse gas taxes	Implementation in participating countries of a tax of USD 25 on CO ₂ eq, increasing by 2.4% per annum. OECD 2008: only OECD countries impose the tax, starting in 2008. Delayed 2020: all countries apply the tax, but starting only in 2020. Phased 2030: OECD countries implement the tax from 2008; BRIC countries from 2020, and then the rest of the world (ROW) from 2030 onwards. All 2008: in a more aggressive effort to mitigate global GHG emissions, all countries implement the USD 25 tax from 2008.	7. Climate change 13. Cost of policy inaction (Delayed 2020) 17. Energy 20. Environmental policy packages	ENV-Linkages; IMAGE suite
Climate change stabilisation simulation (450 ppm)	Optimised scenario to reach a pathway to stabilise atmospheric concentrations of GHG at 450 ppm CO ₂ eq over the longer term and limit global mean temperature change to roughly 2 °C. A variation on this case was developed to explore burden-sharing, using a cap and trade approach to implementation.	7. Climate change 13. Cost of policy inaction 17. Energy 20. Environmental policy packages	ENV-Linkages; IMAGE suite
Agriculture support and tariff reform	Gradual reduction in agricultural tariffs in all countries to 50% of current levels by 2030. Gradual reduction in production-linked support to agricultural production in OECD countries to 50% of current levels by 2030.	9. Biodiversity 14. Agriculture	ENV-Linkages
Policies to support biofuels production and use	Demand for biofuels growing in line with the IEA <i>World Energy Outlook</i> (2006) scenario. DS: a scenario whereby growth in biofuel demand for transport is driven by exogenous changes, keeping total fuel for transport close to the Baseline. OIS: a high crude oil price scenario to determine the profitability of biofuel in the face of increasing costs of producing traditional fossil-based fuels. SubS: a subsidy scenario in which producer prices of biofuels are subsidised by 50%.	14. Agriculture	ENV-Linkages
Fisheries	Global fisheries cap and trade system, representing a 25% reduction in open fisheries catch, with trading allowed within six geographical regions.	15. Fisheries and aquaculture	ENV-Linkages
Steel industry CO ₂ tax	Implementation of a carbon tax of 25 USD per tonne CO ₂ , applied respectively to OECD steel industry only, all OECD sectors, and all sectors worldwide.	19. Selected industries – steel and cement	ENV-Linkages
Policy mix	Three variations of policy packages were modelled, depending on the participating regions: OECD countries only OECD + BRIC Global The policy packages included: ● reduction of production-linked support and tariffs in agriculture to 50% of current levels by 2030. ● tax on GHG emissions of USD 25 tax CO ₂ eq, increasing by 2.4% per annum (phased with OECD starting in 2012, BRIC in 2020, ROW in 2030). ● moving towards, although not reaching, Maximum Feasible Reduction in air pollution emissions, phased over a long time period depending on GDP/capita. ● assuming that the gap to connecting all urban dwellers with sewerage will be closed by 50% by 2030, and installing, or upgrading to the next level, sewage treatment in all participating regions by 2030.	8. Air pollution 10. Freshwater 12. Health and environment 20. Environmental policy packages	ENV-Linkages; IMAGE suite

Structure of the report

The *OECD Environmental Outlook* is divided into two main parts:

- i) *The World to 2030 – the Consequences of Policy Inaction*: describes the Baseline, i.e. the projected state of the world to 2030 in terms of the key drivers of environmental change and the developing environmental challenges, as well as analysing some possible variations to the Baseline.
- ii) *Policy Responses*: focuses on the policy responses at both the sectoral level and in terms of implementing a more comprehensive and coherent policy package.


The first part describes the key elements of the Baseline to 2030, including the main drivers of environmental change (consumption and production patterns, technological innovation, population dynamics and demographic change, economic development, globalisation, and urbanisation) and the key environmental challenges (climate change, air pollution, biodiversity, freshwater, waste and material flows, health and environment). For each of these, the key recent trends and projections to 2030 are presented, as well as some of the policy approaches that are being used to address the environmental challenges. Chapter 6 describes some key variations to the Baseline – for example, how the Baseline would differ if key economic drivers (such as economic growth or global trade) were changing faster than projected in the Baseline. The chapter also explores other sources of uncertainty in the *Outlook* projections. Finally, this first part of the report examines the consequences and costs of policy inaction – essentially the environmental, health and economic impacts embodied in the “no new policies” Baseline scenario.


The second part of the *Outlook* report examines the possible policy responses to address the key environmental challenges, and assesses the economic and environmental impact of these responses. The key sectors whose activities affect the environment are examined, with a brief summary of the trends and outlook for their impacts, followed by an assessment of the policy options that could be applied in that sector to reduce negative environmental impacts. This section assesses the environmental benefits of specific policy options and their potential costs to the sector involved and/or economy-wide (and disaggregated by region where appropriate). This analysis can be used by environment ministries in discussing specific policy options for tackling environmental challenges with their colleagues in other ministries, such as finance, agriculture, energy or transport. The sectors examined include those that were prioritised in the *OECD Environmental Strategy* – agriculture, energy and transport – and also other sectors which strongly affect natural resource use or pollution, such as fisheries, chemicals and selected industries (steel, cement, pulp and paper, tourism and mining).


In addition to analysing sector-specific policies, this part of the *Outlook* also examines the effects of a package of policies (the EO policy package) to tackle the main environmental challenges. The analysis of this EO policy package highlights the potential synergies between policies (i.e. where the benefits of combining two or more policies may be greater than the simple sum of their benefits as separate policies), or potential conflicts where policies may undermine each other. Chapter 21 outlines the key framework conditions needed to ensure the successful identification and implementation of appropriate environmental policies at the national level, in particular institutional capacity and policy implementation concerns. Chapter 22, on global environmental co-operation, highlights the issues for which OECD countries will need to work together in partnership with other countries in order to reduce overall costs of policy implementation and maximise benefits. It also assesses the costs of inaction.

Traffic lights in the OECD Environmental Outlook

As with the 2001 *Outlook*, this report uses traffic light symbols to indicate the magnitude and direction of pressures on the environment and environmental conditions. Traffic lights are used to highlight the key trends and projections in the summary table in the Executive Summary, in the Key Messages boxes at the start of each chapter and throughout the chapters. The traffic lights were determined by the experts drafting the chapters, and then refined or confirmed by the expert groups reviewing the report. They represent the following ratings:

 **Red lights** are used to indicate environmental issues or pressures on the environment that require urgent attention, either because recent trends have been negative and are expected to continue to be so in the future without new policies, or because the trends have been stable recently but are expected to worsen.

 **Yellow lights** are given to those pressures or environmental conditions whose impact is uncertain, changing (*e.g.* from a positive or stable trend toward a potentially negative projection), or for which there is a particular opportunity for a more positive outlook with the right policies.

 **Green lights** signal pressures that are stable at an acceptable level or decreasing, or environmental conditions for which the outlook to 2030 is positive.

While the traffic light scheme is simple, thus supporting clear communication, it comes at the cost of sensitivity to the often complex pressures affecting the environmental issues examined in this Outlook.

While each of the individual chapters discusses the regional developments for the drivers or environmental impacts analysed, Annex A also provides an easily accessible “summary” of the economic, social and environmental developments in the Baseline for each region. Annex B provides a more detailed analysis of the modelling framework used in the development of the *OECD Environmental Outlook*. A number of background working papers, which provide further information on specific issues addressed in the Outlook, were developed to complement the report (see: www.oecd.org/environment/outlookto2030).