Unclassified **PAC/AFF(99)1**

Organisation de Coopération et de Développement Economiques
Organisation for Economic Co-operation and Development

OLIS : 25-May-1999
Dist. : 26-May-1999

Or. Eng.

PUBLIC AFFAIRS AND COMMUNICATIONS DIRECTORATE
PUBLIC AFFAIRS DIVISION

PAC/AFF(99)1
Unclassified

Cancels & replaces the same document:
sent on OLIS 21-May-1999

THE THREE-YEAR PROJECT ON SUSTAINABLE DEVELOPMENT:

A PROGRESS REPORT

This document, prepared under the direction of Deputy Secretary-General Thorvald Moe, is also available on the OECD Internet site.

Internet address: http://www.oecd.org/subject/sustdev

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FOREWORD

A High Level Advisory Group, consisting of representatives from the OECD governments, business and NGOs, which delivered its report to me in 1997, proposed that: "the OECD should be the key intergovernmental organisation that will help governments move towards sustainable development".

With a strong, three-year mandate from the OECD Ministerial Meeting in 1998, sustainable development is now a key priority for the Organisation. We reported on progress to this year's Ministerial Meeting. Ministers largely endorsed our work so far and our plans for the next two years. This is also a top priority for me, as I chair the Director-level co-ordination group for this project, in which our affiliates — the International Energy Agency, the Nuclear Energy Agency, the European Conference of Ministers of Transport, and the OECD Development Centre — are also heavily involved. This progress report, an earlier version of which was vetted by key committees of the Organisation, reports on progress in a number of key areas.

We aim to develop the project so that a Policy Report, containing a number of policy recommendations, and an Analytical Report will be presented to the Ministerial Council Meeting in 2001. A number of intermediate outputs, in the form of Background documents, will be produced over this period.

We have also created an *OECD Round Table on Sustainable Development* to enhance co-operation with other international organisations, business and NGOs, and to gather — on a personal basis —Ministers of Finance and the Environment.

The OECD is committed to contribute to analyses and pragmatic policy recommendations to help governments in Member and non-member countries move towards sustainable development.

Donald J. Johnston

Paris, May 1999

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EXECUTIVE SUMMARY

The three-year Ministerial Mandate.

1. At the Ministerial Council Meeting of April 1998, Ministers asked the OECD to undertake a three-year project on key aspects of sustainable development. This Executive Summary of this *Progress Report* on the OECD three-year project on Sustainable Development provides an overview of the work carried out and planned for the next two years.[1] The last two paragraphs describe the output proposed by 2001 in response to the Ministerial mandate.

Key policy questions for OECD governments...

2. Governments in OECD countries face a common set of key policy questions. Is economic growth, nationally and globally, leading to excessive exploitation of natural resources and to degradation of the ecosystem? Are increases in material welfare, as measured by GDP, providing adequate employment opportunities, and are the benefits widely shared? In other words, do we risk falling short of achieving major environmental and social objectives?

3. Important issues for practical policy formation are connected to these questions. What is the right balance between public policy interventions and market solutions in responding to them? Are governments taking a long-term view of their responsibility towards the current and next generations? How can OECD governments show leadership and commitment to address pressures on the global commons? And how can they help developing countries, many of which lack economic resources and local capacities, to move towards comprehensive sustainable development?

...underpin the paradigm of sustainable development.

4. The concept of sustainable development offers an integrated framework for addressing such questions. The concept originally derives from the scientific literature where it implies the management of a natural resource in ways consistent with the preservation of its reproductive capacity. It has now acquired a broader meaning, implying that the objectives of increasing economic efficiency and material wealth must take into account social and environmental concerns within an overall policy framework.

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1. This Executive Summary was presented at meetings at Ministerial level of the Governing Board of the International Energy Agency (IEA), on 24 – 25 May 1999, and of the OECD Council, on 26 – 27 May 1999.

5. The sustainable development framework also incorporates a focus on equity within and across countries (i.e. the here and now), and a long-term focus on the well being of the next generation. The framework calls for policies that can serve multiple objectives and exploit synergies, and requires that a balance be struck when objectives conflict.

Addressing these questions imply formidable challenges to policy making….

6. Formulating policy in a sustainable development framework means incorporating three key elements: a global dimension, linkages and participation. The first element means that some of the problems pertaining to sustainable development — such as climate change — require global solutions. Even though action will be required at the domestic level, international co-operation is needed, as concerns with their perceived competitiveness implications may impede effective policy reform. To be effective, policies must often extend beyond the national boundaries. Success becomes contingent on international co-ordination and negotiations, even when each OECD country should also act domestically.

7. Linkages between the economic, environmental and social dimensions mean that policy choices can involve difficult trade-offs between objectives that affect different constituencies. More importantly, however, the complementarities among the three dimensions also provide an opportunity for sustainable development to build bridges between the various policy communities, rather than to drive wedges between them. The cross cutting policies and interventions required concern many policy makers, ministries and sectors. They are horizontal policies, beyond the domain of any single ministry or levels of government, where Heads of government may have to exercise overall co-ordination.

8. Finally, a participatory approach is central to successfully meeting the challenge of sustainable development, both nationally and through enhanced international co-operation. Governments cannot exercise sole responsibility. Other stakeholders such as business, community based organisations and other non-governmental organisations (NGOs) have to become active partners.

… also reflecting limits of our analytic...

9. A key objective of the three year OECD initiative is to make the concept operational for public policies. Our approach considers sustainable development to be a key economic issue. Some types of economic decisions contribute to phenomena such as climate change, biodiversity loss and unsustainable exploitation of some natural resources, as well as to income inequality and high unemployment.[2] The response requires modifying economic incentives to incorporate environmental and social concerns. As a result, policies for achieving sustainable development may sometimes diverge from those directed at maximising economic growth in the short-term.

2. "The OECD Jobs Strategy: Policies to Create Jobs", C/MIN(99)9, and "The OECD Jobs Strategy: Assessing Performance and Policy", DEELSA/ELSA(99)5 and ECO/CPE/WP1(99)3.

10. The OECD approach also emphasises meeting these concerns at the lowest possible costs, and that these costs should be representative of the *full* costs to society of the various economic activities. It suggests that a number of insights need to be applied at both the macro- and sectoral levels. These include:

- An emphasis on how the "capital base" of our economies — i.e. man-made, natural and human capital — is evolving.

- The importance of science, technology and human resource development in enhancing the productivity of existing capital, or in generating pressures on some types of resources.

- The assessment of the degree of substitutability or complementarity between different assets.

But while these insights offer important guidance to policy makers, they also have limits.

11. Economic valuation techniques are not easily applied to some ecological resources, like preserving biodiversity, or to social objectives like promoting participation. As a result, they do not allow comparisons of the future benefits of climate change policies, that will accrue to generations with higher levels of material well being, to those of public health, infrastructure and education, that will accrue earlier to individuals who may need help more urgently. Uncertainty, irreversibility and the risk of catastrophic events pose additional challenges for the application of analytic tools to improve present policies on these issues.

... and measurement tools.

12. We also need to improve our capacity to measure and monitor the state of our environment and society, and their interactions with economic development and traditional economic indicators like GDP. The OECD has been at the forefront of the development of environmental indicators and of social indicators, in addition to more conventional and well established economic data and indicators. These indicators cover both the "outcomes" of the development process, and the "inputs" (or assets) that sustain it, with various degree of sectoral and spatial detail. However, such measures have so far had a fairly limited impact on policy making. A challenge for the future is to integrate and make them a practical tool for public policy.

13. What are some of the obstacles? While full monetary valuation allows consistent aggregation, it requires defining prices for goods that have no markets. While summary indicators of sustainability like "genuine savings" have played a useful role in focusing attention on the sustainability of economic growth, estimates have so far been based on strong assumptions and partial information. Building on efforts underway in other international agencies and universities, the OECD is seeking to develop, and build agreement on, a framework for better integration among economic, environmental and social issues. A number of workshops and conferences are foreseen in this process.

Practical progress is best pursued on a case-by-case approach, starting from challenges such as climate change...

14. The OECD approach suggests that progress towards sustainable development is best achieved through a pragmatic, case-by-case process, starting from a few major threats such as climate change. The Kyoto Protocol, which commits most OECD countries to limit emissions of greenhouse gases, is an historic step that marks their determination to curb climate change, an objective requiring global solutions. Achieving the Kyoto targets will require integrated and cost-effective policies to ensure that decisions to produce, consume and invest take climate goals into account. Domestically, this calls for greater use of economic instruments to deliver consistent price signals —such as subsidy reform, green taxes, "full costs" resource pricing and emission trading — as well as other measures. Internationally, it calls for accelerated diffusion of climate-friendly technology and effective implementation of the international mechanisms such as emissions trading included in the Kyoto Protocol.

15. OECD work on climate change since the fourth meeting of the Conference of the Parties to the Climate Change Convention (COP4) in 1998 has aimed at assessing progress by countries in implementing domestic mitigation strategies under the 1992 UN Framework Convention on Climate Change; and to analyse and quantify the effects of different implementation strategies. The main findings of this work, summarised in this Report, stress that relative to a "Business as Usual" scenario, Kyoto targets imply a reduction in emissions of some 30 per cent, and that by 1995 emissions of greenhouse gases were generally higher than in 1990 (the base year for Kyoto targets). Few of the domestic policies necessary to reaching these emissions targets are in place today.

16. Moreover, while the costs of meeting emission targets through domestic measures alone are likely to be significant, international co-operation offers important opportunities to reduce these costs through use of the so-called "flexibility mechanisms". Economic instruments — such as emission trading and environmental taxes — aiming to achieve emission abatement at least cost will become even more important as more ambitious targets are agreed for stabilising concentrations of greenhouse gases, an objective that calls for the participation of developed and developing countries alike according to their "common but differentiated responsibilities."

17. Other key features of climate policies pertaining to the role of technology transfers, of sectoral measures at the domestic level, and of policies to assist non-member countries in addressing global environmental concerns, are taken up in different parts of this Report. The Organisation is committed to strengthening its analytical capabilities and policy dialogue so as to be of best assistance to OECD countries and the international community at large. Analytic reports on climate change policies will be released ahead of the fifth meeting of the Conference of the Parties to the Climate Change Convention (COP5) in 1999 with a follow up for the sixth meeting (COP6).

...and the sustainable management of natural resources...

18. Sustainable development brings a new perspective to concerns over the use of natural resources. In this perspective, a central policy question is whether the earth's ecosystem could sustain the high pressure on natural resources that would result if all countries were to adopt lifestyles similar to those now prevailing in the most economically developed countries. In general, given the considerable scope for substitution among resources, what matters more than absolute scarcity is whether human ingenuity can keep combining man-made, natural and human capital in ways that enable human needs to be met. In some cases, however, the scope for substitution may be limited and absolute scarcity be a matter of concern.

19. In the case of non-renewable resources, a general trend towards more efficient use implies that the most important issue is not availability, but what to do with the waste streams they generate. In the case of renewable resources, however, many ecosystems are under stress. Even for water — perhaps the most indispensable resource — problems arise because of its uneven geographic and temporal distribution. Managing these resource so as to support sustainable development requires optimising the net benefits to society from current and future uses in the light of both commercial and non-commercial values. This requires internalising negative production externalities, proper management of access to resources, innovative approaches to the collection of resource rent, and reforms of inappropriate support policies. The transition to such practices, however, is likely to give rise to adjustment problems and resistance to change. OECD work in these areas is aiming to present recommendations to Member countries for sustainable resource management and for managing the transition to sustainable use in areas such as agriculture, energy, fisheries and biodiversity.

…focusing on the instruments available to policy makers to "get prices right"..

20. The importance of externalities — the costs and benefits to society of economic activities that are not reflected in their market prices — is not limited to natural resources. A major obstacle in achieving sustainable economic development arises from the presence of external environmental costs and the lack of well-defined property rights for many environmental resources. Open access to such resources free of charge means that producers and users lack the economic incentives to take the full costs of environmental degradation into account. But externalities are also pervasive in other policy areas such as technology, training and education policies, where the divergence between private and public returns may lead to under-investment and depreciation of skills. Thus a key factor in an effective pursuit of sustainable development is correcting for "market failures" and removing — as far as possible — distortions caused by inappropriate policies ("policy failures").

21. A number of steps may be required to move in this direction. These include:

- The reform of subsidies that are harmful to the environment.
- The use of economic instruments such as taxes and charges for harmful environmental externalities, and incentives for the provision of environmental public goods.
- The creation of markets where they do not exist, e.g. allowing trading in pollution and emission permits where suitable.
- A better appraisal and valuation of external effects.

22. In other words, those responsible for pollution should be liable according to the "Polluter Pays Principle", while consideration might be given to remunerating those who use their own resources to meet a demand for environmental public goods. Policies should also be guided by the "precautionary principle", e.g. the lack of full scientific certainty should not be a reason for postponing cost-effective measures to prevent environmental degradation in the presence of threats of serious or irreversible damage. Economic instruments can be important, in a number of circumstances, to get prices right and to achieve environmental objectives at the lowest costs. Their introduction, however, may meet political resistance to the structural changes in consumption and production patterns they are meant to enhance.

23. But, as importantly, establishing better framework conditions for sustainable development also requires better *ex ante* integration of different sectoral concerns, as often what appears as a "policy failure" from an environmental perspective may be motivated by social (including sectoral and regional) considerations. It also requires careful policy design, to minimise risks of policy failures, and exploiting opportunities by harnessing market forces. As differences in country and sectoral practices in this area are large, so is the scope for learning from "best practices" through country reviews of economic, environmental and energy policies, peer pressure and policy dialogue.

... to favour the creation and diffusion of clean technologies...

24. Technology will be critical in meeting the needs of current and future generations and in de-linking economic growth from environmental degradation. But appropriate technological change is not automatic, and technologies may also lead to pressures on natural resources, create health hazards and raise difficult ethical considerations. OECD governments have a key role to play as market failures, including information and pricing failure, risk stifling rather than stimulating technologies that may enhance sustainable development. They must improve present framework conditions so as to provide the right incentives and price signals to firms and influence consumers' awareness and behaviour. They often have a direct role in the financing of the basic research underlying innovation in clean technologies, an area that accounts for about five per cent of public R&D expenditures.

25. Fiscal and other measures to encourage the diffusion of cleaner technologies exist in several countries but, overall, such programmes are too recent and limited. OECD governments have also an important role in enabling developing countries to take full advantage of existing options for clean production by supporting capacity development. OECD work will aim to formulate recommendations for designing cost-effective innovation policies capable of supporting sustainable development goals. This will include: analysis of the concepts and measurement of eco-efficiency and resource efficiency; work on how innovation and environmental policy instruments can best promote environment-related innovation; in-depth analysis of specific technologies; and case studies with industry of how firms incorporate environmental objectives into their management strategies.

... and to help non-member countries in establishing policy frameworks for sustainable development.

26. While global economic integration has the potential to promote more efficient resource use and higher material welfare, it may also amplify and/or redistribute environmental and social pressures towards non-member countries.[3] This requires establishing in these countries the economic, legal and regulatory frameworks necessary to ensuring compliance with social and environmental safeguards. The OECD is engaged in a dialogue with non-members on how to meet this challenge in a number of areas. There is a need to identify the key features of effective national strategies for enhancing sustainable development, building on experience to date. This requires deepening in-country dialogues, strengthening local capacities and participation, and clarifying the linkages between the social, environmental and economic objectives of sustainable development.

27. OECD countries also should strengthen the coherence between their trade, investment, environment and development policies. The OECD is working to find ways of involving major non-members in efforts to address global environmental concerns, such as climate change, biodiversity, water availability and desertification. These challenges are closely related, and will need to be addressed together. A good way to integrate environmental and development goals is to enable non-member countries to take full advantage of cleaner production technologies, an area where the International Energy Agency (IEA) and the OECD are working actively together. A collaborative process among international organisations has led to agreement on a working set of "core indicators" to monitor progress of developing countries towards a range of economic, environmental and social objectives. Work is continuing to improve the quality of existing data, and a joint review of the progress achieved is planned in the spring of 2000.

3. "Trade, Investment and Development: The Challenges of Policy Coherence in a Global Economy", SG/LINKS(99)1/REV1 and "Trade and Investments and the Developing World", ECSS(99)7.

The OECD is committed to helping Member countries to face up to these challenges through a major horizontal project...

28. The OECD is committed to helping Member countries address fundamental sustainable development issues, in response to the three-year mandate from Ministers adopted at the OECD Council Meeting of April 1998. The challenge, for the Organisation as much as for Member governments, is to move beyond a narrow, sectoral approach to important policy issues to one geared to greater *ex ante* integration. The response of the Organisation has involved the development of an horizontal project, which involves most OECD Directorates and close co-operation with the OECD affiliates, the International Energy Agency (IEA), the Nuclear Energy Agency (NEA), the European Conference of Ministers of Transports (ECMT) and the Development Centre. To enhance the co-operation with other international organisations such as The World Bank, The World Trade Organisation, UNEP, UNCTAD and UNDP, and to provide intellectual stimulus to OECD efforts, an *OECD Round Table on Sustainable Development* was established in the summer of 1998. The Round Table gathers, in a personal capacity, officials from Ministries of the Environment and of Finances, from the above-mentioned international organisations, and from business and NGOs.

...that will aim at substantive outputs for the meeting of OECD Ministers in 2001.

29. The three-year horizontal project on Sustainable Development is expected to lead to three types of documents:

- A Policy Report to Ministers, providing recommendations on policies for enhancing sustainable development. This will draw flexibly on other documents prepared in the process.

- An Analytical Report, with inputs prepared by different Directorates and working groups, with an advanced draft to be prepared by end-2000 (a provisional outline of this Report is provided in Table 1).

- A series of Background Reports also prepared as documentation for workshops and conferences, developing in more detail some of the components of the OECD work.

30. It is suggested that the *Policy* and *Analytical* Reports be reviewed by *ad-hoc* joint committee, gathering officials from capitals in the economic, environment and social fields. Review of other products, including those prepared as inputs to the horizontal projects by the different OECD Directorates and working groups, will continue through the various committees and working parties of the Organisation. Based on this documentation, a joint meeting of Ministers of Finance, Environment and Social Affairs is envisaged as an integral part of the Ministerial Council Meeting in 2001.

Table 1. A Provisional Outline of the 2001 Analytical Report on Sustainable Development

Part A. The Outlook for Sustainable Development

1. Key economic, environmental and social challenges and opportunities

Part B. A Policy Framework for Sustainable Development

2. Key Policy Principles
3. Measurement
4. Institutions and Decision Making
5. Enhancing Framework Conditions for Sustainable Development
6. Technology and Sustainable Development

Part C. Policy Responses: Key Issues

7. The management of natural resources
8. Responding to climate change

Part D. Policy Responses: Sectoral and Local approaches

9. Energy
10. Transport
11. Agriculture
12. Local approaches

Part E. Globalisation and Sustainable Development

13. Trade, Investment and Sustainable Development
14. Strategies for Enhancing Sustainable Development in developing and non-member countries

This outline of the Analytical Report is, at this stage, tentative; it may be adjusted in the course of 2000, in the light of the substantive outputs produced for the various committees and working parties. In any case, it is proposed that chapters of this Analytical Report be presented to sectoral committees and working parties in the course of 2000. An ad-hoc committee will vet the Analytical and Policy Reports early in 2001 in preparation of the 2001 Ministerial Council Meeting.

CHAPTER 1. SUSTAINABLE DEVELOPMENT: A FRAMEWORK FOR POLICY

What are the challenges?

31. Sustainable development calls for an integrated set of policies that maximise human welfare within an inter-temporal framework. The Brundtland Report defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations, 1987). This definition raises important challenges for policy making and for economic analysis, with three features worth highlighting.

32. First, this definition implies a reference to "needs" in a broad sense, not only economic needs but also needs for a clean environment, for a secure and cohesive society and for ample employment opportunities. Second, implicit in this definition is a focus on "inter-generational" equity, implying that the next generation should be secured opportunities similar to those available to the current one. Third, this definition puts an emphasis on "intra-generational" equity. This intra-generational perspective applies both across and within countries. It suggests that preservation of the environment should be a joint responsibility of developed and developing countries, and implies that all individuals should benefit from the opportunities created by globalisation and technology, and have a stake in the progress of society.

Defining development

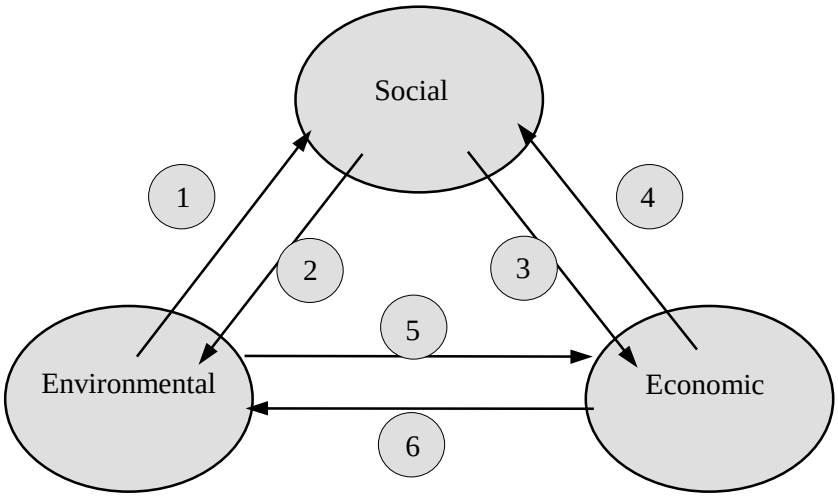
33. Most economic analyses have tended to identify development with the growth of real per-capita production or consumption, and to focus on conditions for the durability of economic growth such as preserving financial stability and a low and stable inflationary environment. Enshrined in sustainable development is a concern with the *quality* of economic growth as with its *quantity*. In this perspective, sustainable development encompasses three different dimensions of welfare — economic, environmental and social —and conditions for economic, environmental and social sustainability. The *social* dimension to sustainability emphasises the importance of well functioning labour markets and high employment, of adaptation to major demographic changes like population ageing, of stability of social and cultural systems, of equity considerations, and of participation in more effective decision making. The *environmental* dimension focuses on the stability of biological and physical systems, and on preserving access to a healthy environment. These requirements are recognised as distinct from, and as important as, economic growth. The emphasis is also on the links among these three dimensions, on their complementarities, and on the need for balancing them when they conflict.

Interactions and links among the key dimensions of sustainable development

34. These key dimensions of sustainable development involve complex synergies and trade-offs. Synergies imply that there is scope for interventions that allow achieving multiple objectives, for example by phasing out subsidies that are damaging for the environment and/or for the economy. But trade-offs are sometimes unavoidable, as national priorities in terms of different objectives may differ, and as objectives can at times conflict. For examples, policies aimed at improving economic efficiency can run counter

objectives for equity and cohesion; *vice versa* policies to achieve equity objectives may do so in ways that impinge on the well-functioning of markets unless an integrated approach is followed.

Figure 1.1. Some key interactions between the economic, social and environmental dimensions



Key

1. Health hazards; impacts on living and working conditions
2. Pressure on environmental resources; environmental awareness of citizens

3. Quantity and quality of the labour force, consumption
4. Income distribution, employment opportunities

5. Productive functions of the environment (resource and sinks functions)
6. Pressure on environmental resources, investment in environmental protection

35. A simplified representation of some of the links between the social, economic and environmental dimensions of sustainable development is provided in Figure 1.1.

– The interaction between the economic and environmental dimensions encompasses, on one side, the effects on the environment of economic activities and policies, either as a result of firms' behaviour or of government interventions that harm (e.g. support to environmentally damaging activities) or benefit (e.g. incentives to clean technologies) the environment. Conversely, environmental resources (including amenities) may provide important productive services, while some measures to protect the environment may impact significantly on the economy. The OECD "pressure-state-response" framework has been influential in mapping the interactions between the economy and the environment, as changes in environmental effects can be directly linked to economic activities that drive them.[4]

4. In this framework, "pressure" on the environment (due to economic growth, population and structural changes) leads to changes in the "state" of the environment (for example, pollution and waste generation)

- The interaction between the environmental and social dimensions is more complex, as many of these links are difficult to observe directly. Environmental degradation will result in health hazards for the exposed population, and policies to limit this degradation may improve working and living conditions. Conversely, social conditions will impact on the environment. While this relationship is most obvious in the case of developing countries — where effective response to de-forestation often depends on effective alleviation of poverty — education, awareness and changes in consumer habits are important elements contributing to effective environmental policies in OECD countries. More generally, features of social organisations, such as norms and trust, may reduce behaviour damaging to the environment, for neighbours and third parties.

- The interaction between the economy and the social dimension includes the provision of human inputs to economic activities, and the way in which social norms, attitudes and institutions affect the functioning of markets — for example, by reducing transaction costs and the need for policy interventions. Conversely, most economic processes will affect society at large, providing the foundation for greater prosperity but also affecting the distribution of economic benefits between individuals. Some of these links are not directly observable, hence the difficulty of mapping directly threats to social sustainability to specific economic forces.

Some principles for sustainability

36. Making this definition of sustainable development operational is difficult. This reflects *inter alia* the challenge of attaching shadow prices to a number of dimensions (mainly in the environmental and social sphere) and of defining property rights for a number of goods (e.g. biological resources). Because of these difficulties, our approach is not to consider a broad concept of human well-being as a concept to be maximised. Rather, we interpret "sustainability" as a set of boundary conditions which economic development should respect. As many of these conditions will not be binding in terms of agents' decisions, the focus is on:

- Guiding policy in identifying major conditions for sustainability on the economic, environmental and social side.

- Developing an economic environment within which these conditions are recognised in day-to-day decision making, so that economic decisions that violate them are no longer attractive.

- Devising policy instruments that give agents better incentives to meet these conditions.

This approach suggests a number of perspectives for policy making that are discussed below.

Preserving the capital base of our economies and societies

37. A key determinant of the potential to satisfy the needs of the present and the next generation is the availability of capital. In the most recent literature on sustainable development, this stock includes natural capital (including both natural resources and environmental assets); man-made capital (including both physical capital and financial assets); and human capital (including health and education). Social

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and to society's "responses" (government policies, adaptation and measures taken by individuals and firms). See OECD (1999), *Towards Sustainable Development: Environmental Indicators*, Paris.

capital, a concept encompassing social institutions, networks and norms, may also be included in this representation although, in practice, investments, depreciation and rates of returns on social capital are difficult to identify.[5] In this perspective (and in the absence of technical progress, see below), a condition for sustainability is that the total stock of capital is non-declining.[6]

38. To the extent that individuals living today already fully integrate future concerns into current actions, "sustainability" would be of little concern. For example, forward looking economic models with overlapping generations explicitly link current decisions to the consumption (well being) of future generations. However, the levels of consumption over time generated by these models may not be consistent with the requirement of preserving the consumption possibilities of the next generation when the discount rate used exceeds the regeneration capacity of the resource considered. Although this conclusion depends on assumptions about the relationships between different types of capital , this suggests that economic decisions based on rational calculations may result in unsustainable practices.[7]

Substitution and complementarity between different types of capital

39. A key question is to what extent the different components of wealth can be substituted for each other. To the extent they can, depletion of natural and environmental capital would be consistent with a non-decreasing overall capital stock if offset by an increase in other forms of capital. This corresponds to "weak sustainability". "Strong sustainability", in contrast, assumes that for some types of capital there is no substitute, and that its degradation would lead to a loss for future generations. While substitution of natural for man-made capital has been one of the main features of economic growth in the past, for some natural assets some minimal levels may be critical for development. This perspective is most relevant when the loss of capital is irreversible, as in the case of non-renewable resources (biodiversity) or of renewable resources that are exploited beyond their capacity of reconstitution (such as fish stocks). In the case of most resources, however, it is likely that substitutes can be found, at least for marginal changes. While the assessment of the degree of substitutability of the different components of the capital stock is fundamentally dependent on value judgements, these two approaches also inform different perspectives on measurement (*see* Chapter 6).

40. While the above discussion mainly focuses on the degree of substitution of the different types of assets, to a large extent the three forms of capital complement each other in producing welfare, and each of them is more productive if accompanied by sufficient supply of the others. At one extreme, the economy would not be able to function without some of the basic services provided by the environment, including shelter and food. A clean environment also often means a healthier population and hence a higher productivity. Similarly, reducing some atmospheric (ground-level ozone) and water borne (heavy metal)

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5. While several definitions of social capital are discussed in the literature, they all share a focus on networks and trust relationships between individuals. However, social capital is generally acknowledged to have both positive (e.g. trust may reduce transaction costs between individuals) and negative (e.g. rent seeking behaviour of long-standing civil groups) effects on human well being.

6. While the "capital" framework is most relevant for the inter-generational perspective, it may also be regarded as important for the "intra-generational" one. Empowerment of individuals and poverty alleviation are themselves a function of control over resources and of access to different types of capital. Pearce D. W., G. D. Atkinson (1998), "The Concept of Sustainable Development: An Evaluation of Its Usefulness Ten Years After Brundtland", *Swiss Journal of Economics and Statistics.*

7. Pearce D. W., G. D. Atkinson and W.R. Dubourg (1994), "The Economics of Sustainable Development", *Annual Review of Energy and Environment.*

pollutants may result in higher crop yields, and naturally available high quality potable water may be less expensive than purifying polluted water through man-made technologies. Indeed, with respect to commercially valuable renewable resources such as fish stocks, ensuring that they are sustainably used (i.e. not overexploited) allows for higher total revenues from their continued use over a longer period of time, as well as preserving employment opportunities in the sector. Complementarities are also important between human and social capital, as the return to learning by individual students is likely to be enhanced by the personal communication and relationships that exists in classrooms.

Technology and population

41. The need for a constant capital base can be qualified by two factors. The first is *technology*. In addition to preserving the capital base, opportunities available to the next generation will depend on the productivity of these assets, hence the importance of technological progress. While the role of technological improvements has long been a source of debate in the literature on economic growth, much of this debate is also relevant for the discussion of sustainability. It has been argued that, for most OECD countries, the empirical magnitude of technological change is such that it could swamp the accounting for depletion of environmental resources and environmental pollution.[8] On the other side, technology can also lead to increased pressure on some natural resources, create health hazards, and raise difficult ethical considerations. As emphasised by *new growth theories*, technology comes into being as a result of identifiable processes — such as expenditures on research and development, the level of skills of the workforce, and firms' practices in making use of these skills (*see* Chapter 5). It follows that current economic decisions will affect the well being of the next generation through more than asset depletion.

42. The second factor is *population.* Maintaining a constant level of *per capita* well being over time requires that economic activity expands in line with population. While increasing the supply of human resources, higher population will also increase the demand on other types of capital, for example on natural resources and other environmental services, possibly stretching resource use beyond its critical "carrying capacity"[9]. In addition to population levels, patterns of human settlements and concentration of the population in specific areas may affect sustainability at the sub-national and local level, adding a crucial "spatial" dimension to sustainable development.

Cost effectiveness

43. Improving economic, environmental and social conditions will generally entail opportunity costs. All policy objectives should thus be pursued at minimum cost, and efforts should be made to ensure that the costs of each extra resource spent are equal, as far as possible, across the entire range of possible interventions. While cost-effectiveness, by itself, does not guarantee that the mix of policy interventions will reflect the appropriate balance between the preferences of society for different targets, it is an important requirement for individual policy interventions. The criterion of cost effectiveness is relevant for economic, environmental and social policy interventions, although in the case of the latter it raises

8. Weitzman and Löfgren (1999) have argued that the size of the "technological change" premium could well swamp any accounting for the depletion of natural resources. Hamilton et al. (1998) argue however that the size of this premium is a function of assumptions on the nature of technical change.

9. The notion of "carrying capacity" is drawn from biology, and suggests that a given area can only support a given population of a particular species. In the context of sustainable development, this concept suggests the existence of a saturation point to human population, beyond which the yield of ecological resources will start to decline.

difficult issues in terms of the identification and measurement of specific outcomes in areas such as education, employment, health and other social policies.

44. In the field of environment and natural resource management, where the objectives and the instruments chosen differ considerably across countries, differences in cost-effectiveness are likely to be large. In general, command-and-control measures dominate the field, although increased use of economic instruments such as taxes, charges and tradable emission permits may be expected to improve cost effectiveness (*see* Chapter 2). Moreover, economic instruments may also provide permanent incentives to reduce emissions and pollution through technology improvements, and the proceeds they generate may be used to reduce other distortionary taxes. Thus, improving framework conditions (Chapter 2) is important for more rapid implementation of new technologies (Chapter 5). The three-year horizontal programme on sustainable development will include the elaboration of studies of how countries go about achieving their objectives relating to the environment and resource use, *inter alia* through country reviews.

Economic Valuation

45. Balancing economic, environmental and social objectives in a sustainable development framework would be facilitated by valuing environmental and social resources in monetary terms, as economic resources are. But attaching a price to the availability of a natural resource is difficult given imperfect information and competing priorities. Since market prices often do not reflect the values of environmental services in particular, and the "willingness to pay" for such services is not always observable, non-observable values may have to be estimated. These include:

- Use values, i.e. the benefits accruing to people who directly use the environmental assets (forests, soil, water, air, outdoor recreation).

- Option values, i.e. the benefits which accrue to people not from the actual use of environmental assets, but from retaining the option to use them in the future (e.g., tropical plants). Option values can also be characterised as "indirect use" values.

- Bequest values, i.e. the values attached to environmental assets that people want to transmit to future generations (e.g. biodiversity, recreation and scenery).

- Existence values, which are derived from the values attached to the mere existence of environmental assets, even if people will never use them (e.g. habitats).

46. While different techniques may be used in assessing these values for different environmental resources (e.g., observation of market prices, "revealed preferences" and direct surveys) they are not easily applied to some ecological resources like preserving biodiversity, and even more to social objectives such as promoting participation. Furthermore, the environmental or social effects of consumption and production patterns may persist long after the products or services have been used and disposed of. The relevant time horizon for a number of environmental effects may range from several centuries (as in the case of greenhouse gas emissions or radioactive leakage) to eternity (in the case of species extinction).

47. Quantitative comparisons of costs and benefits of economic activities require computing *shadow prices* and applying a *discount rate* to the future.[10] Cost-benefit analysis can be a useful tool for guiding decisions on alternative projects, but ethical criteria need to be introduced explicitly when considering

10. The discount rate reflects how much less a future cost or benefit is worth compared with the same cost or benefit occurring in the current time, expressed as a certain percentage reduction per annum. It reflects the preference of present over future consumption or use, and generally accounts for risk.

projects with long-term consequences, in order to avoid the risk of undervaluing the welfare of future generations.[11] More generally, however, there are limits in our capacity to compare utility both between individuals living today and between generations. For example, available valuation tools do not allow comparisons of the future benefits of climate change policies, that will accrue to generations with higher levels of material well being, to those of public health, infrastructure and education that will accrue earlier to individuals who may need help more urgently.[12] Uncertainty, irreversibility, and the risks of catastrophic events create additional difficulties for valuation. Because of these limits, non-economic criteria and hard political decisions often become inevitable when dealing with objectives that are difficult to compare directly in quantitative terms.

The need to internalise externalities and remedy policy failures

48. The prices used for economic valuation should reflect societal preferences, and reflect the full costs to society of various activities. However this is rarely the case. A major cause for unsustainable practices is the presence of externalities that lead to sub-optimal development of economic, environmental and human capital. In the environmental field, the presence of external environmental costs and the lack of well-defined property rights for many resources mean that producers lack incentives to take the full costs of environmental degradation into account. But externalities are also pervasive in other policy areas such as technology, training and education, where the divergence between private and public returns may lead to under-investment and depreciation of skills. Thus "getting prices right" is a key criterion in the pursuit of policies for sustainable development. From the perspective of society as a whole, the "right" price is the one that reflects different economic, environmental and social objectives, as well as attendant risks and uncertainties.

49. Externalities originate from both policy and market failures. *Policy failures* may result from actions that, in many cases, may hinder sustainable development. For example, subsidised prices may encourage the depletion of capital stocks. *Market failures* may stem from prices that do not include externalities — e.g. the costs to society of a reduction of the availability of clean air or water. When positive or negative externalities occur[13] market prices will give the wrong signals, and under or over-supply of goods and services will result.[14] Market failures may also reflect asymmetries of information and the absence of competition, as producers in non-competitive markets can maintain selling prices above costs and may have little incentive to improve quality. As with market failures due to external effects, a number of instruments are available to governments to reduce these inefficiencies.

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11. Geoffrey Heal (1997), "Valuing our Future: Costs-Benefit Analysis and Sustainability", PaineWebber Working Paper Series in Money, Economics and Finance. As suggested by the author, logarithmic discounting, as opposed to conventional geometric models, would tend to result in higher values attached to future events. This is also more consistent with experimental studies suggesting that (implicit) discount rates used by individuals tend to drop as the horizon extends and as their income increases.

12. Thomas C. Schelling (1997), "The Costs of Combating Global Warming: Facing the Tradeoffs", *Foreign Affairs*, November/December.

13. Externalities may also be positive, when production or consumption creates benefits for people besides the producers, sellers and buyers of the products. In some cases, the producer of the good that generates positive externalities may capture their market value, e.g. the positive externality of an enhanced landscape associated with the use of better agricultural practices may be exploited through markets for rural tourism.

14. As long as negative external costs are not accounted for, there will be an overuse of the resource(s) concerned.

50. Both failures partly stem from an inadequate understanding of the functions of the different assets in the economy and how these have to be treated if overall welfare, and thus sustainability, is to be increased. Wrong market signals may imply an over-exploitation of, for instance, environmental resources. With corrected market signals — for example through environmental taxation — policy makers may secure a more efficient resource use, and higher welfare both for the current and the next generation. The quality of the policy measures taken to correct market failures will determine how close the resulting prices truly reflect the preferences of society. This will generally reflect first, whether members of society are well informed about the choices available, and second, whether the decision-making process is open, accountable and inclusive of all relevant stakeholders. In many cases, present knowledge is adequate to implement proper policies, but in practice conflicts of interests and resistance to change have contributed to limited progress in policy reforms.

Policy implications

51. In the absence of well-functioning markets, and of a set of prices leading to an optimal balance of economic, social and environmental capital, the integration of these different concerns can only be achieved through collective action. This requires that the interactions between the economy, the environment and society be taken into account at the stage of the formulation of the different policy interventions. All too often, measures are targeted to one of the three dimensions without properly investigating the effects on the other, leading to unforeseen effects and costs. For example, subsidies that are motivated by objectives of support of specific regions and communities often impose a heavy burden on the environment and natural resources. Moreover, one single measure often affects all three dimensions at the same time, as feed-back loops may be pervasive. Responding to the challenge of sustainable development hence requires institutional and technical capacity to assess the economic, environmental and social implications of development strategies, and to formulate and implement appropriate policy responses. Achieving this objective requires changes in present policy practices in such areas as taxation and subsidy reform (Chapter 2); cost-efficient policies to curb emissions of greenhouse gases (Chapter 3); policy to regulate access and exploitation of natural resources (Chapter 4); technology policies (Chapter 5); and policies for development co-operation (Chapter 7). These are reviewed in the rest of this *Progress Report*. Needless to say, there are important interactions and synergies between policies in these areas.

52. Better information and modelling are also needed to respond to this challenge. The use of a consistent modelling framework, including macro-models and applied general equilibrium models, for building plausible scenarios of global developments may allow important insights about the magnitude of different driving forces and challenges laying ahead. For example, the OECD general equilibrium model GREEN is used to assess economic costs of different strategies for reducing emissions of greenhouse gases (see Chapter 3). Ongoing work in the context of the forthcoming OECD *Environmental Outlook* aims to use these models to gradually increase our ability to interpret the linkages between the economy and the environment.

53. Moving towards sustainable development also requires better institutions and decision making. All OECD countries now have in place ministries (or agencies) responsible for implementing national economic, social and environmental policies. In the case of environmental policies, it is a recent phenomenon in some countries. Many interventions on the environmental and social side have, however, the character of remedial, *ex-post*, interventions. Awareness of the necessity to integrate environmental and social policies with economic and sectoral policies has been increasing in OECD countries, but the degree of policy and institutional response varies. Some governments are trying to evaluate the environmental impacts of national budgets, but overall environmental and social concerns do not figure prominently in setting the stance of macroeconomic policies. There is also a need for better assessment of the social and environmental consequences of economic policies, both at the macro and sectoral levels. To

achieve more effective co-ordination, some countries have created new institutions. In the environmental field, legislation has been consolidated in a number of countries to improve consistency, whereas responsibility for decision making has been decentralised in several countries. The challenges for governance and decision making will be addressed through a survey of Member countries' institutional practices in handling sustainable development issues, which could also include a number of in-depth country reviews.

CHAPTER 2. ENHANCING FRAMEWORK CONDITIONS FOR SUSTAINABLE DEVELOPMENT: SUBSIDIES, TAXES AND THE CREATION OF MARKETS

Introduction

54. Relative prices play an essential role in the deployment and accumulation of man-made, human and natural capital. As emphasised in Chapter 1, because of both market and policy failures, relative prices often differ from optimal ones, and markets may not exist for a number of products. Improving price signals implies making sure that existing prices better reflect the *full* marginal costs and benefits to society of different economic activities and, in a number of cases, bringing market forces into play where markets do not exist. This chapter considers how various instruments may be used to achieve a better integration of environmental concerns in economic decisions, as well as of economic concerns into environmental policy making. It does not elaborate on how to favour the integration of social concerns in economic decisions, nor the role of policies to change relative prices so as to achieve social objectives, a broad agenda that covers a large number of OECD activities. However, as highlighted below, pressures on the environment are often exacerbated by government programmes aimed at social objectives, as in the case of subsidies to the exploitation of natural resources. Often, these interventions lead to outcomes that are damaging for both the environment and the economy, and may even fail to achieve their stated social objectives. When conflicts between economic, environmental and social goals arise, a challenge for policies is that of introducing reforms that better balance these goals (Box 2.1). A number of policy instruments available to policy makers to achieve a more environmentally sustainable economic development are described below, together with obstacles to their effective implementation, and with an overview of ongoing OECD work aimed at improving their policy design and implementation.

Box 2.1. Balancing economic, environmental and social objectives: the case of water pricing

In many countries, water has traditionally been under-priced, most often to support agricultural and water-intensive industrial activities or to ensure minimum levels of water services for all households. However, many countries have now recognised the need to recover the full costs of water provision, in order to ensure the financial viability of water utilities and the maintenance of the infrastructure. As a result, a trend to higher water prices and full cost recovery can be observed in several OECD countries.

The increasing pressure on available water resources has also required the consideration of the environmental effects of its use. Many OECD countries have now adopted pricing structures that encourage conservation, including increasing block-volumetric tariffs (with charges per unit of water used that increase with consumption levels), environmental taxes and charges on water use or sewage disposal. These trends have been accompanied in a number of cases by better-targeted social policies, with a shift from generalised below-cost provision to all consumers towards direct income support.

Source: OECD (1999), *Pricing of Water Services in OECD Countries: Update,* February

Policies for enhancing market signals

55. Various instruments try to promote environmental protection by changing the incentives faced by producers and consumers. To be cost-effective, these instruments should provide for marginal abatement costs for a particular kind of environmental damage to be aligned across sectors. These instruments include the reform of support measures that are damaging for the environment, the introduction of taxes, charges and fees on environmentally harmful products, and the reform of existing institutions and regulatory frameworks. Although command and control measures still play a large role in environmental policies, the use of economic instruments appears to have increased over the last decade. Ongoing OECD work aims at:

- Extending the analysis and the information base available to policy makers for improving the design and implementation of these instruments.

- Assessing the impacts on the environment of different measures.

- Reviewing countries' approaches to the achievement of their environmental and resource use objectives through economic, environmental and energy reviews.

Subsidy reform

56. Subsidies have a variety of forms. They can involve direct budgetary transfers from governments to producers, indirect transfers from consumers to producers (in the form of higher prices than those prevailing on world markets)[15] or preferential tax treatment (i.e. tax revenues foregone)[16]. They can also impact on output, purchases, raw material, labour and capital inputs, income or profits. Subsidies are frequently granted for social or economic reasons. However, they often fail, in a number of sectors, to achieve their intended objectives, leaking away to unintended recipients such as input suppliers or customers, or becoming capitalised into the prices of factors of production with inelastic supply. It is estimated that as little as 20 to 50 per cent of market price support to agriculture (the most common form of agricultural support in OECD countries) may reach farmers.[17] In addition, most subsidies are likely to stimulate over use of inputs and production, and to lock-in prevailing and often inefficient technologies, as they are conditional on inputs and production volumes.[18] While in principle the effects on the environment of these support programmes may be both positive and negative, in practice negative effects tend to dominate in most cases. Due to these failures, policy reforms are underway in a number of sectors:

- Agriculture. Substantial sums are annually transferred to agriculture (around $360 billion in OECD Member countries, according to 1998 data). Much of the support has stimulated over production, which has exacerbated environmental problems through inappropriate farm practices and use of pesticides and fertilisers, but may also allow countries to provide

15. For example, it is estimated that transfers from consumers in the form of higher prices accounted for around 67 per cent of support to farmers in 1996-98, as measured by the Producer Support Estimate (PSE), the remainder paid in the form of direct budgetary transfers from governments. OECD (1999), *Agricultural Policies in OECD Countries – Monitoring and Evaluation 1999,* Paris.

16. OECD (1996), *Tax Expenditures: Recent Experiences,* Paris.

17. OECD (1995), *Adjustment in OECD Agriculture: Issues and Policy Responses,* Paris.

18. OECD (1998), *Improving the Environment Through Reducing Subsidies,* Paris.

environmental benefits, such as the preservation of amenities and soil conservation and stability. Further, rather than contributing to higher farmers' income, much of this support leaks away to input suppliers and customers, often benefits larger farmers more than smaller ones, where support is linked to production levels, and distorts trade flows. Once the support gets enshrined in the price structure, it often becomes difficult to remove. In view of these factors, reforms are aimed at reducing overall support, moving away from measures that distort production and trade towards better targeted income support and — in some countries — to incentives for the provision of those environmental amenities that are not remunerated, including those jointly produced with agricultural output.

- Fishing industry. Poor economic performance of the fishing industries has often prompted calls for government financial transfers. Rather than addressing the underlying problems, including those associated with poorly defined property rights, governments have often responded to these calls through financial transfers that may further exacerbate the problems. For example, the expectation of a temporary improvement in performance may stimulate the entry of more productive resources into the fishing sector, and thereby increases the level of exploitation of fish stocks. [19] On the other hand, other forms of transfers such as those directed to fisheries management and research may be necessary pre-requisites for the sustainable use of fisheries resources. The OECD is currently undertaking a major study on the impact of government financial transfers on fisheries resource sustainability, and on reform experiences.

- Energy. Support to energy in OECD countries decreased significantly in recent years, but large subsidies remain in several non-OECD countries. Little comparable data exist, with the main exception of producer subsidy equivalent (PSEs) for coal. According to this yardstick, support to the coal industry in five OECD countries peaked in 1989, and declined to roughly $7 billion in 1996. Subsidies to coal have in most cases not secured employment, but merely postponed necessary structural adjustments. They have contributed to higher emissions of greenhouse gases, by stimulating the continued use of coal-fired power generation at the expense of alternative, less carbon-emitting forms of generation, such as gas turbines or renewable energies.[20] In addition to direct budgetary transfers, energy prices do not always reflect external costs on the environment, human health and energy security, and policies aiming at internalising these costs should be considered as part of improving framework conditions for sustainable development.[21]

- Transport. As in the case of energy, taxes and user charges on various transport modes often do not cover public spending on infrastructure, nor their health and environmental costs. While the first constitutes a direct subsidy, the second implies an "implicit subsidisation". According to some estimates, full internalisation of these external costs might lead to an

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19. With the declaration of exclusive economic zones (EEZs) in the late 1970s, many countries that had no longer access to these zones began programmes to retire capacity and to pay for the access to EEZs of coastal nations. At the same time, coastal nations supported the expansion of domestic capacity in order to utilise the stocks that they now had exclusive rights to.

20. For a discussion of subsidy reform see IEA, *Energy Policies of IEA Countries*, Paris, various issues.

21. This was recognised by Environment Ministers at the Fourth European Conference on the Environment (June 1998), who stressed the need for promoting action to reform energy markets and pricing, to ensure that prices internalise the environmental costs of energy production and use.

increase of transport prices by 15 to 30 per cent in European countries.[22] Work by ECMT is considering how policy reforms may allow governments to better internalise these external costs. Work in the OECD is addressing *inter alia* the role of inter-modal transport solutions in alleviating road congestion and of policies to influence road traffic demand.

57. Subsidies can therefore be an important source of policy failures, and the reform or elimination of these subsidy regimes is a way of correcting these failures. In many situations, the original objective of a particular subsidy policy may no longer exist, while in other situations other instruments may be available which are more efficient in achieving the same objective, without negative externalities. For example, subsidies in several sectors may be tied to the use of better processes or to the achievement of environmental goals, such as the use of renewable or low-carbon fuels in energy and land set aside (with environmental safeguard). While previous OECD work has examined some of the external environmental benefits of different agricultural practices, future work will consider the principles and criteria for determining the appropriate remuneration for these environmental benefits, and assess some of the consequences of reform options (Box 2.2).

Box 2.2. OECD work on measuring the environmental effects of agricultural policy reform

In addition to the ongoing collection of data on support to agricultural consumers and producers, and to the continuing refinement and development of these statistics, the OECD is contributing to the analysis of the effectiveness of agricultural support and its effects. For example, the *Policy Evaluation Matrix* (PEM), which builds on earlier work on measuring the *transfer efficiency* (the ratio of income benefits received by farmers to costs of support provided by policies) of agricultural policies, provides a partial-equilibrium framework for assessing the effects of a number of policy changes. This draws on the *Producer Support Estimate Database*, which was revised in 1998 to reflect changes in policy measures in OECD countries and provides a classification of measures of support according to a variety of criteria. The work is already generating preliminary results for selected OECD countries on the relative quantitative effects of agricultural support on production, farm incomes and trade.

Work is also underway to better understand the effects of agricultural policies on farm practices, the environment and employment. This includes measuring trends in the environmental performance of agriculture through *agri-environmental indicators*; and quantifying the possible environmental effects of future agricultural trends. This will require integrating the OECD *AGLINK* model for production and trade by commodities with agri-environmental indicators and the production impact from the PEM. This work will provide quantitative information of the impact of agricultural subsidy reform on key environmental variables, such as greenhouse gases emissions.

58. The importance of subsidy reform, which is necessary but not always sufficient for the improvement of environmental outcomes, is not limited to OECD countries. Over the next twenty years, two thirds of the increases in economic growth and energy demand will come from non-member countries, whose energy policies are of crucial importance for the achievement of sustainable development globally and, in particular, for the prevention of climate change (see Chapter 3). In many developing countries subsidised prices do not reflect the full costs of energy. The IEA is therefore undertaking the project "Energy Prices and Subsidies in non-member Countries". Co-operating closely with other international organisations, such as The World Bank, the project, which relies also on extensive in-house co-operation, aims to highlight and, as far as possible, to quantify:

- The magnitude of economic efficiency losses due to energy subsidies.

22. ECMT (1998), *Efficient Transport for Europe: Policies for Internalisation of External Costs*, Paris. According to these estimates, accidents are the largest category of externality, followed by environmental costs. While these estimates excludes the valuation of externalities due to road congestion costs, according to some studies these may be even larger than those due to accidents and environmental costs.

- The impact of energy subsidies on oil import demand and oil export availability.
- The impact of energy subsidies on greenhouse gas emissions.
- The cost of energy subsidies to governments budgets.
- The potential of the removal of energy subsidies for emission trading.

The study will cover China, Russia, India, South Africa, Brazil, Iran, Indonesia, Kazakhstan and Venezuela, which together cover over 70 per cent of the greenhouse gas emissions of non-OECD countries.

59. In a number of cases, OECD countries are submitting their support programmes to comprehensive review, both nationally and in various international *fora*, in order to reduce ineffective or harmful subsidies and to make them more effective and efficient. The OECD contributes to this effort through the gathering of data on subsidy levels for a number of sectors, and through analysis of their effects.[23] Data collection efforts have improved substantially over the years for some sectors, leading to robust and internationally comparable indicators (e.g. agricultural and coal producer and consumer subsidy estimates). However, for other sectors the development of comparable statistics has only begun (e.g. fisheries), and in others yet conceptual agreement on measures of subsidisation is far from finalised (e.g. transport).

Environmental taxes

60. Environmental taxes — i.e. compulsory, unrequited payments on tax-bases deemed to be of particular environmental relevance[24] — are an important instrument available to governments for internalising the costs of externalities. These taxes increase the costs of undertaking a given activity in line with its external effects, or social costs, and provide incentives that discourage undesirable activities. In addition, according to their specific context, governments may choose to use the revenues generated to reduce other, more distortionary, taxes — such as indirect taxation and taxes on labour. Based on comparable data for 18 OECD countries, revenues from environmentally-related taxes accounted for 1.75 per cent of GDP in 1995, with large variation across countries (from a low of 1 per cent in the United States to a high of 4.5 per cent in Denmark). As shown in Figure 2.1, around 90 per cent of the revenues generated from these taxes come from non-industrial sources. While several OECD countries have established "Green Tax Commissions" in the 1990s — and many OECD studies in the past have considered the design and implementation of environmental taxes[25] — better comparative data and information are still needed. Current OECD work is directed to complete the database on environmentally-related taxes, to assess their environmental effectiveness, to review their practical implementation issues, in particular their implications for competitiveness and income distribution and their potential for reducing greenhouse gas emissions.

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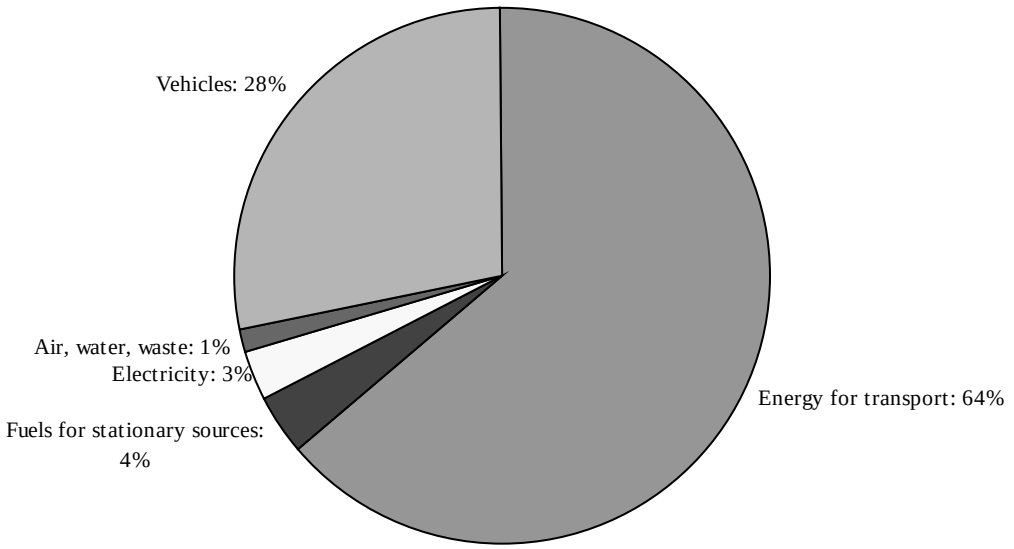
23. Recent trends in subsidy reform and reduction, and an analysis of their effects on the environment, are summarised in OECD (1998), *Improving the Environment Through Reducing Subsidies*, Paris.

24. This include energy products, transport equipment and services, emissions to air and water, ozone depleting substances, certain non-point sources of water pollution, waste management and noise. A preliminary analysis of these taxes is presented in OECD (1999), *Consumption Tax Trends*, Paris.

25. Most recently, OECD (1996), *Implementation Strategies for Environmental Taxes*, Paris and OECD (1997), *Environmental Taxes and Green Tax Reform*, Paris.

61. Given the challenge of introducing new environmental taxes in a context of pressures to reduce the overall tax burden, environmental tax reforms are often applied in a context of revenue neutrality, with additional environmental taxes compensated by the reduction of other taxes. Tax shifts and the introduction of tax reform as a 'package' constitute a key way to ease implementation. Some OECD countries are engaged in policies to "green" the tax system, increasing environmentally based taxes while reducing income taxes and social security premiums. Several OECD reports have looked at the social, economic and environmental consequences of green taxes, concluding that tax and environmental policies are mutually supportive.[26]

Figure 2.1. Shares in total revenues from environmental taxes



Source: OECD (1999), *Consumption Tax Trends*, Paris.

Creating markets

62. The creation of markets is an important option to internalise external effects. Examples of market creation include the introduction of tradable permits for the release of certain pollutants; the auctioning of water rights; the development of eco-labels and of other certification schemes which create separate markets for environmentally-less-damaging goods and services; and the introduction of deposit refund schemes.

63. In a number of circumstances (see below), tradable permits encourage the attainment of environmental goals at lower costs and higher efficiency than regulatory approaches. To this end, "emission reduction credits" or "allowances" are allocated among polluters or users of natural resources, and then traded on a market. Agents facing high abatement costs would buy permits rather than installing more costly technology, and agents with low abatement costs would sell permits, with the market clearing at a price equating marginal abatement costs across agents. Emission reduction "credits" are generally defined as the difference between "actual" emission levels and those prevailing under a baseline scenario,

26. OECD (1993), *Taxation and the Environment: Complementary Policies*, Paris.

with these credits being subsequently used as pollution permits, sold to other agents whose emissions are higher than in the baseline scenario, or saved for the future ("banking"). Some estimates of the benefits of trading in the context of climate change policies are given in Chapter 3.

64. A recent OECD workshop, reviewing country experiences with domestic tradable permits for environmental management, showed that most experiences to date apply to air-related pollution (sulphur oxides, chlorofluorocarbons — CFCs —, lead in gasoline). The SO_2 trading scheme in the United States, launched in 1990 to address the acidification problem, is by far the most comprehensive and large scale system set up so far. According to evaluations, this scheme — which is characterised by unlimited trading, a sophisticated monitoring system and severe penalties for non-compliance — allowed significant costs savings compared to regulatory instruments (between one-third and one-fourth) and strong over-compliance (emissions were 30 to 40 per cent lower than total allowances). Other, more limited experiences exist in the field of water management (pollution), land (development rights) and natural resources (water quantities and fisheries). However, to work effectively, tradable permits require careful design and implementation, and consideration of factors like transaction costs, the initial allocation of permits, the definition of baseline, the location of emissions and impacts, and their linkages with other policy instruments such as regulation and taxes (*see* Chapter 3). Further, tradable permits may not be suitable instruments when environmental impacts are site specific. The OECD is presently preparing guidelines on the use of domestic tradable permit schemes.

65. Eco-labelling and certification schemes have also been used to allow consumers to choose between products with different production or disposal processes. In several countries, labels and standards are used to indicate the energy efficiency of electrical equipment, the nature of agricultural processes (e.g. levels of organic farming, free-range animal production), and the sustainability of harvesting wood. The success of these schemes is often dependent on consumers' trust in these schemes and awareness of the differences between products. Future OECD work will consider options for creating markets for biodiversity products and services, particularly in the form of eco-tourism opportunities.

Charges and fees

66. Charges and fees are payments for the costs of providing collective services. For example, when governments incur a cost in the collection and treatment of sewage waste, they may levy a charge on the users of these services to cover the costs of provisions. The levying of charges is a direct way of internalising the costs of providing these services, as they ensure that those who benefit from them bear their costs. OECD work on water services and biodiversity has analysed the working of fee charging systems. More extensive information on these instruments will be provided by the ongoing OECD survey on the use of economic instruments for pollution control and natural resources management.

Improving institutions and regulatory frameworks

67. Despite an increasing diffusion of economic instruments, direct regulations still play a large role in environmental policies. While in theory a fully informed regulatory agency could design cost effective measures, in practice the necessary information is rarely available. As a result, in the presence of differences in abatement costs among polluters, they will generally be less efficient than economic instruments. In addition, they may stifle technological improvements by locking in inferior technologies (*see* Chapter 5). As a result of these features, governments are actively strengthening the role of market forces through reforms of their regulatory and institutional structures, a process that the OECD monitors through a number of country reviews. Often, changes in regulatory frameworks have been prompted by the privatisation or liberalisation of water, transport, energy and telecommunications and by the breaking-

up of large monopolies, in line with the overall thrust towards more market based solutions in OECD countries. These reforms aim to reduce market distortions, generally increase the efficiency of resource allocation and lower the cost of provision, for example by providing better information on the costs of intermediate products and market access to competing suppliers. The implications for the environment are, however, complex. For example, the ongoing liberalisation of the energy sector can have positive effects on the environment through improved efficiency of existing plants, faster penetration of cleaner technologies (primarily natural gas fired plants) and retirement of the more costly fossil-fired plants. However, by making production processes less wasteful and more efficient, these reforms can also lead to lower prices and increased consumption of electricity, with negative effects on the environment through higher emissions of greenhouse gases, sulphur dioxide and nitrogen oxide. Comparative assessment of country experiences in this field will help decision-makers in designing reforms that maximise the gain in economic efficiency while reducing the potential of damaging effects on the environment.

Effective policy design

The combination of various instruments

68. The choice of the appropriate instrument for achieving environmental objectives should, as far as possible, observe the policy principles outlined in Chapter 1 — notably cost efficiency —and consider a number of factors. These include the nature of the damage and the uncertainty of its effects, the geographical scale of the environmental problem (i.e. local, national or global), the number of sources of pollution, the administrative and enforcement costs of the various instruments, and public acceptance and confidence in each of these instruments. In practice, first best solutions may be constrained. Regulations are applied while taxes and charges are in place and *vice versa.* Moreover the various instruments interact in complex ways, as a function of behavioural responses to each measure and of the importance of different objectives. Finally, each policy instrument has its advantages and disadvantages. Charges and taxes, for example, are generally more transparent and easier to implement and enforce, but may give less certainty in terms of the level of pollution reduction that they can achieve. Emission trading provides more certainty about the size of the emission reductions, but its efficiency gains may not materialise when there is a low number of market participants, when emission sources are small and mobile, and when administrative, monitoring and enforcement costs are high. Finally, specific regulations may be appropriate where pollution is thought to be very harmful, or where the size of the damage varies in different geographical areas. In practice, for a number of environmental threats, combining instruments efficiently, effectively and equitably may be a way to get good results. For example, the introduction of tradable quotas for CFCs in the United States was accompanied by a tax to eliminate windfall profits that otherwise would have occurred. As another example, the Dutch policy on water pollution has combined a tightening of permit regulations, the introduction of charges, and financial incentives for technological improvements. Recent and ongoing work has focused on the development of policy instruments for ensuring the conservation and sustainable use of biodiversity (Box 2.3.); for addressing the environmental, social and economic sustainability of agricultural practices; and for considering the environmental effects of transportation and fuel usage.

Box 2.3. Recent work on the use of different policy instruments for biodiversity conservation and sustainable use

A recent OECD study reviews national experiences with different incentive measures targeted at biodiversity conservation. This work, based on 22 case studies, considers a variety of policy instruments, such as economic incentives, regulations, environmental funds, information provision and capacity building, in a range of ecological, political and cultural contexts. One of its main conclusions is that combinations of various policy instruments are usually necessary to tackle most biodiversity pressures. The need to combine various instruments reflects the complexity of biodiversity and of the pressures that act upon it, and the necessity of realising the public and private values associated with it. The *Handbook* provides a practical tool for the design and implementation of integrated policies aimed at providing incentives for the conservation and sustainable use of biological resources.

Source: OECD (1999), *Handbook on the Implementation of Incentive Measures for the Sustainable Use and Conservation of Biodiversity* (forthcoming).

Ex-ante integration of policies

69. While a number of instruments are available to correct market and policy failures that are damaging for the environment, preventing failures from occurring is obviously preferable to curing them. In most cases, such prevention requires a broad perspective over the policy issues involved. For example, the design and reform of sectoral policies will need to consider not only issues specific to the sector considered but also the wider effects on the economy, social aspects and the environment. It is not always easy to consider all these effects simultaneously, because of insufficient information, uncertainty about the causal links involved, and changes in circumstances that may influence the ultimate effects of policies. However, examples of countries that have achieved a better integration of policies are found in several areas, including natural resource management, agriculture, transport, energy, as well as taxation and government spending — where environmental and social considerations are increasingly shaping their design. This, as underlined in Chapter 1, is a key thrust of the OECD work on sustainable development. For example, significant progress has been made since the first meeting of the OECD Joint Working Party on Agriculture and the Environment in 1993 in analysing the linkages between agriculture and the environment, and quantifying the environmental effects of agricultural activities.

Improving knowledge

70. Even though a lot more can be done in changing present policies on the basis of what we know already, designing better policies also requires better information available to policy makers, in terms of both better quality data and of improved analysis. In the first area, major improvements are needed in the gathering of comparable and reliable data. Current efforts, and limits, in the fields of support measures and environmental taxes were described above. A proposal for standardising the reporting of the environmental effects of support, taxes and resource pricing, and to incorporate this information in OECD *Environmental Performance Reviews*, is currently being developed.

71. But areas where better knowledge and understanding would allow the design of better policies also include the appraisal of external effects; the development of indicators (*see* Chapter 6); the use of modelling techniques (*see* Chapter 3); and qualitative studies to investigate the relevant interdependencies and trade-offs. In each of these areas, the OECD and its affiliates can assist countries. For example, work by the ECMT provides insight on estimates of external costs generated by the different transport modes, and the uncertainties in estimation methods in this field.

International co-operation

72. To a large extent, the reduction or elimination of price distortions, the implementation of economic instruments, and the creation of markets are the responsibility of national policy. However, implementing subsidy reduction or introducing environmental taxes in any given country may have implications for competitiveness — perceived or real — which may affect disproportionately specific firms and sectors.[27] If so, the effects on competitiveness may result in leakage effects, i.e. emissions may be moved from the country applying more stringent policies for the protection of the environment to other countries. While the magnitude of these leakage effects is an empirical issue, in these cases international co-operation can facilitate, and in some cases be a prerequisite, for policy reform.

73. One area where international co-operation may facilitate policy reform is that of tax exemptions to energy and raw material production and use. Special tax regimes not only deprive governments of revenues but also, more importantly, lead to large price differentials, efficiency losses and higher costs of achieving CO_2 emission targets agreed with the Kyoto Protocol. In this context, ongoing work by the OECD and the IEA is looking at the prevalence and magnitude of various support programmes that benefit producers and consumers of three major primary energy sources (coal, oil, and gas). This work aims to assess the trade distorting effects of these programmes and to estimate the effects of reducing these distortions in terms of lower emissions of greenhouse gases. More work is needed to develop policies that avoid international tax competition with respect to energy taxes, particularly on fuels for international transport (Box 2.4); and that integrate subsidy removal in strategies to achieve global environmental objectives.[28] Other areas where international co-operation will facilitate reform include agricultural policy (including *inter alia* improvements in the classification of transfers, and work on the effectiveness of policy measures), transport policies; and the effect of trade measures on resource efficiency and on social and environmental objectives.

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27. In many cases, however, the argument on the "competitiveness" effect of "green" policy reform is a confused one. Reduction in subsidies (with negative effects on some producers) will generally create room for lower taxes (with positive effects for others) and a better overall functioning of the economy. Moreover, exemptions from green taxes granted to some producers in the name of concerns about "competitiveness", will generally lead to higher taxes applied to other producers, and higher distortive effects overall (as distortive effects rise more than proportionally with its rate).

28. As noted in OECD (1998), *Improving the Environment through Reducing Subsidises*, Paris: "Where OECD Member countries have, or develop, common environmental goals or principles — in particular those under global or regional environmental conventions — the removal of support measures which encourage the environmental damage can contribute towards the attainment of these goals and the polluter pays principle. As such, support removal can be seen as one of a number of policy tools for realising environmental objectives".

Box 2.4. Examples of price distortions requiring international co-operation: Tax exemptions for energy use in international transport.

Energy used in international transport, e.g. by air and sea, is hardly taxed. From an environmental perspective this has contributed to over-use of energy intensive international transport, such as airfreight of salmon from Scandinavia to Asia and North America and of flowers from Africa to Europe. Energy tax exemptions are also granted to most high-sea fisheries and to coastal fisheries in some countries. In a number of cases, these exemptions have effectively reduced the effectiveness of lower subsidies to fisheries. These exemptions are the source of significant inefficiencies, since they will result in large differences in marginal costs of energy savings and fail to give the right price signals in areas where they are most needed. Overall, sea and air transport accounts for 2 and 3 per cent, respectively, of total CO_2 emissions from fossil fuel. OECD analyses of the economic and institutional aspects of the tax regimes of some international transport modes has included special issues of *Carbon/Energy Taxation* on "Marine bunker fuel charges" and on "Charges on Aviation Fuels".

Future work

74. The work described above builds heavily on activities agreed upon by sectoral committees and working parties. Further developments could take place, for example, along the lines the *Shared Goals for Action* agreed upon by Member countries during the recent Environment Ministerial Meeting (Paris, 2-3 April 1998). Identified priorities for the future include:

- Promote effective policies and regulatory structures to protect the natural environment and human health.[29] This includes the removal of government and market distortions that adversely affect the environment, the use of economic instruments and the creation, within an appropriate regulatory framework, of markets to promote environmental objectives. More efforts are especially needed in those sectors (particularly fisheries, some forms of energy, transport and industry) where lack of comparable data hampers the analysis of the social and environmental effects of support policies and taxes.

- Promote integrated approaches that encourage the coherence of economic, environmental and social policies. This will require ensuring that prices of natural resources reflect their true environmental and social values, by phasing-out environmentally damaging subsidies and tax breaks, and by the 'greening' of the tax system.. Further work on the internalisation of externalities, and the development of integrated approaches to policy-making is especially needed, and will be pursued through country-reviews and other studies.

- Strengthen international co-operation in meeting global and regional environmental commitments. As stressed in previous OECD work, the removal of support measures that encourage environmental damage can contribute towards the attainment of the goals set under global and regional environmental conventions. While several international conventions indicate some of the priority areas for co-operation, further work will be necessary to realise these shared objectives.

- Support participation, transparency, and accountability in overall economic and sectoral policy-making at all levels. Lack of internationally comparable data on subsidies and taxes seriously hampers efforts to analyse their effects and to design better policies. While work is ongoing to collect comparable data in a number of sectors, this should be extended to allow

29. For an analysis and recommendations of the reform of regulatory structures in OECD countries, see OECD (1997), *The OECD Report on Regulatory Reform*, Paris.

better monitoring of tax competition between countries, and to analyse the costs of distortive pricing policies.

CHAPTER 3. CLIMATE CHANGE

Introduction

75. There is increasing scientific consensus that global warming is under way, linked at least in part to human economic activity. The considerable attention paid to this problem over the past ten years resulted in part from the 1992 UN Framework Convention on Climate Change (UNFCCC). Despite this attention, however, current indications are that emissions of greenhouse gases (GHGs) are rising faster than expected, and that the initial UNFCCC aim for emissions for the year 2000 will be substantially exceeded in almost all OECD countries. Moreover, the date by which stabilisation of world emissions (let alone the reductions necessary to stabilise atmospheric GHG concentrations) can be expected is receding into the future. The Kyoto Protocol, agreed in 1997 but yet to enter into force, adopted binding targets involving cuts in emissions, relative to the 1990 level, for the period 2008-2012.[30]

76. Finding effective policies to respond to climate change is one of the central challenges to sustainable development. Climate change provides a concrete example of how economic development may need to be modified to take account of ceilings on GHG emissions, with implications for economic, energy and environmental policies in Member countries. Responding to climate change also poses a challenge to international co-operation as its global nature — its damage does not depend on the site of emissions — requires broad participation. As with other issues in the sustainable development agenda, equity considerations should affect the design of climate change policies. Its impacts and costs are likely to be unevenly distributed among major regions of the world and, domestically, among sectors of the economy. Countries that have caused the bulk of emissions are not those most likely to suffer its worst impacts. Assessments from the International Panel on Climate Change (IPCC) indicate that the most severe harmful impacts will occur in the Southern Hemisphere, possibly aggravating current economic disparities between the North and the South (IPCC, 1996a). The long time frames of climate change, and the uncertainty of its possible future effects, confronts policy makers with particular dilemma as the benefit of today's actions will accrue to future generations while inaction may to lead to a variety of adverse, and possibly irreversible, effects. Climate change impacts are also inter-linked with other global environmental problems, including loss of biodiversity, deforestation, stratospheric ozone loss, desertification and freshwater degradation. Responding to this challenge requires better co-ordination of policies and decisions, both domestically and internationally[31], and better communication and exchange between policy makers and scientists.

77. Concern about global warming has been reflected in the OECD work programme for almost a decade — involving a number of OECD directorates and affiliates, including the International Energy

30. Emissions targets were set for most OECD countries and a number of economies in transition. This group of countries is frequently referred to as "Annex I countries."

31. Many of the instruments discussed in Chapter 2 in a broader context are highly relevant for domestic policies for curbing climate change. Thus, it is necessary to integrate climate policies into this broader framework.

Agency — and activities in this area have provided a substantial body of evidence. The OECD and the IEA have provided a number of inputs to the fourth meeting of the Conference of the Parties to the UNFCCC (COP4) in Buenos Aires in 1998. Thus, the focus of this chapter is on outputs subsequent to that date, and in particular on the papers presented to Working Party No. 1 of the Economic Policy Committee and to the Environmental Policy Committee in March 1999.[32]

78. This chapter first discusses the costs of meeting the Kyoto targets, the properties of international emissions trading in reducing the overall costs of abatement, and some of the domestic policies needed. The second section considers some of the work that remains to be done in clarifying important aspects of the Protocol, while the third section examines some of the arguments advanced in the ongoing discussions on whether to limit international emissions trading. The fourth section discusses the extension of binding GHG emissions limits to developing countries, and their incentives to accept such constraints, and the fifth raises some issues in evaluating the cost of climate change and the need to adapt to changes that seem likely to occur. The last two sections present some concluding remarks and the main lines of future work.

Meeting the Kyoto emissions targets

79. The Kyoto Protocol calls for GHG emissions in the period 2008-2012 to be reduced, relative to their 1990 level, by some 5 per cent for Annex 1 countries as a whole. The reduction for OECD countries overall is around 7 per cent, but with variations among countries — particularly within the European Union following its (separate) burden sharing agreement (Table 3.1.). These targets are tighter than it seems because of the growth of emissions that would normally occur in the meantime: relative to this "Business as Usual" (BaU) scenario, the targets imply reductions that may amount to some 30 per cent. Indeed, by 1995 emissions were higher than in 1990 in the majority of OECD countries. Where emissions have fallen, it is usually due to largely unrelated events or policies of a one-off nature: in transition countries and (eastern) Germany, to collapses in output, and in the United Kingdom, to liberalisation of the electricity supply industry and reform of coal subsidies encouraging a switch to gas.

32. Respectively, "Taking action against climate change: the Kyoto Protocol", ECO/CPE/WP1(99)6, and "OECD and climate change: domestic policies to limit greenhouse gas emissions," ENV/EPOC(99)6. Revised versions of these papers are envisaged as inputs to COP5.

Table 3.1. Overview of national emission trends, Kyoto objectives and EU burden-sharing

	1990 GHG emissions *(million tonnes CO_2 equivalent)*	Percentage change 1990-1995	Kyoto target for 2008-2012 (as a % of 1990)
Non-EU OECD			
Australia	406	6	8
Canada	558	10	-6
Czech Republic	188	-24	-8
Hungary [1]	102	-24	-6
Iceland	3	5	10
Japan	1190	8	-6
New Zealand	76	0	0
Norway	49	6	1
Poland [1]	564	-22	-6
Switzerland	54	-2	-8
United States	5713	5	-7
European Union			–8.0
Burden-sharing targets:			
Austria	78	1	-13.0
Belgium	139	6	-7.5
Denmark	72	10	-21.0
Finland	65	3	0.0
France	498	0	0.0
Germany	1204	-12	-21.0
Greece	99	6	25.0
Ireland	57	4	13.0
Italy	532	2	-6.5
Luxembourg	13	-24	-28.0
Netherlands	207	8	-6.0
Portugal	68	6	27.0
Spain	301	2	15.0
Sweden	65	3	4.0
United Kingdom	715	-9	-12.5

1. The data for Hungary and Poland refer to, respectively, to 1985-87 and 1988 (the baseline of the Kyoto targets for these countries).

Source: UNFCCC official national data.

80. Few of the domestic policies necessary to contribute to reaching the emission targets are in place today. Such policies, to be cost-effective, will have to include market- and subsidy-reforms, particularly in the agriculture, transport and energy sectors (see Chapter 2 for estimates of subsidy levels in some of these sectors). Subsidies to energy industries, especially coal, have declined considerably over the past decade, but remain substantial; OECD case studies indicate that abolition of selected energy subsidies could reduce CO_2 emissions from the energy sector by between 1 and 8 per cent.[33]

81. As underlined in Chapter 2, making use of economic instruments will also help cost effectiveness. Some steps are being taken towards the introduction of a carbon tax in a number of

33. OECD (1997), *Reforming Energy and Transport Subsidies: Energy and Environmental Implications*, Paris.

countries.[34] As an alternative to a CO_2 tax, a system of domestic tradable permits is in many ways equivalent, and has similar efficiency properties.[35] It has some advantages compared with a tax: it may be better suited to meeting quantitative targets, when there is uncertainty about the level of CO_2 tax that would be required; and it could be linked to international trade in emissions allowances as foreseen in the Kyoto Protocol. No such system is currently in use, though the sulphur dioxide trading system in the United States has encouraged a lot of interest (*see* Chapter 2).[36] However, tradable permits also have a number of drawbacks as compared with taxes — especially in small countries with few participants to trading and without linkage to international emissions trade — and it may be possible to apply both instruments simultaneously.

82. One of the challenges for both cost-efficient policies such as carbon taxes and emission trading is how to deal with existing heavy emitters. These emitters often ask for some exemption from a CO_2 tax, or for sufficient amount of free allocations of emission allowances ("grandfathering"), to avoid facing a sudden large increase in costs. Industry arguments about adverse effects on competitiveness have led countries to grant exemptions to some emitters, even though these exemptions tend to seriously weaken the link between the tax paid and carbon emitted.[37] While preferential treatment may be warranted in an initial phase, partly to help overcome political resistance, these exemptions should be phased out rapidly to avoid reducing the overall incentive to abate. It should also be noted that "grandfathering" and tax exemptions, often lobbied for on "competitiveness" grounds, reduce government revenues and thereby potential reductions in other taxes which may have even more distortionary effects on economic performance.

83. A number of other measures have been considered in some Member countries to supplement market forces or to deal with market imperfections. Such measures include regulatory policies for materials, buildings and products, green government procurement approaches, research, information and public awareness programmes. Complementing economic instruments, these measures can accelerate diffusion and development of technologies, encourage consumers to satisfy "needs" with good and services with a lower carbon content, and change consumption patterns. Voluntary agreements to reduce emissions — between governments on one side and industrial sectors or enterprises on the other — is a response to the resistance to market based instrument. Voluntary agreements have important drawbacks, however. Some types of voluntary agreements establish relative performance targets, which provide firm with a degree of certainty about feasibility and cost, yet the overall degree of abatement is hard to predict. Marginal abatement costs may also vary among firms and industries, losing opportunities for adjustments

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34. Germany, Italy, Austria, Norway, Sweden, Finland, Denmark and the Netherlands have some form of energy/carbon tax, though the link with the carbon content of energy is usually weak. France, New Zealand and the United Kingdom are planning or considering the introduction of such a tax.

35. In particular, that marginal abatement costs are equalised across the economy, implying that reductions in emissions are undertaken at least cost. A discussion of this and other aspects of emission trading and carbon taxes can be found in OECD (1998), *Economic Outlook*, No. 63, June, pp. 200-203, Paris.

36. A number of countries are exploring how to set up a CO_2 trading system including by launching pilot trading schemes (see www.oecd.org/env/cc).

37. In Germany, the burden of the energy tax is capped — if a firm's payments of the energy tax exceed savings from lower labour taxes (reduced as part of an attempt to reap a "double dividend") by more than 20 per cent, the excess is to be refunded. In Finland, a carbon tax had been introduced in the early 1990s. The electricity supply industry, facing competition from abroad, argued for tariff protection to compensate for a carbon tax on its own fossil fuel inputs. When such a tariff turned out to be forbidden by EU rules, the Finnish government exempted the electricity sector from carbon tax, introducing instead an electricity tax, which targets carbon emissions very poorly. The German energy tax was also shaped by concerns about competition from abroad in the absence of an EU-wide policy on carbon taxes.

that would reduce overall costs. This is also a concern about regulatory approaches; where they are required, cost effective formulation is important.

84. Much OECD research has gone into estimating the economic costs of implementing the Kyoto targets. The Secretariat's GREEN model yields results that are broadly in line with other models. GREEN simulations suggest that, if countries succeeded in meeting the Kyoto targets with only cost-efficient domestic measures, i.e. without international emission trading, this would imply losses of annual real income in the main OECD regions varying from 0.2 per cent to 0.8 per cent, about 0.5 per cent overall (Table 3.2). Apart from the assumption that policies can be fully effective in achieving equalisation of marginal abatement costs, these figures also assume no costs due to reallocation of labour. Both assumptions may imply some under-estimates of the cost of abatement policies.[38] On the other hand, GREEN currently deals only with CO_2 from energy, and does not consider either CO_2 from forestry or other greenhouse gases. This may cause costs to be overstated, since reductions in emissions of methane and nitrous oxide, or increases in CO_2 stored by forestry, could probably contribute substantially to the Kyoto reduction commitments at relatively low cost, at least in Europe.[39] Moreover, policy reforms such as cuts in energy subsidies could further reduce costs of reaching the Kyoto targets.

Table 3.2 Costs of Kyoto in OECD regions, 2010

	Change in GDP, per cent		Change in real income[1)], per cent		Implied carbon price, 1995 $ per tonne of carbon	
	Without trade	With trade[2)]	Without trade	With trade[2)]	Without trade	With trade[2)]
United States	-0.27	-0.16	-0.33	-0.40	231	92
Japan	-0.03	-0.02	-0.24	-0.19	189	92
European Union	-0.17	-0.08	-0.77	-0.33	181	92
Other OECD	-0.29	-0.18	-0.68	-0.64	228	92
OECD total	-0.18	-0.10	-0.48	-0.34	..	..

1. Changes in real income differ from changes in GDP because of terms-of-trade changes. These arise mainly from *a)* changes in imported energy prices, and *b)* changes in domestic prices needed to maintain balance-of-payments equilibrium (*e.g.* to improve the balance of trade to finance emission allowance purchases). Important influences on these are, on *a)*, the initial structure of trade, in particular the degree of dependence on imported energy and, on *b)*, the price elasticities of demand for imports and exports.
2. Unrestricted trade among Annex I countries, i.e. including "hot air" trade.

85. International trading of emission allowances allows the real income losses in OECD countries to be significantly reduced, according to GREEN simulations to about one third of one per cent on average. In part, these gains are at the expense of higher overall emissions — due to "hot air" in Russia and the Ukraine, discussed below. Without "hot air" gains, trading reduces the average real income loss in OECD countries from about 0.5 per cent to about 0.4 per cent. The implied carbon tax (or price of emission allowances) would be around $90 per tonne of carbon ($27 per tonne of CO_2).[40] Trading generally allows

38. Work is currently under way to introduce a degree of labour market rigidity into GREEN.

39. Gielen D. and T. Kram, "The role of non-CO_2 Greenhouse Gas in meeting Kyoto Targets," in OECD (1998), *Economic Modelling of Climate Change. OECD Workshop Report*, 17-18 September, Paris.

40. A survey of results from a number of models suggests that results from GREEN are relatively central. See ECO/CPE/WP1(99)6, Table 3. Prices are expressed in 1995 dollars. For comparison, the 1995 international oil price was equivalent to about $150 per tonne of carbon. If countries were to meet their

OECD countries to meet their emission targets with higher levels of GDP than in a scenario without trading, but some of these gains are offset by the need to purchase emission allowances from abroad.

86. The Kyoto targets apply to emissions a decade from now. Nevertheless, it has been argued that strong action to force emissions reduction should be taken early in order to stimulate technical progress and innovation, leading to reduced abatement costs later on. On the other hand, it could be beneficial to wait longer until cheaper abatement technology is available in the future.

87. GREEN, in which progress in energy technology is exogenous, cannot assess these arguments. However, simulations suggest that a gradual phasing in of action to meet the Kyoto targets, starting as early as possible, incurs lower costs than waiting and then introducing measures more abruptly. This is mainly because it minimises the extent to which rapidly changing relative prices force premature scrapping of capital equipment. On both the technology and capital scrapping argument, early clarification of the conditions for implementing the Kyoto Protocol would be important to accelerate progress.[41] While changes in relative prices will stimulate the search for more climate-friendly technologies, market signals may not be always sufficient, and there may be also a role for more direct government interventions to enhance the innovation and diffusion of clean technologies. A number of instruments to achieve this are discussed in Chapter 5.

Modalities for implementing Kyoto

88. Negotiations on the modalities for implementing the Convention and the Kyoto Protocol take place in the Conference of the Parties (COP) to the UNFCCC and its subsidiary bodies.[42] The Kyoto Protocol, negotiated at the third meeting of the COP ("COP3") embodies the emissions commitments and an outline — but not the details — of how these will be defined, monitored and enforced. COP4, in Buenos Aires in November 1998, made only little progress towards defining these details, but set the aim of finalising them at COP6 in 2000[43]. Among the modalities to be settled are those related to the compliance system for the Protocol which may be considered in three parts: *i*) monitoring and reporting; *ii)* review and verification; *iii)* non-compliance responses and enforcement.[44]

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emissions targets individually, the required carbon taxes are estimated to range from $100 to $300 across OECD countries.

41. GREEN does not embody any forward-looking behaviour. If agents anticipated future relative price changes — e.g. the introduction of a carbon tax — the advantages of targeting early emission reduction would probably be reduced. Early clarification of the Protocol would help formation of such expectations.

42. The Secretariats of the OECD (principally from the Environment Directorate) and IEA support this process, particularly by providing the secretariat to the Annex I Expert Group. This *ad hoc* group undertakes and oversees technical analysis to support decision making on climate-change.

43 The Protocol will not enter into force until ratified by countries accounting for at least 55 per cent of Annex I emissions, and by at least 55 countries. Eight countries have so far ratified; no Annex I countries have ratified.

44. See Corfee Morlot J. (1998), *Monitoring, Reporting and Review of National Performance under the Kyoto Protocol*, OECD Information Paper, October, Paris and "Ensuring Compliance under a Global Climate Agreement", ENV/EPOC(98)5/Rev1, for more details. Both papers were prepared for the Annex I Expert Group and the COP4 meetings.

89. *Monitoring and reporting* aims to gather information to enable assessment of compliance with the emissions targets. It is largely the responsibility of parties to the Climate Convention themselves, who are required to produce inventories of their own emissions (and removals through sinks, such as carbon being stored by forests) of greenhouse gases. Agreed guidelines have been established but they are not yet sufficiently precise. Work is needed to improve accuracy, to ensure comparability between countries and to deal with uncertainties in measurement, particularly for non-CO_2 gases and for sinks.

90. *Review and verification* would use the information reported to ascertain compliance, and includes checks on the self-reporting procedures. It currently consists of an "in-depth" review process, with a visit to the reporting country by a team of experts, which identify errors and irregularities (including information gaps), but they are not charged with verifying inventory data. Yet, such verification, within a stronger review procedure, may be essential for an effective non-compliance procedure under the Protocol.

91. *Non-compliance procedures* are as yet unspecified. Although domestic emissions limitation schemes could provide for financial penalties for non-compliance, a solution that fits well with the use of economic instruments in the context of "getting prices right", there is little precedent for an international treaty to provide for financial penalties.[45] In some cases, being publicly declared in non-compliance may act as a significant penalty, and revoking the right to participate in international emission trading may be a serious sanction. More explicit enforcement "sticks" are not readily available, although measures such as trade or economic sanctions may be explored. It has been suggested that some "carrots" should also be considered, including the possibility of making funding from international financial institutions or the financial mechanism of the Convention conditional on compliance. However, these would only affect the transition countries within the Annex I group.

92. While non-compliance measures may be necessary in any case, their importance is highlighted by discussions of the international flexibility mechanisms of the Kyoto Protocol, in particular emissions trading and joint implementation, whose benefits are based on the assumption of strict enforcement of national targets. In the case of the Clean Development Mechanism, no national target is involved but emission cuts in non-Annex I countries will be defined with respect to a project-specific baseline that will have to be agreed.[46] The institutional aspects of international emissions trading are likely to be complex. Important elements of the system include a framework tracking holdings and transfers of emissions allowances; how to cope with trade between governments and between legal entities, some of which may or not be emitters themselves; and issues such as who is liable when trading itself results in non-compliance.[47]

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45. OECD (1998), *op. cit*. The EU "Stability and Growth Pact" is perhaps the only example, in a rather different domain.

46. The Kyoto Protocol defines a Clean Development Mechanism (CDM) under which Annex I countries can obtain credits that can count towards their emission reduction target (*see* Box 7.4). The idea of CDM is that the Annex I country may sponsor an investment project — for example the conversion of an electricity generating station from high to low carbon content fuel — in a non-Annex I country. The resulting emissions reductions would then count as if the sponsoring country had reduced its own emissions.

47. See Mullins, F. (1998), *International Emission Trading Under the Kyoto Protocol*, OECD Information Paper, October, Paris for more detail on options under consideration. Current work in the Annex I Expert Group is building on this paper.

Emissions trading: should it be restricted?

93. Curbing emissions through market based instruments such as emissions trading will significantly reduce the economic costs of complying with the Kyoto targets. However, uncertainty about compliance enforcement has been suggested by some parties as a reason to restrict emissions trading. Other arguments for such restrictions include: *i*) the "supplementarity" provisions of the Protocol; *ii*) the need for domestic action to stimulate technical and social innovations; *iii)* "hot air"; and *iv)* measurement errors.[48] This section considers each issue in turn.

94. In general, however, it should be noted at the outset that buying permits is not a way for individual countries to avoid bearing the cost of action. Although some agreed emission cuts will not occur in buyer countries, those cuts will nevertheless be made somewhere and the buyer countries will pay for them. Moreover, by reducing the overall costs of cutting emissions, trading may allow more ambitious emission targets.

95. The need to buy emissions allowances and the resulting higher cost of related goods and services should cause people and firms to economise on their use of GHG-producing products and services,[49] thereby triggering some reduction in domestic emissions in buyer countries too. This may go some way towards meeting the "*supplementarity*" provisions of the Kyoto Protocol, which, however, have not yet been defined.[50] While it is argued that restrictions on trade and the resulting more costly domestic action in buyer countries could further stimulate *technical and social innovation* in those countries, this would correspondingly reduce it in other countries, and the net result is not clear cut. Domestic ancillary benefits of reduced emissions could be enhanced by restrictions on buying emissions allowances, but again this would be at the cost of reduced ancillary benefits in seller countries. In any case these benefits could be achieved by separate action.

96. Another concern arises from what has been described as "*hot air*". This refers to the likelihood that emissions in some countries, where the level of economic activity has fallen significantly since 1990, will be below the target level even if they take no action at all. These countries would thus be in a position to sell emission allowances that they would not otherwise use — "hot air." Hence, trade would increase overall emissions, though not above the agreed aggregate Kyoto targets. Restricting such trade, however, could be considered a retrospective renegotiating of these targets. In any case, the "banking" provisions of the Protocol allow emissions not "used" in one period to be carried forward for use in subsequent periods, though in practice future negotiations on emissions allowances might be affected by such banking.

97. *Measurement errors* have also been suggested by some to justify limits to trade, to ensure that only "real" emissions reductions are traded. However, measurement error is really a problem for

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48. The issue of potential use of market power in the market for emission permits is discussed in ECO/CPE/WP1(99)6.

49. Provided the costs of buying emission allowances are passed on. This would be automatic if individual emitting enterprises were responsible for their own emissions. Otherwise this depends on governments passing the costs of their purchases of allowances on to emitters.

50. The Kyoto Protocol includes language to the effect that allowances obtained through trading, joint implementation and the Clean Development Mechanism has to be supplemental to domestic action. Some interpret it to mean that purchases should not exceed half the required emission reductions. Even this would be ambiguous since it could be argued that this should mean reductions compared with the BaU, which cannot be observed, but which are certainly much greater than the nominal reductions in the Protocol.

compliance assessment rather than for trading. This is because, for any given estimate of emission levels, trading does not increase actual emissions, only redistributes them. Nonetheless there may be concern that the revenue to be earned from selling allowances induces countries to understate their actual emissions.

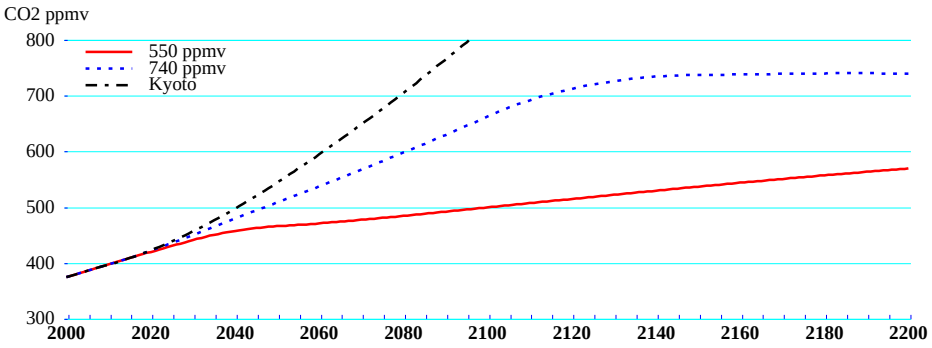
98. A case is also made by some for the use of trade restrictions in the context of *compliance enforcement*. Parties to the Protocol who do not respect the emissions limits would not be allowed to sell allowances, though there is no obvious reason to prevent them buying. It is also argued in favour of preventing countries from trading if they do not meet requirements in respect of reporting emissions trends and other technical requirements of the Protocol. However, the threat of withholding the right to trade allowances may be a very weak mechanism for enforcing emissions compliance. Unless much stronger sanctions are agreed upon, the Protocol risks becoming ineffective.

After 2012

99. The attainment of the Kyoto targets will only be the beginning of what needs to be an effort sustained over many decades if atmospheric concentrations of greenhouse gases are to be stabilised. Without market based solutions over the longer term, implementation of the necessary measures seems unlikely. GREEN simulations estimate that the cost, relative to the BaU, of maintaining emissions by Annex I countries constant at the levels embodied in the Kyoto Protocol will reach around 1½ per cent of annual GDP by 2050. However, the impact on atmospheric GHG concentrations would also be small: at best, this scenario would delay by one decade the time when the 550 ppmv[51] level is reached, and concentration levels would continue to rise steadily (Figure 3.1). In fact, there is nothing that Annex I countries can do on their own to stabilise concentration levels: even if they reduced their emissions to zero, expected growth in the rest of the world would be too high. Thus, the participation of non-Annex I countries is essential.

100. Three possible scenarios for global emissions and atmospheric concentration are shown in Figure 3.1. Each of these scenarios assumes significant participation by non-Annex I countries.

Figure 3.1. Alternative concentration paths



Note: ppmv = parts per million by volume.
These concentration paths are derived from assumed emissions paths using the model of Wigley (1993) with coefficients from Ha-Duong et al.(1997). For more detail, see ECO/CPE/WP1(99)6/ANN3.

51. Carbon dioxide, parts per million by volume. It is estimated that the level of atmospheric concentration increased from around 280 ppmv in pre-industrial times to some 360 ppmv today. A level of 550 ppmv thus represents an approximate doubling of the pre-industrial concentration and has often been considered as an implicit target for the end of the 21st century. The UNFCCC does not specify a target value.

101. What incentives face non-Annex I countries to accept quantitative emissions targets? Concern about climate change and its impact should be a primary motive, but — depending on the level of development — may not be a very high priority for many countries.[52] Secondly, there are ancillary benefits to reducing GHG emissions — reduced local air pollution, for example; these may be important, but are difficult to quantify. Thirdly, by signing up to emissions targets with tradable allowances, countries may find it beneficial to reduce their emissions and sell surplus allowances to other countries (the Clean Development Mechanism may be the means by which developing countries come to recognise these gains). A fourth possibility is that the richer countries may make side-payments to induce developing countries to contribute to avoiding climate change, when the other incentives are insufficient.[53]

102. The costs for individual countries of meeting a concentration target, as well as the gains from trade and the size of possible required side-payments, depend importantly on how emissions allowances are distributed among countries. Precisely because of its influence on costs, this is a contentious issue. To induce participation of countries ranging from very rich to very poor, some notion of equity will need to be satisfied. One stylised rule for allocation of emissions allowances is equal per capita emissions, corresponding to the idea that property rights in climate (change) should be held equally[54]. Imposing such an allocation in the short run would, however, be very costly for current high emitters, so one might aim for convergence through time towards equal emissions per capita, with the rate of convergence being chosen so as to allow sufficiently gradual adjustment. One such convergence rule (referred to as "egalitarian" below)[55] was used in simulations of the concentration scenarios shown in Figure 3.1. To illustrate the importance of the allocation of emission allowances for overall costs and the gains from trade, an alternative stylised "grandfathering" rule was investigated, which entails freezing the share of each region in overall emission allowances at its 2010 value.[56] The implications of the two rules were explored in two scenarios, with concentrations stabilising at 740 and 550 ppmv respectively.

103. Costs clearly increase with the degree of ambition of the emissions constraint (Figure 3.2). In the absence of emission trading, overall (world) costs are lower when the grandfathering allocation rule is used, while full trading renders the aggregate costs much less dependent on the distribution of allowances.

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52. Non-annex I countries are an extremely heterogeneous group. Space constraints prevent a proper reflection of this here. One generalisation assumed to hold is that avoidance of climate change is a "superior good" — the value attached to it is an increasing function of income per head, *ceteris paribus*.

53. A discussion of the game theory (coalition formation) aspects of this can be found in "Taking action against climate change: the Kyoto Protocol", ECO/CPE/WP1(99)6.

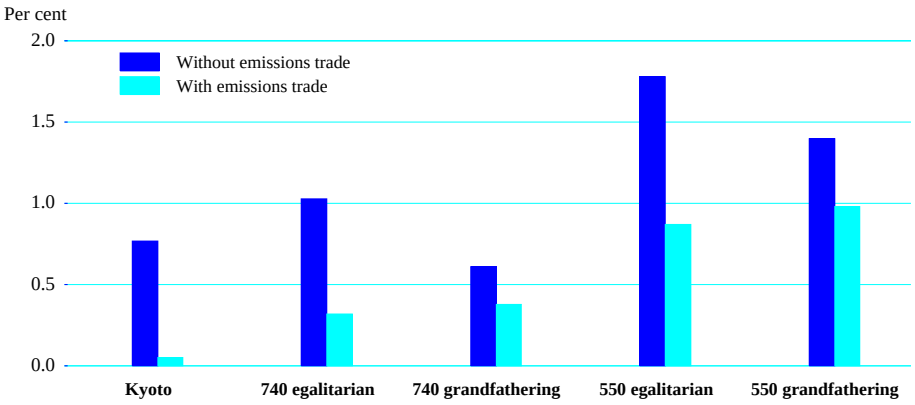
54. This obviously does not take into account that for reasons of e.g. climate and geography, countries are not equal to begin with.

55. The method chosen was to allow non-Annex I regions' emissions to grow unconstrained until their per capita emissions reached the average level of constrained regions. At this point they are given tradable allowances which subsequently decline in per capita terms.

56. Of course, other rules are possible and should be considered in future work.

Figure 3.2. Average costs of alternative scenarios, 2010-2050

World real income loss,[1] per cent



1. An average of the discounted costs over the years 2010-2050, discounted at 3% per annum.

104. The role of side-payments can be considered in the context of the most ambitious of these emission scenarios (the "550 ppmv" scenario of Figure 3.1). With egalitarian burden-sharing and no trade, total costs in the period 2010-2050 are almost 2 per cent of GDP: 1.5 per cent for Annex I countries, over 2 per cent for the rest (on average). With emission trading, total costs are reduced by half, with non-Annex I regions being, on average, better off than in the BaU scenario. Even with trading, however, some non-Annex I regions are worse off. If Annex I countries make transfers to compensate these regions, they would have to transfer approximately 0.3 per cent of their GDP, with average non-Annex I incomes then almost 1 per cent higher than in the BaU scenario (Table 3.3). The average annual real income loss in OECD countries over 50 years remains under 2 per cent, however.

Table 3.3. Real income gains and losses, 2010-2050, with trading and transfers to non-Annex I countries

Per cent	OECD	Annex I	Non-Annex I
Change in real income	-1.6	-1.7	1.0
of which:			
GDP	-0.4	-0.5	-0.4
Emissions trading	-0.6	-0.7	1.6
Transfers	-0.3	-0.3	0.6
Other	-0.3	-0.3	-0.8

Note: Corresponds to the 550 ppmv (parts per million by volume) scenario of Figure 1. Non-Annex I regions' emission allowances are as described in note 51. Real income change is calculated as an average of the discounted change over the years 2010-2050, discounted at 3 per cent per annum.

Climate change: prevention *and* adaptation

105. Preceding sections have discussed the costs of action to reduce GHG emissions and thereby to limit climate change. Unfortunately it is difficult with present knowledge to complete the cost-benefit picture by comparing these costs with their benefits (i.e. the costs of the climate change that would

otherwise occur). The costs of climate change are largely unknown, partly because the likely climate changes themselves are not easy to predict in sufficient regional and local detail. Even for the broadest of indicators, global average temperatures, there is quite a wide range of uncertainty attached to the IPCC projections: between 1.0 and 3.5° C by the second half of the 21st century if CO_2 concentrations double, itself an uncertain assumption.

106. Temperature changes and, probably more importantly, changes in the quantity and distribution of precipitation will certainly have economic consequences. There are no robust estimates of the economic costs, however.[57] For most OECD regions the usually quoted estimates are for losses of between 1 and 2 per cent of GDP.[58] Higher figures, up to 8 per cent, are obtained for some non-OECD regions.

107. Even if these estimates for the OECD area may not seem enormous, there are a number of reasons for continuing to work for GHG reduction policies. First, most estimates are for the costs of climate change that will probably occur anyway (if the consensus scientific forecasts are reasonably accurate), even if quite successful emission reduction policies are introduced. In the absence of such policies, changes would be larger and probably continue for several centuries, and the damage may well increase much more than proportionately. Secondly, even narrow self-interest implies that OECD countries should be concerned about severe consequences of climate change in developing countries, as these may exacerbate tensions due to migration pressures and water scarcities, for example. And self-interest was not the motivation behind the UNFCCC, which expresses explicit solidarity with countries that may be worst hit by climate change. Thirdly, the ancillary benefits of actions to reduce GHG emissions may be quite substantial, although little quantification of them is available at present.[59]

108. Finally, GHG reduction policies should also be motivated by precaution. The process of climate change is not fully understood. There may be discontinuities that could generate very severe outcomes[60] as well as changes in the frequency, distribution and severity of extreme events (such as extreme heat spells, storms and hurricanes). At the same time, it is also possible that very little would happen to the climate. But expenditure that could reduce the risk of severe outcomes may be worthwhile, even if it did little to alter the average "expected" outcome. While this is obviously true in principle, there is at the moment little information to guide decisions on just how much weight to attach to this precautionary principle and how much mitigation effort it justifies.

109. Since climate change cannot be prevented entirely, it will be necessary to adapt to it. The necessary adaptation may not be very onerous — as elsewhere, research is needed to narrow the range of possibilities that needs to be considered. The likely rate of climate change may mean that it is imperceptible from year to year or even from decade to decade. Adaptation to climate change may be only

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57. See IPCC (1996). ECO/CPE/WP1(99)6 contains a very brief summary of the IPCC analysis of possible effects of global warming on climate patterns in OECD countries and of cost estimates in the literature.

58. Fankhauser S., R. Tol and D. Pearce (1998), "Extensions and alternatives to climate change impact valuation: on the critique of IPCC Working Group III's impact estimates," *Environment and Development Economics*, Vol. 3, pp. 59-81.

59. And reducing GHG emissions may not be the only, or the most efficient, way to achieve benefits such as reduced local air pollution.

60. Two remote possibilities are: *i*) a collapse of part of the Antarctic ice-shelf, that could lead to rises in sea levels of several meters over a period of decades (central predictions are for around 0.5 metres over the next century); and *ii*) a cessation, or severe weakening, of the north Atlantic ocean circulation (the Gulf Stream) that gives western Europe its relatively mild climate.

a small part of the changing background to most people's lives; ensuring that adequate information is available and allowing market forces to act to reallocate resources will in many cases be sufficient. However, long-term planning will be necessary in land-use policy, particularly in low-lying coastal areas or inland flood plains. Water supply infrastructure may also need to anticipate possible climate change effects, whether changes in overall quantities of precipitation or, as seems likely, increased seasonal variation and possibly greater frequency of both storms and dry periods. This may also have implications for urban planning. Decisions on the location of new developments now can have implications many decades ahead in terms of vulnerability to water shortages or to flooding.[61]

Conclusions

110. OECD analysis undertaken since COP4 illustrates the challenges of complying with the Kyoto targets. Relative to a "Business as Usual" scenario, the targets may imply reductions in GHG emissions of some 30 per cent. Developments in the first half of the 1990s have implied in most countries a further increase in emissions relative to 1990 levels — the base year of Kyoto targets for most countries. Few of the domestic measures necessary to contribute to reaching these emissions targets are in place today.

111. International emission trading can make a big contribution to reducing overall abatement costs, and efforts need to be made to resolve the differences that exist over how it should be implemented. The considerable attention given to this subject, including in this Chapter, should not divert policymakers from the need to start domestic action. Indeed, if too many countries expect to be able to meet their target through buying emission allowances in the future market for permits, they risk being faced with unexpectedly high permit prices. Continuing work on improving the timeliness of emissions data, and on modelling its links with economic activity, should improve the accuracy of forecasts of emissions to reduce this risk.

112. In the longer run, OECD emissions need to fall substantially and developing country emissions growth needs to be limited. Negotiating country allocations of emissions allowances, which will amount to a form of wealth, will be difficult. It will likely require explicit consideration of equity, rights and responsibilities, and of the possibility of providing direct financial inducements to some countries. As illustrated above, market based solutions — including trading — are essential to contain the costs of emissions abatement in a long-term perspective, while many developing countries may be better off with such schemes.

113. Regardless of the success of measures to restrict emissions, adaptation to some degree of climate change is likely to be necessary. More attention should be paid to the long-term implications of current decisions and, in particular, to the needs of most vulnerable countries.

Future work

114. Progress so far suggests a number of themes that need to be pursued in future work:

- Assessing the costs of measures to reduce greenhouse gas emissions.

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61. Urban planning, through its impact on transport choices, can also affect GHG policy itself. A variety of other impacts in economic sectors, such as agriculture and fisheries or tourism, may be relevant to policy choices and the need for adaptation. These merit further study.

- At the domestic level, this involves improving our understanding of how economies will adjust to different measures. It includes further development of in-house models as well as monitoring modelling efforts elsewhere. Problems of adjustment in the labour market and in particular sectors may be studied. Further analysis of the cost-efficient instruments, and of the feasibility of "win-win" solutions, will be analysed.

- At the international level, this includes further development of the GREEN model and analysis of emissions trading, joint implementation and the Clean Development Mechanism. The implications of future allocation methods for emission allowances are very important; this involves both their evolution through time and their distribution across countries, particularly in terms of burden sharing between OECD countries and developing countries.

– Measuring the benefits

- Identifying and quantifying the direct benefits resulting from reducing climate change is a major part of the current IPCC programme. The OECD Secretariat needs to keep abreast of progress and maintain contacts with researchers, but plans no active role.

- Reducing GHG emissions has important ancillary effects on the environment. The Secretariat will pursue the quantification and valuation of these effects.

– Dealing with barriers to cost-effective implementation

- Least cost policies are not always easily implemented. The role of adequate information provision, dealing with start-up costs, pressure from interest groups, worries over competitiveness effects, are examples of areas that can be explored. Member countries may learn from the experience of others in these fields, i.e. through country reviews.

– Institutions

- As with other issues on the sustainable development agenda, climate change policies involve many ministries and agencies, and non-governmental organisations sometimes play an important role. The OECD Secretariat will undertake work to assess how well these collaborate to produce a climate change programme that is coherent, as well as consistent with other environmental and economic objectives.

115. The OECD will continue its analytical work, i.e. with the aid of the GREEN model and efforts to improve it. On the basis of discussions in the Economic Policy (EPC) and Environmental Policy (EPOC) Committees, and interactions between them, it will provide inputs to COP5 and COP6. The OECD may also provide an informal forum for discussions of some practical implications of its analytic work. The Secretariats of the OECD and IEA will also continue to support the Annex I Experts Group and the Forum on Climate Change.

CHAPTER 4. THE SUSTAINABLE DEVELOPMENT OF NATURAL RESOURCES

Introduction

116. Natural resources underpin sustainable development. In addition to the raw materials for meeting human needs — food and water, clothing and shelter, energy and tools — they provide environmental amenities and services. Because many natural resources are vulnerable to irreversible damage or depletion, arguments over their abundance have been going on for centuries.[62] A central question is whether the earth's ecosystem can sustain the high pressure on natural resources that would result if all countries were to adopt lifestyles similar to those prevailing in most OECD countries. The answer to this question depends in part on the resource management decisions in OECD countries over the coming decades and whether it proves possible to enjoy similar levels of well-being as in the past at lower environmental cost.

117. This chapter introduces some of the main issues that OECD governments are confronting regarding the use of natural resources, and explores some of the possible remedies. Managing a portfolio of natural resources is a complex balancing act, as resources differ in their physical characteristics, abundance, and value to different members of society. Optimising the stream of benefits they provide requires considering not only inter-temporal trade-offs, but also interactions between different resources — a task made more difficult by the absence of, or imperfections in, markets for many natural resources — and uncertainties about future developments in their demand and supply. General principles can help to identify areas where current policies can be improved. However, managing the transition to more sustainable practices also requires careful consideration of social adjustment problems, which may otherwise derail reform.

The nature of natural resources

Properties of natural resources

118. Natural resources include those parts of the earth's biological and mineral endowment from which society derives value. Energy from the sun, and its derivatives, are sometimes included, as well as the earth's atmosphere and the spectrum of radio-wave frequencies. While bearing in mind the importance of regarding natural resources in economic terms, distinguishing them according to various technical properties can aid in understanding the forces of nature that influence their abundance and shape the approaches taken towards their management.

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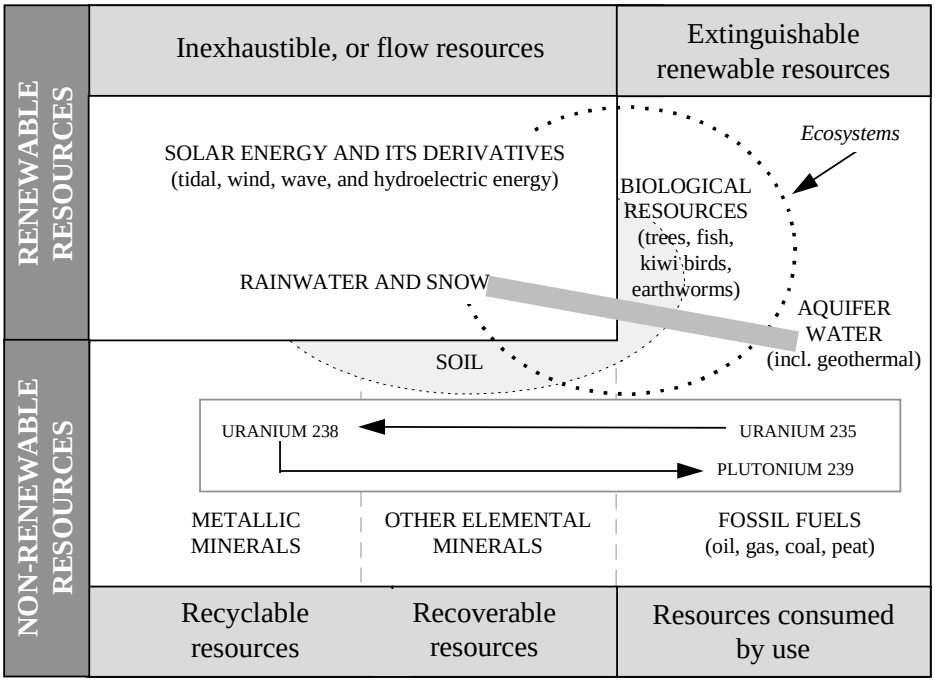
62. Warnings about shortages of material stocks and deteriorating environmental quality appeared in the literature even before Thomas Malthus (1798) wrote his famous essay. Renewed warnings were voiced in various studies in the 1950s, following the shortages created by the Second World War, and in the 1970s, with the publication of *The Limits to Growth* (Meadows, *et al.*, 1972).

Figure 4.1. A classification scheme for natural resources based on their physical characteristics



Source: Inspired by Rees (1985), *Natural Resources--Allocation, Economics and Policy*, Methuen, London and New York. p. 13.

119. Figure 4.1 distinguishes two major categories, non-renewable and renewable resources. *Non-renewable* resources (i.e., minerals, mineraloids and rocks) are those with a finite initial endowment. They may be further divided into *i)* materials from which metals are extracted; *ii)* materials used for their intrinsic chemical or fertiliser properties; *iii)* materials used for their special or aggregate physical properties (e.g., building materials and gemstones); and *iv)* materials used as sources of energy.[63] Concerns about future supply limitations usually focus on the first and fourth categories.

120. *Renewable* resources are, or can be, naturally replenished within a sufficiently short time-span to provide an indefinite stream of benefits. They can be further divided into those that can be diminished or extinguished through human activity if not managed sustainably (e.g. biological resources, the atmosphere), and those which cannot (e.g. tides and winds). A characteristic that distinguishes many biological resources from other resources, and one that complicates their management, is their mobility: fish and birds do not recognise national borders. Also, whether the resources are commercially exploited has major implications for both valuation and management.

121. Some natural resources do not fit neatly into any one particular category. Soil, for example, is a composite of minerals, organic compounds, and living and decaying organisms — neither wholly mineral nor wholly biological. An ecosystem — i.e., an assemblage of organisms, mineral nutrients, atmospheric gases, and an influx of solar energy and water, all interacting as a functional unit — can also be regarded

63. DeVerle P. Harris and Brian J. Skinner (1982), "The assessment of long-term supplies of minerals", in *Explorations in Natural Resource Economics* (V.K. Smith and J.V. Krutilla eds.), pp. 247-326, Johns Hopkins University Press for Resources for the Future, Baltimore and London.

as a natural resource, though of a much different kind than any of its constituent parts.[64] Ecosystems rarely have distinct geographical boundaries, and are constantly exchanging materials and energy with adjacent ecosystems and the abiotic environment; the "balance of nature" is what ecosystems maintain.

122. The speed at which *mineral* resources are depleted depends on their nature, on technology, on changes in prices and on demand patterns. At one end of the spectrum, many metallic minerals, once extracted and transformed into a relatively pure state can be (and often are) melted down and used again. At the other end of the spectrum are fossil fuels — rocks, mineraloids and compressed gases containing hydrocarbon compounds (and associated impurities) — that cease to exist once consumed. Indeed, by emitting pollutants and carbon dioxide, they create adverse consequences that have to be set against their benefits if a full valuation is to be attempted. Nuclear fuels constitute a special case in that, in the process of decaying, one resource (^{235}U) can transmute another less valuable resource (^{238}U) into one (^{239}Pu) that is as valuable as the first (see Box 4.1). The consumption of nuclear fuels also creates wastes, some of which are extremely long-lived, dangerous and consequently difficult and costly to dispose of.

Box 4.1. Uranium resources

Uranium is widely dispersed over the earth's crust and oceans. As documented in the OECD Nuclear Energy Agency's publication, *Uranium 1997 — Resources, Production and Demand*, current estimates of total conventional resources of uranium amount to about 16.3 million tonnes — 270 times today's annual rate of usage. Conventional resources refer to ores produced using conventional mining technology wherein uranium is either the primary product or an important by-product. Unconventional resources, in which uranium exists in very low grades or is recovered as a minor by-product, include about 22 million tonnes occurring in phosphate deposits. The earth's oceans are estimated to contain up to 4 000 million tonnes of uranium.

Uranium resources are classified according to confidence levels of occurrence and expected recovery costs. Uranium prices have been very low in the last 10 years and consequently uranium exploration, economic assessments and production have decreased. Currently, uranium production is satisfying about 60 per cent of the world's reactor requirements; the rest is being covered by excess utility and producer inventories, and material recovered from decommissioned nuclear warheads. These excess stockpiles could fulfil half of the world's uranium demand for at least the next 12 to 15 years. By then, new exploration is likely to lead to the discovery of additional uranium resources and the re-classification of already identified resources into more economic and certain occurrence categories.

Over the long term, natural uranium requirements will depend on the fuel-cycle strategies and reactor technologies. Consumption per kWh can be reduced by recovering more of the ^{235}U present in natural uranium (i.e., lowering enrichment plant tails assays), and by recycling uranium and plutonium recovered from reprocessed spent fuel (increasing by about 30 per cent the potential energy that can be recovered from the original fuel). Breeding plutonium in liquid-metal cooled fast reactors could allow the extraction of 60 times as much energy from the original uranium as currently obtained from conventional thermal reactors. Future technological developments and appropriate management may extend the useful life of the uranium resources over several centuries, even if total uranium requirements were to increase considerably.

123. The resilience of extinguishable flow resources to human pressure depends on the nature of the resource and the intensity of its exploitation. Most soils can be tilled virtually indefinitely if they are managed well; mismanaged they can disappear in a matter of years.[65] Similarly, groundwater aquifers

64. Marine ecosystems do not include soil *per se*, though to some extent bottom sediments and coral rock serve an analogous function.

65. Depletion (through oxidation) of carbon-rich soils exposed as a result of drainage, by contrast, cannot be halted except by re-flooding.

differ in the rates at which they are naturally replenished. Many are being drawn down today at rates far exceeding their regeneration.[66] In the case of non-domesticated plants and animals, species with longer reproductive cycle are generally the more vulnerable to changes in their environment. On the whole, the mega-fauna of the world is most at risk of extinction.

124. Many abiotic resources are, or can be, obtained from different geologic or geochemical environments or, like freshwater, from both renewable (rainwater) and non-renewable (aquifer) resources.[67] Usually the grade and costs of extraction vary among different deposits and ores. The energy needed for mining, milling and smelting copper ores, for example, differs by an order of magnitude between sulphide and (much more common) silicate ores. The oceans contain traces of virtually every known element, but the costs of extracting all but a few of them are prohibitive under present technologies.

Issues related to scarcity

125. Most discussions of scarcity relate to the role natural resources play in satisfying human material needs: water (for metabolic needs), food, medicine, sanitation, clothing, shelter, heat, illumination, and communication. Some natural resources (e.g., petroleum) can be used to meet several of these needs, and most needs can be met by more than one natural resource. There is considerable scope for substitution among resources. What matters from this perspective, referred to as "weak sustainability" in Chapter 1, is not whether a particular natural resource will be available indefinitely, but whether human ingenuity can keep combining man-made, natural and human capital in ways that enable these needs to be met.

126. Of the various non-living natural resources exploited by humans, *water* is perhaps the most indispensable. To meet metabolic needs, every person requires daily around 6 litres of freshwater — ideally water that is free of pathogens and pollutants. Crops and livestock need a lot of water, although the amount actually consumed for agriculture is far more than what is technically required. Water is also used as a solvent in numerous industrial and chemical processes. For many other human uses water is convenient but not indispensable, especially in the volumes currently used. However, while there is ample water available to meet current and future human requirements, problems arise because of its uneven geographic and temporal distribution (Box 4.2), and mismanagement. Ongoing activities at the OECD, as mentioned in Chapter 2, are helping to improve knowledge in this area.

66. Perhaps the most notable example is the massive Ogallala Aquifer that underlies a large portion of the Great Plains of the United States and is an important source of irrigation water.

67. Until the development of reinforced concrete and the electric-powered centrifugal pump, humans obtained most of their water from lakes, free-running streams, and shallow wells. Over the last century, large storage reservoirs have been built, and wells have penetrated deep into ancient aquifers.

Box 4.2. Global water trends

The global demand for freshwater has increased over four-fold during the last 50 years — double the rate of population growth. Irrigation and industrial uses have accounted for most of this growth, but household consumption has also increased rapidly, particularly in developing countries with expanding urban populations. In some countries — mainly in Africa and Asia — lack of clean water is a major factor contributing to the spread of disease, and a constraint on economic development. The World Resources Institute projects that the number of people living in water-scarce countries will represent 13 to 20 per cent of the global population by 2050.[1] Most of these people will live in the Middle East and Africa. Even countries with adequate water resources (e.g., the United States, China, India, Pakistan, and Mexico) will have areas affected by drought and restricted supply. The potential impact of climate change on hydrological systems and food production adds uncertainty to these projections.

Currently, water resources in seven OECD Member countries are subject to either high or medium stress. In another eight countries water availability is becoming a constraint on development, and significant investments will be needed to assure adequate supplies. Several countries, though water-rich on a national scale, have extensive arid or semi-arid regions, where development has been shaped by water scarcity. Only a few have both low population densities and abundant water resources.

1. World Resources Institute (1996), *World Resources: A Guide to the Global Environment*, Oxford University Press, London.

127. Concerns about the ability of *agricultural land* to feed a growing world population have resurfaced with the uncertainty about the effects of climate change, and pressures on agricultural land from other economic activities. In OECD countries, where soil conservation programmes are well developed, maintaining the quality of agricultural land is an important but not a critical issue. A further concern over the long-term, is the gradual, and largely irrevocable, loss of prime agricultural land to urban and industrial uses. As a recent OECD study points out, agricultural land in OECD Member countries shrank by 2.2 per cent in the 12 years preceding 1992-93, whereas urban and industrial land grew by 0.8 per cent.[68] At the national level, changes in agricultural land use ranged from a net increase of 7.7 per cent in Norway, to net losses of over 20 per cent in Ireland. Over the same period, agricultural output increased in volume terms by 16 per cent.

128. Regarding *minerals* and *energy*, scientists and entrepreneurs are constantly developing new, resource-saving materials (e.g., optical fibres) and technologies (communication by wireless telephones) to replace those based on more costly resources (copper wire). Low prices can lead to increased consumption, but in general the trend has been towards more *efficient* use of resources for any given level of consumption — at least to the extent that relative scarcity is reflected in prices. In the case of energy, technological advances continue to bring down the costs of extracting useable energy from the sun's rays and from waves and winds. Even the earth's finite resources of fossil fuels are not about to run out; supplies from conventional sources are already beginning to replace unconventional sources (Box 4.3). The most important issue for energy resources is not their availability, but what to do with the waste streams.

68. "Agricultural policies and changes in agricultural land use", AGR/CA/APM(99)2.

Box 4.3. The outlook for fossil fuels

According to the IEA's 1998 *World Energy Outlook*, conventional crude oil production is likely to peak between 2010 and 2020. This range reflects different assumptions on the amount of oil that can be ultimately recovered from conventional deposits. A majority of experts place the world's ultimately recoverable conventional oil at between 2 000 billion and 3 000 billion barrels, of which 800 billion barrels have already been produced. Production from conventional deposits will cease some day, but almost certainly not until after 2050.

Meanwhile, oil produced from unconventional sources will gradually increase in importance. Currently, most of the world's unconventional oil comes from a few large, near-surface deposits of tar sands or extra-heavy crude oil; from oil synthesised from coal; and from liquid fuel produced from plant matter. Estimates of the amount of oil that can be ultimately recovered from non-renewable unconventional sources vary from 300 to 2 000 billion barrels. For most deposits it would take a rise in the price of crude oil to $ 25 to 30 per barrel (in constant 1990 dollars) before significant new developments take place.

Cumulative production of natural gas to date has exhausted less than one-sixth of the 11 500 trillion cubic feet (325 trillion cubic metres) that can be expected to be recovered ultimately from conventional deposits. Assuming consumption increases at an annualised rate of 2.6 per cent (the base case assumption in the 1998 W*orld Energy Outlook*), some 41 per cent of natural gas ultimately recoverable from conventional sources will have been produced by the year 2020, suggesting production peaking by the year 2030. Substantial untapped reservoirs of unconventional gas are known to exist, but the economics of producing from them are highly uncertain. However, as advances in technology push production costs downward, and output from conventional reservoirs peaks, it is likely that supplies from unconventional deposits will begin to displace the latter, starting in North America.

The 1998 *World Energy Outlook* sees no supply problems affecting coal during the first two decades of the next millennium. Beyond 2020 it is difficult to project coal production, as it will depend critically on demand conditions, which will be affected strongly by government policies and the prices of alternative energy sources. Given the abundant and widespread endowment of coal world-wide, lack of economically exploitable resources is not likely to be a constraint on production, while other concerns — notably, coal's high carbon content and CO_2 emissions from its use — may be more important in shaping its future production prospects.

129. The state of biological flow resources is more difficult to characterise succinctly. Regarding those that are commercially exploited, there is no shortage of *forests* producing wood and wood products: wooded areas constitute one-third of the OECD land area — a proportion that has remained fairly stable in recent years. However, single-species plantations (dominated by conifers) are gradually replacing mixed, natural forests. *Marine fish stocks* are recovering in some areas, but 16 per cent of stocks are still over-exploited, and another 6 per cent are depleted and will not return to levels consistent with their single-species maximum sustainable yield (MSY) without some reduction in fishing activity.[69] Stocks of wild salmon are threatened by numerous hazards including over-fishing, dams, pollution, and diseases spread by farmed salmon.

130. Based on indicators of biodiversity, many *ecosystems* in OECD countries appear to be under stress. On average, 3 per cent of known species in OECD countries (for which sufficient data are available) are endangered or vulnerable to extinction. For invertebrates, the percentage of known species endangered or vulnerable is below 3 per cent, but for mammals and amphibians the ratio is above 20 per cent. Being averages across several OECD countries, these figures obscure significant variations in terms of numbers of species and the nature of the threats.

131. The available data suggest that in many countries substantial proportions of the species that are known to exist were experiencing declines in their numbers during the mid-1990s. This is particularly true

69. FAO (1999), *The State of World Fisheries and Aquaculture -- 1998*, Food and Agriculture Organization of the United Nations, Rome.

for amphibians and reptiles. Over 25 per cent of the populations of known amphibians in OECD countries are decreasing, and in some countries populations of *all* the known amphibious species are declining.[70]

Natural resources and their value to society

132. Commercially exploited natural resources have been a major source of wealth for several OECD economies.[71] However, the value to society of natural resources does not depend solely on the profits derived from their exploitation. Natural resources also provide amenities and services — not least, the maintenance of the earth's life-support system — as well as satisfaction to people purely from knowing that they exist, qualities that are seldom if ever reflected in market prices.

133. Resources left in their natural or semi-natural state, particularly forests, streams, and in-shore waters, provide both on-site and off-site uses. Thus, the total value to society of such a resource should include the different use, option and existence values of all individuals (*see* Chapter 1).[72] Although, in practice, the measurement of these values is difficult, these concepts are useful for thinking about how certain policies might affect total welfare.

134. Most mineral resources, such as copper ores, coal deposits and salt deposits, are mainly valued for the materials, energy or services that can be derived from them (including the present value, if positive, of any additional revenues that could be earned by postponing production). For these resources, existence values tend to be nil or close to nil. For most other resources, however, value to society is more complex. For example, herring have a market value as a food for humans, but also a value as food for other food fish (such as cod) and marine mammals (such as killer whales) from which many people derive existence value.[73] The existence value that people ascribe to other resources, such as penguins or geysers, often is highest if the resources remain in their natural state. In other cases, it is the interaction between humans and natural resources — as expressed, for example, in an agricultural landscape — that creates an amenity that people may wish to preserve. In the case of many landscapes and ecosystems, the whole is worth more than the sum of the parts.

135. Individuals differ in the values they attach to the same natural resources, both across society and over time. An urbanite may feel that all wolves living in the wild should be protected; sheep ranchers may hold very different opinions on the matter. Before the late 1800s, beaches were places to store small boats, not to sunbathe; today they are the centrepieces of billion-dollar tourist developments. The first example illustrates the difficulties managers face in reconciling competing demands on resources (wolves) for which there are no markets; the second the difficulty of predicting the consequences of changing tastes and incomes.

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70. OECD (1997), *OECD Environmental Data — Compendium 1997,* Paris.

71. In a range from 0.2 (Japan) to 15 (Norway) per cent of GDP for non-renewable resource extraction; and from 0.1 (Italy) to 7.7 (Iceland) per cent of GDP for renewable resource extraction. See "Enhancing Environmentally Sustainable Growth: A Framework for EDRC Country Reviews", ECO/CPE/WP1(99)8.

72. OECD (1994), *Project and Policy Appraisal: Integrating Economics and Environment,* p. 42, Paris.

73. Marine mammals also sometimes prey on other marine mammals. See, for example, Robert Irion (1998), "Whale of an appetite: Orcas are preying on the sea otters of the Aleutians," *New Scientist*, 24 October, p. 25.

Managing resources sustainably: Policies for optimising current and future use

136. The fundamental objective of policy should be to maximise the net benefits to society, over time, from the use (commercial and non-commercial, on-site and off-site) of natural resources. Two major economic issues complicate the application of this rule within a limited time frame[74]:

- The fact that markets do not operate for some aspects of these uses or do not operate effectively (sometimes because of policy errors).

- The assignment of rights to access and use, natural resources.

Market failure may sometimes be corrected by establishing property rights or formalising rights that were previously informally recognised or disputed (see Chapter 1). However, such an approach is less likely to be viable for non-commercial and off-site uses.

137. Because natural resources differ in the degree to which their depletion or degradation is reversible, maximising their benefits over time is not straightforward. For mineral resources (including fossil fuels and water), a central policy question is the optimal rate at which the remaining stock should be depleted. This question, in turn, depends on the uniqueness of the resource (i.e., what substitutes are available and at what cost), the opportunity cost of capital, and expectations about prices, government taxes and regulations, and technological developments on both the supply and the demand side.

138. For renewable resources, by contrast, the choices are many and varied. Society can use them up now, leave them in a natural state, or pursue intermediate strategies. Historically, virgin stocks of natural resources, such as timber or fish, have been initially exploited at rates exceeding maximum sustainable yield — accepting that the annual yield will be diminished for many years thereafter. While such a strategy can make sense from a commercial standpoint, its environmental effects can be severe. Today, management plans often impose temporary reductions in harvesting levels in order to allow stocks to recover to a level where they will support a higher annual yield.[75] Ongoing OECD work on fisheries is considering how such a strategy could help in restoring particular marine fish stocks.

Internalising negative production externalities

139. The exploitation of most commercial natural resources gives rise to externalities — water, air and noise pollution, congestion — which, as elaborated on in Chapter 1, impose costs to others. A significant amount of OECD work has considered how to make those who are responsible for externalities bear more of these costs.

140. Generally when people think of externalities associated with the exploitation of natural resources they think of effects on human health and well-being (e.g., of air-borne pollutants and noise) or natural ecosystems (e.g., from oil spills). Yet the effects of one primary industry on another can also be profound. The fishing industry suffers frequently from such interference, as fish are prevented from migrating upstream by hydroelectric and irrigation dams, killed by oil spills, thermal discharges, and acidic runoff from mine tailings, and inhibited from reproducing where suspended sediments from farmland and cleared

74. Roger Rose and Anthony Cox (1991), *Australia's Natural Resources: Optimising Present and Future Use*, ABARE Discussion Paper No. 91.5, Australian Government Printing Service, Canberra.

75. See, OECD (1997), *Towards Sustainable Fisheries*, Paris.

forests pollute their rivers. But there can be positive interactions as well. For example, offshore oil platforms can interfere with fishing, but they can also create habitat for marine life.

141. Government interventions to reduce the negative environmental externalities from the exploitation of natural resources are common. In most OECD countries, mining and oil production are subject to strict controls relating to environmental discharges and land disturbance, and companies are usually required to post bonds to ensure that funds will be available to restore production sites. In other primary industries, however, policies have been applied less evenly. While programmes to help farmers conserve soil and water date from the 1930s in several OECD countries, these were aimed mainly at protecting the fertility of cropland. Only since the mid-1980s have governments seriously turned their attention to reducing off-farm effects.[76] Agricultural pollution remains a problem, nevertheless, particularly in areas where livestock are raised intensively. Nutrient pollution due to intensive aquaculture is also receiving increased attention. Although some countries have traditionally treated fish farms like their agricultural counterparts (i.e., regulating them lightly), the trend has been towards applying more stringent controls.

Accounting for existence and other non-use values

142. One of the biggest challenges for governments is to incorporate non-market considerations into their resource management decisions. OECD work has highlighted some encouraging examples for *water* management and *forestry* (Box 4.4). Traditional water management practices, especially in arid and semi-arid areas, have often ignored the effects of regulating flows of previously untamed rivers on aquatic and associated wetland ecosystems, leading to the retreat or disappearance of unique ecosystems once dependent on larger and irregular water flows. That situation is changing. The Water Reform Framework introduced in Australia in 1994 acknowledged "the environment as a legitimate user of water." In the United States, steps are being taken to restore some of the water flow to the Everglades, a unique wetland ecosystem threatened by agricultural pollution and urban development. In the 1980s, the Netherlands modified the design of its storm-surge barrier across the mouth of the Oosteschelde estuary so as to allow water to flow freely through the estuary except on the rare occasions when the barrier is in use.

76. Rules regarding pesticides, which have been in place in most OECD countries for several decades, are the main exceptions. A survey of agri-environmental policies is provided in the OECD (1995), *Sustainable Agriculture*, Paris.

Box 4.4. Forests and biodiversity

Forests can provide benefits besides pulp and timber. Well-managed forests, along with natural forests, serve a vital function in the global oxygen/carbon-dioxide cycle, conserve soil and water, and reduce risks of flooding. They can also provide recreational opportunities and scenery. Old-growth forests are rich in biodiversity. The sustainable use of forests should aim at maintaining their full potential to fulfil these multiple functions. Forest-based biodiversity is threatened mainly by unsustainable timber extraction, by conversion to agricultural land, by harmful air pollutants, and by intensive forestry practices, such as limiting stands to a single species of the same age (monoculture). On the other hand, harvesting forests products from commercial plantations may reduce pressure on natural forests.

The trend in OECD countries toward increased attention to forestry management, as well as improved understanding of the benefits of multi-use forests, have contributed to more sustainable practices. It is now generally accepted that timber and other forest products are renewable resources which, if managed correctly, can be sustainably harvested and still allow for significant biodiversity.

The management of forests in the pursuit of economic and social objectives has a long history in OECD countries, especially in Europe. But even in Europe the use of integrated resource management techniques to enhance the biodiversity or other environmental values of forests is relatively new. To protect biodiversity it may be necessary to set-aside certain forested areas (e.g., those that contain particularly rich or endangered ecosystems), rather than attempt to regulate their use. OECD experience attests to the importance of local community participation, transparency and fairness in government dealings with private landowners. Non-governmental organisations can help identify priority areas for protection, and pressure key players to participate in conservation programmes.

143. Policy-makers are paying more attention to environmental amenities in *agriculture*.[77] These amenities include symbiotic plants and animals that depend on agricultural land for food or shelter; landscape and recreational opportunities; and water management. As much modern farming does not co-exist easily with non-agricultural plants and animals, research is helping to identify low-cost practices that can increase biodiversity without substantially reducing crop and livestock production. Recognition of the linkages between farmland and the rural landscape is also increasing. However, designing policies to ensure that producers receive adequate incentives for the public goods they provide, while minimising distortions in product markets, remains a major challenge.

144. Another aspect of biodiversity that is receiving increasing attention in OECD countries is genetic diversity within the sector itself. Farmers once made use of a wide range of cultivars and animal breeds. Over time, however, the genetic base of agriculture has become narrower. Concern over such "genetic erosion" has focussed on the loss of traditional varieties, which have been gradually replaced by more uniform, modern varieties. While selective breeding has yielded crops and livestock that are highly productive, it has also made them more vulnerable to certain diseases. Breeders, as a consequence, are constantly seeking out older material or closely-related wild species in order to find genes that are more disease-resistant. Such genetic material is irreplaceable, and for this reason a number of gene conservation systems, including gene banks, have been set up in OECD countries. In order to better assess the effectiveness of these conservation efforts, the OECD is developing indicators of genetic resources in agriculture.

145. *Fishermen* also have to alter their practices in order to reduce the harm done to non-target species and to the marine ecosystem in general. For example, governments have recently prohibited the use of drift-nets for certain species, closed fisheries when the mortality of a protected specie (eastern spinner

77. OECD (1997), *Environmental Benefits from Agriculture – Issues and Policies (The Helsinki Seminar)*, Paris.

dolphins) breaches certain limits, and required the use of devices to frighten seabirds who might otherwise become entangled in fishing gear.[78]

Reducing and re-orienting support policies

146. Governments have been subsidising natural-resource-based industries for decades if not centuries. The OECD regularly measures support to agriculture, fishing and coal mining, and has examined support to water consumption (*see* Chapter 2). Rates of assistance for some forest products, minerals and energy products (besides coal) are also high in some countries.[79] While some of these support measures may not be incompatible with the sustainable management of natural resources, others are.

147. Subsidisation of natural resource implies three main challenges. First, to the extent that production costs are lowered, risks reduced, or prices received by the producer increased, productive capacity and effort are stimulated. Higher levels of output in the short-term often come at the expense of production in later periods, distorting activity in favour of current production. Second, resource allocation within the economy is affected, usually for the worse. Third, users receive distorted signals regarding scarcity, retarding the development of resource-conserving technology. For example, OECD work has shown that the adoption of water-conserving technologies depends crucially on what users are charged for the resource. In many countries, water prices still do not reflect full market value, and often do not cover the costs of collection and distribution. This is often the result of a culture where water, like energy, was seen as a good to be provided by the state rather than as a product to be marketed. The results are over-pumped groundwater aquifers, reduced river flows, salinisation, thermal, chemical, and biological contamination of water supplies, and deteriorating infrastructure.

148. Managing natural resources sustainably does not necessarily mean the elimination of all related government expenditure, however. Clearly, governments (as well as civil society) have an important role in, for example, purchasing and managing nature reserves. In the case of commercially exploited resources, governments — just as managers of any income–generating or wealth-embodying asset — will spend money on collecting and processing information to determine whether those exploiting the resource are doing so in an approved manner, as well as on policing and enforcing rules and regulations. Even in the case of commercially exploited resources, there may be joint products of a public good nature (e.g., wildlife habitat) that may justify government support for activities carried out by those who furnish these public goods. OECD work over the next two years will try to determine what counts as public goods (as opposed to club goods, for example), to identifying means for measuring the demand for these goods, and to devising means for getting an optimal supply of them.

Managing access to resources and collecting resource rent

149. Governments have always played a key role in determining access to natural resources. The nature and degree of government control over *commercially* valuable natural resources varies among resources, nations, and sub-national units.[80] In most OECD countries, the majority of agricultural land,

78. OECD (1999), *Review of Fisheries in OECD Countries*, Paris.

79. See, for example, D. Malin Roodman (1998), *The Natural Wealth of Nations*, W.W. Norton, New York and London.

80. Two areas rich in natural resources (apart from the atmosphere) are not owned by any government or private person: Antarctica, and international waters — i.e., waters beyond the 200 nautical mile (370

apart from semi-arid range-land, is vested in private hands. A significant share of the forested area is also privately owned though most governments own large tracts that they lease to private logging companies. Rights to mineral, oil and natural gas deposits, even those underlying private land, are generally held by governments, which then grant licences to companies who wish to exploit them. The United States, which allows mineral rights to be privately held, is the major exception, but even there the government controls significant mineral and hydrocarbon resources. Water rights range from purely public to purely private, typically being more elaborately defined in areas with low precipitation. Rights to catch fish in marine waters generally belong to and are allocated by governments, but in some countries and for some fish they have been assigned to individuals, usually as a proportion of an annually determined "total allowable catch" (Box 4.5). Rights to use particular radio frequency bandwidths (or "spectrum") are typically allocated by governments in exchange for public service obligations or, increasingly, auctioned.

Box 4.5. Assigning and regulating rights to exploit living marine resources

Access to fisheries resources has traditionally been managed in "open" regimes, where no individual fisherman has the right to exclude other producers from harvesting any part of the resource. From an individual fisherman's perspective, leaving fish to grow and reproduce risks losing the fish to other fishermen or predators. Competition drives stocks below the optimum levels (*i.e.* the stock size that would yield the maximum returns for the group as a whole). Fishermen thus impose an external cost on each other (and other potential users of the resource) in the form of lower future benefits. By not paying the full opportunity cost of the fish they harvest they tend to harvest too much of the resource.

To correct these problems, governments are increasingly restricting and attenuating access rights by setting up marine reserves and by imposing input controls (e.g., limits on the numbers of vessels), output controls (e.g., individual quotas), and technical measures (e.g., mesh size restrictions). Typically, several different interventions are used in combination. The recent OECD study *Towards Sustainable Fisheries* recognised that there are no universal solutions to management problems in fisheries. It did find nevertheless that rights-based management systems, such as individual quotas used in conjunction with technical measures, can improve the performance and sustainability of certain fisheries. Also, changing institutional arrangements can enhance a proprietary interest in the resource. Involving fishermen in decision-making processes (co-management) often yields promising results.

150. Over the last century, governments have also become owners of large areas of land and water where the mining or harvesting of natural resources is usually limited or forbidden. Access to these parks and nature preserves for recreation and other non-consumptive uses varies widely, ranging from free and unlimited entry to fee-for-access. Because protected areas are generally regarded as national assets that should be accessible to all interested citizens, governments often find it difficult to limit access even when the pressures created by too many visitors become unsustainable. Some of these issues are being examined in the context of OECD *Environmental Performance Reviews*.

151. Government involvement in the *harvesting* of natural resources is less common and declining. Today in OECD Member countries, private individuals and companies carry out most farming, logging,

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kilometre) exclusive economic zones of coastal states. Under a 1959 treaty, use of Antarctica's resources is largely limited to scientific research and tourism. Multilateral governance of the high seas is less complete. International instruments cover most of the major commercial fishing zones outside national jurisdiction. Most OECD countries fishing in these zones are members or observers in the regional fisheries management organisations (RFMOs) set up to administer those instruments that have been ratified (see, *Review of Fisheries in OECD Countries*, 1999 forthcoming). However, many RFMOs are still trying to work out mechanisms for dealing with compliance problems, including those connected with fishing vessels flying flags of non-member states. Such problems are currently under investigation by the OECD Fisheries Committee.

fishing and mining. The main exceptions are in energy and water. Because of the large scale of investments required, or the strategic nature of the resource, many governments at the beginning of the 20th century formed state-owned enterprises to develop energy resources (including hydroelectricity) and large-scale irrigation. In recent years, many of these enterprises have been sold to private investors. However, most governments continue to regulate access to resources under their control (through licences, permits, and other means), and in some cases they even determine total production levels.

152. Government ownership and control over natural resources raises a number of issues, and imposes a heavy fiduciary responsibility on managers — who often find themselves under pressure from interest groups to maintain or expand natural resource production to protect jobs. One of the most controversial issues is the distribution of monetary returns from the use of natural resources, particularly the "resource rent" arising from their scarcity. When resources are privately owned and traded, rents tend to become incorporated into the purchase price of property, be it a hectare of farmland or a transferable quota for the right to catch fish. When the resources are vested in the state, government managers (or political governing bodies) must decide on how to collect and spend (or invest) the rent.

153. Producing and marketing the resource is one way of collecting the rent, though the historical performance of state-owned resource monopolies suggests that much of the rent they collect tends to be dissipated through inefficient management. Alternatively, governments can attempt to capture this rent from private users of resources. Practices vary among countries and across different natural resources. In the case of privately owned agricultural and forested land, it is common for governments to tax the market value of the property. Access fees are typically charged for publicly owned range-land and forests, and royalties from (non-state-owned) producers of oil, gas and minerals. Examples of government attempts to capture resource rent from water users (especially farmers) are rare, as are attempts to levy resource rent taxes (or to auction off property-rights) in fishing. While a few countries collect special fees to pay for government-provided services (such as monitoring and research costs), these are not directly related to the economic rent derived from the resource. The setting and expenditure of resource rents is an area in which further research would be useful.

Making the transition to more sustainable policies for natural resources

154. Much progress has been made in the identification of policy frameworks for the sustainable management of natural resources. Yet the actual transition to such policies — which is now overdue — is likely to give rise to adjustment problems, creating resistance to policy change. Because many natural-resource industries suffer from chronic imbalances, such as excess capacity, a major focus of current OECD work is on ways of "managing the transition", an area where the trade-offs between natural resource sustainability and social implications are most evident.

155. Given the antiquity of some of the industries involved, and the hazards in changing the complex web of laws, traditions and property rights that have evolved along with them, managing the *transition* to sustainable use of natural resources may prove as difficult as defining the desired steady-state conditions. Inappropriate incentives over time create expectations that are costly and painful to change, while many government financial transfers, including those provided through sector-specific social policies, may have contributed to structural imbalances. Yet adjusting use levels may create short-term problems (redundant capital and labour), hence intensifying economic and social dislocation.

156. Around 40 million workers (of which 32 million farmers) are directly employed in primary industries in OECD countries. Many of these workers have specialised skills, but are poorly educated. Moreover, because the activities of primary industries tend to be carried out in rural and remote areas,

alternative employment opportunities for these workers may often be limited. OECD work on agriculture[81] and fisheries has stressed the importance of redeployment measures (including training) for redundant workers; of ending policies that encourage young people to seek employment in industries that lack the resource base to sustain them; and of developing new economic activities that build on local environmental amenities. Re-deploying displaced workers to environmental restoration projects (as is happening in fisheries and uranium mining) can sometimes help to ease adjustment problems and to improve the environment.

Future work

157. Future work will deepen the analysis of various aspects relating to the sustainable management of natural resources. These activities are taking place in sectoral committees, working groups and joint working parties, and could also include workshops of a horizontal nature. The Analytical and Policy Reports on Sustainable Development to the 2001 OECD Ministerial Council Meeting will present policy recommendations to Member countries on framework conditions for better resource management, and on managing the transition to the sustainable use of natural resources. Ongoing and future work, which will be reported in these two documents, include the following:

- Best practices for achieving sustainable agriculture. An OECD workshop on Farming Systems, Technology and the Environment, hosted by The Netherlands, will concentrate on the challenges and opportunities posed by technological developments in the sector.

- Concerning energy, a joint activity between the IEA and the coal industry will consider how market uncertainties are affecting coal supply developments. NEA activities on uranium production will focus on environmental issues in mining and milling, and the restoration of production sites.

- Several studies will examine the costs and benefits of the transition to sustainable fisheries, including social impacts, the effects of government financial transfers and of post-harvesting policies and practices (including eco-labelling) on sustainability.

- Following up on country case studies on implementing biodiversity incentive measures, an OECD workshop in the autumn of 1999 will consider the Valuation of Ecosystem Services. This will be followed by the publication of a Handbook on Techniques for the Valuation of Biodiversity and Their Use for Policy Making. Other work will consider ways to create markets for biodiversity goods and services through certificates and labelling.

- A synthesis report on how to balance the preservation of rural amenities with the development of local and regional economies has just been published.[82] Future work will focus on methods of valuing natural and cultural assets and on developing indicators for amenities.

- Resource management policies will receive greater attention in the context of the upcoming OECD environment and economic country reviews.

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81. See, for example, OECD (1994), *Farm Employment and Economic Adjustment in OECD Countries*, Paris.

82. OECD (1999), *Cultivating Rural Amenities: An Economic Development Perspective*, Paris.

158. In addition, proposals for future workshops are being discussed in various committees. One such workshop could deal with the treatment of resource rent, assessing the potential for increasing the net flows to taxpayers from natural resource management policies, and exploring issues related to ownership and control, uses of the resource rent, and alternative forms of taxation.

CHAPTER 5. TECHNOLOGY AND SUSTAINABLE DEVELOPMENT

Introduction

159. Technology is critical to securing sustainable development goals, in particular in de-linking economic growth, as measured by GDP, from environmental degradation and unsustainable resource use. Significant reductions in energy and materials intensity and polluting emissions will require technological advances in products and processes, as well as organisational and behavioural changes. These technologies can contribute to the improved performance and competitiveness of industry. Global environmental concerns — including loss of biodiversity, climate change, ozone layer depletion and desertification — will also require the best scientific and technical insights for assessment and solution.

160. But appropriate technological change is not automatic. In traditional growth theories, new technology is an *exogenous variable* appearing from outside at the right time and right price.[83] In reality market failures, in terms of information deficiencies and inappropriate pricing, risk suffocating rather than stimulating technologies capable of enhancing sustainable development. Producers and consumers may lack knowledge about the environmental impacts of different products and activities. As elaborated upon in Chapters 1, 2 and 4, the prices of many goods and services often do not reflect resource use or environmental and social externalities. As a result, new substitutes tend to be more expensive than conventional technologies. The costs of developing new, clean technologies and integrated approaches are often high and the timeframes long. Where the benefits are more public than private, the result is insufficient industrial investment and inadequate technological innovation. Providing proper price signals would increase investment in clean technologies (*see* Chapter 3).

161. *Endogenous growth theories* acknowledge that technological change occurs as a result of identifiable processes including corporate investment and public policies. Governments have an important role to play in getting the prices right and in providing a climate for environment-related innovation. The economic, legal and physical infrastructure is an important determinant of levels and patterns of research and development, institutional interactions, education and training, investment and finance, communications, etc. Market factors, such as consumption trends, and government regulation are important influences on the innovation climate. In general, the design of framework conditions for sustainable development should be set from the perspective of balancing increases in material welfare with long-term environmental and social challenges and the actions needed to address them.

162. Governments have a more direct role in developing and diffusing technology for sustainable development and in the financing of the basic research that underlies innovation. Technology development has become the focus of an increasing number of public research partnerships with the private sector. Governments may also act to ensure that existing valuable technologies are more widely used. For example, the technologies needed to meet the Kyoto targets for greenhouse gas reduction are mostly available today, but may require — in addition to improved framework conditions — government action to

83. For an overview of exogenous and endogenous growth theory and the role of technology, see Aghion, P. and Howitt, P. (1997), *Endogenous Growth Theory*, MIT Press, Cambridge, Mass, USA.

see that they are much more widely deployed (Box 5.1). At the international level, governments need to work together to promote the use of clean technologies on a global scale as well as to address global-scale ecological issues.

Box 5.1. Energy technology and climate change

The Kyoto Protocol has committed OECD governments who are parties to Annex I to take actions to reduce greenhouse gas emissions. Technology will play an important role in achieving targeted emissions reductions and can facilitate reductions at lower cost. Important energy technologies include large-scale wind turbines, photovoltaics, nuclear power, natural gas-fired turbines, and fuel cells for transportation and power generation.

The adoption of these technologies has been slow. Long lead-times are needed for the refinement and commercialisation of new energy technologies. Investments in replacement stock with improved environmental performance are costly and only periodic for industry. Most energy technologies with superior environmental performance are more expensive than current techniques. Futher, relatively low prices for fossil fuels make it difficult to justify replacing them from the cost perspective of an individual agent. Getting prices right for energy inputs will thus help to get the right technologies in place.

The technologies needed to meet the Kyoto targets are mostly available "on the shelf" today, but governments may need to take action to ensure that they are broadly implemented. Demonstration and diffusion programmes can help make clean energy technologies more widely known and available. Verification and certification programmes can help more experimental energy technologies clear the last technical and regulatory hurdles. Research and development partnerships with industry can accelerate the emergence of new energy technologies. Government procurement programmes can steer technology development towards a sustainable path. Fiscal and financial incentives may speed-up the adoption of innovative energy techniques.

Beyond Kyoto, ever more demanding targets for reduced emissions will be required (*see* Chapter 3). Current, even cutting-edge technologies may not be able to meet such targets. In the longer-term, fundamental research on alternative energy technologies is needed to lower emissions. Changing practices of energy use and consumption will also help put the world on a lower-emissions path. Governments need to promote lifestyles and technologies that alter the relationship between the supply of energy services and environmental degradation. They need to work together to underwrite the research and development costs for technologies which are crucial for addressing global-scale ecological issues.

Source: "The Role of Technology in Reducing Energy Related Greenhouse Gas Emissions", International Energy Agency, Committee on Energy Research and Technology .

Creating an innovation climate for sustainable development

Improving framework conditions

163. Technological breakthroughs for sustainable development can be promoted by incorporating environmental and social criteria into innovation systems. Enterprises are the motors of innovation and their performance depends on the incentives they receive from the economic and regulatory environment. For example, reforms may be needed in:

- Intellectual property regimes to stimulate innovation and technology diffusion.
- Competition policies to promote healthy rivalries and to facilitate collaborative research.
- Education and training policies to develop human capital on a continuing basis.

- Financial and fiscal policies to enhance the availability of capital to innovative firms.

- Communications policies to increase the flow of information.

Developing technology for sustainable development can be facilitated through an improved understanding of the innovation process.

164. New insights into the nature of the innovation process have changed perceptions about the appropriate role of governments. The specific instruments of science and technology policy are being adapted within a broader framework that stresses the importance of policy coherence and of inter-linkages within innovation systems. Policies to promote research collaboration, facilitate firm networking and clustering, encourage institutional ties, diffuse technology and increase personnel mobility are taking on new significance. However, the success of these approaches depends on the overall policy environment, encompassing both macroeconomic and structural conditions. Policy coherence also implies improved integration of environmental and technology policies and better co-ordination among environmental and technology agencies. Some recent approaches to environmental innovation have been based on the concept of "*environmental clusters*" (Box 5.2).

Box 5.2. Fostering environmental clusters

Innovation mostly occurs within clusters of inter-related firms. Firms generally do not innovate alone. Rather they interact with similar companies, specialised suppliers, service providers, firms in related industries, and associated institutions such as universities and research institutes. Such clusters revolve around knowledge spillovers, pooled labour markets and exchanges of products and technology. As seen in Silicon Valley, they are usually found at the juncture of an entrepreneurial business climate, readily available risk capital and a business-friendly academic infrastructure. Clusters might also be based on geographic or natural resource advantages. Innovative clusters are emerging as drivers of growth and employment and are determining the pace and direction of development for entire regions, industries and sometimes countries. Governments can influence the development of clusters. Regional and local policies and development programmes can play a nurturing role. National governments must establish the appropriate frameworks in terms of competition, education, and financial and other policies. Newer approaches to stimulating cluster creation are also being tried by OECD governments, ranging from focused R&D schemes and competitions for funding to public procurement and investment incentives.

Finland launched an *Environmental Cluster Research Programme* in 1997 to promote both environmental entrepreneurship and sustainable development. It targets the emerging environmental goods and services industry, one of the country's fastest growing sectors. The government provides seed funding for research on new environmental technologies to be carried out by consortia of producers and suppliers, universities and institutes. Collaborative projects enhance networking among researchers and users and facilitate innovation. Improving eco-efficiency through the application of life-cycle techniques in agriculture, forestry, basic metals and water management is the initial subject for research. The Ministry of the Environment co-ordinates the programme together with the Ministry of Trade and Industry, the Technology Development Centre (TEKES) and the Academy of Finland.

Source: OECD Committee for Scientific and Technological Policy, National Innovation Systems project.

Encouraging market pull

165. One of the most important conditions for innovation to support sustainable development is technology pull from consumers and markets. It is often not a lack of research, but a lack of demand that limits technological progress, as well as a lack of correct pricing. Industry will not have an incentive to produce greener products or to invest in cleaner production processes in the absence of market rewards. Making the leap to less wasteful consumption in the longer-term will require changes in existing styles of working and living and in the highly-resource intensive habits that now predominate. Research indicates

that awareness of environmental issues is on the increase among consumers, but this has not yet translated into far-reaching changes in everyday buying and living patterns. Although environmental investments are starting to be rewarded in the marketplace, public policies should seek to accelerate these trends and strengthen market pull.

166. Governments are taking initiatives to shift consumer behaviour towards modes that are more supportive of the environment. They can implement mandatory and voluntary product standards to promote energy and water efficiency. They can use taxes to influence consumption away from harmful goods, such as certain batteries or fuels, and encourage the development of substitutes. They can support ecolabelling schemes to inform consumers on the environmental characteristics of products and processes and broaden their choices. They can encourage reporting by enterprises on emissions and the environmental implications of their activities as well as increase public access to these registries. They can use green government procurement and encourage green investment instruments to further sustainability priorities. Mostly, governments can overcome information deficiencies by increasing consumer knowledge of the ecological impacts of their behaviour and product choices and of the potential benefits of alternative consumption patterns. However, resolving many of the environmental challenges posed by current market trends, such as growing demand for more mobility and transport, may require more far-reaching changes in consumption behaviour. It will also depend on broader societal participation and support, as well as on government co-operation with industry, the media, schools and other influential institutions and groups.

167. Public resistance to certain technologies can also be a barrier to use. New technologies can lead to pressures on natural resources and health and safety hazards and raise difficult ethical considerations for society. There are major trust implications for technology acceptance, which may result in certain technology options being rejected or inadequately developed. For example, both nuclear energy and biotechnology may offer valuable technical solutions to enhance sustainable development. A challenge is to increase our knowledge and public understanding of the social costs and benefits of alternative technologies, which involves agreeing on approaches for risk management. Public perceptions and understanding of different technologies can be enhanced by broader involvement of society in setting research agendas and standards of use and oversight. This will help stimulate technology development that responds to the broader needs and preferences of society.

Formulating environmental policies

168. Environmental innovation takes place mostly in industry, where framework conditions and regulations are an important influence. The need to comply with environmental regulations has led industry to develop and adopt various pollution control techniques and equipment. However, traditional forms of environmental regulation have not generally led to radical technological change, although they have contributed to significant pollution abatement over the years. In many cases, command and control approaches have been a predictable stimulus to small, incremental improvements along established pathways, often in the form of end-of-pipe technologies. More dynamic environmental policies that promote prevention rather than abatement, and the development of clean technologies and integrated approaches — including economic instruments — are needed (see Chapter 2).

169. Environmental policy instruments differ in their effects on innovation. *Product standards* tend to prompt incremental innovation or modifications at the margin. *Product bans* can stimulate radical innovation in the form of replacements but entail disruptions and costs. *Performance standards* are technically flexible while *technology specifications* tend to stifle innovation. *Economic instruments*, such as pollution charges and tradable permits, have more dynamic potential to stimulate innovation but have

not always been set at sufficiently high levels in the case of the former or used extensively in the case of the latter. Nor have *voluntary agreements* brought much pressure for technological change thus far.

170. In general, economic instruments should be used more frequently as substitutes for — and complements to — traditional forms of regulation. Moreover, changes in implementation as well as new approaches could substantially improve the regulatory framework for environmental innovation. The way regulations are implemented and enforced has a strong influence on industry programmes to develop technologies to comply with new standards. Systems for early warning and timed introduction of new policies can help reduce regulatory uncertainty for industry. Expedited government review procedures and verification and certification schemes can speed market introduction of new technologies. Shifting away from technology specifications towards end results can increase the flexibility for industry in meeting compliance. Environmental policy instruments and improved framework conditions more generally are more likely to stimulate innovation when they take into account the industry - and even firm - specific context. New types of voluntary agreements and approaches such as extended producer responsibility, disclosure requirements and environmental management systems, which can encourage changes in resource inputs and the complete redesign of products and processes, may also be valuable.

Developing and diffusing environmental technologies

Conducting research and development

171. Shrinking research budgets and shorter research timeframes in industry and government raise concern about the long-term innovation needed for sustainable development. Governments must assure a continuing basic research and development (R&D) effort on broad enabling technologies to support sustainable development goals. R&D related to the environment accounts for about 2 per cent of R&D budgets in the case of research directly on the environment, and an estimated 5 per cent when environment-related research on other objectives is added, such as that on energy, agriculture and the atmosphere. It is true that research in many technology fields — such as biotechnology and information technology — can lead to beneficial environmental spillovers. In the case of information technology, new developments can help organisations monitor different aspects of their environmental performance at reduced cost. But overall, given the pressing nature of many ecological concerns, government expenditures on research that could be environmentally beneficial seem to be very low by most measures and may thus warrant review.

172. From the perspective of concepts such as *eco-efficiency* and *resource efficiency*, environmental technologies are those which minimise the resource and energy intensity of goods and services and polluting emissions, and that enhance society's overall management of its resources. Technology foresight exercises have been one means of identifying useful technologies and important areas for research, including in the environmental realm. Although not intended to pick winners, technology foresight helps enterprises and countries identify useful areas for research and development. And the foresight process is valuable in forging linkages between society and research and generating interactive processes to match technology development to social needs and market pull. Recent foresight studies have underscored the seriousness of ecological challenges and the importance of environment-related research. They have highlighted a number of key technologies for sustainable development, e.g. biotechnology, information technology and fuel cells, as well as specific applications, e.g. clean cars (Box 5.3).

Box 5.3. Technologies for sustainable development

Biotechnology. Biotechnology comprises a growing number of applications relevant to industry, agriculture, public health and the environment. Because biotechnology uses the processes of nature, it holds a vast potential for sustainable development in all sectors, perhaps more so than any other generic technology. Biotechnology can reduce the use of energy and materials, including chemicals, and cut down or eliminate waste, for example by recycling. Modern process biotechnology (bioprocesses) is now penetrating industrial operations in many sectors, leading to cleaner industrial products and processes. Agricultural biotechnology could reduce, if not replace, the use of pesticides and other polluting agro-chemicals. In the environment, bioremediation and other molecular technologies are increasingly helpful to reduce pollution and contamination of air, water and soil. The effects of these new technologies can be felt already. While biotechnological advances are very promising, they raise major social, economic, political and ethical questions. Moreover, a lack of public understanding, public concerns about safety and environmental effects, ill-adapted regulatory frameworks and a number of technical bottlenecks still limit the use of biotechnology for sustainable development.

Clean car technologies. Future cars could feature alternative batteries, lightweight materials, direct injection engines, fuel cells and/or enhanced recyclability - all leading to lower fuel consumption and emissions.

Photovoltaics. Buildings, automobiles and decentralised power units using photovoltaics or light-based energy are envisioned.

Advanced sensors. Sensors will be used to monitor air and water quality as well as global changes in the climate, stratospheric ozone layer, marine environment and varied ecosystems. Global information systems can aid precision farming, saving resources while maximising output.

New materials. Advanced materials technologies will facilitate recycling of consumer goods and of manufacturing inputs and further the implementation of life-cycle concepts.

Smart water treatment. New membrane technologies and biological treatments will be able to purify wastewater by removing organic compounds and could lead to community or home-based water treatment units.

Smart waste treatment. Approaches to reducing municipal waste, cleaning-up hazardous waste and treating nuclear waste will be based on new enzymes, catalysts and other advanced techniques such as transmutation.

Renewable energy. Improved power storage technology and combined conversion systems will increase the use of electricity from renewable sources such as solar power, wind power and biomass.

Source: OECD Workshop on Technology Foresight for Sustainable Development, December 1998.

Forming public/private partnerships

173. While new technologies are primarily developed and brought into use as a result of business decisions, governments also play a role in developing technology and are increasingly conducting applied research in partnership with industry. Such public/private partnerships are a means for doing more with less, although there may be risks of misdirecting resources and capture by private interests. They can leverage private investments in innovation and direct it towards critical research needs. They can enhance linkages among enterprises, and between enterprises, universities and public research institutions, and foster interactions that are crucial to the innovation process. In the environmental realm, partnerships are valuable because they reduce obstacles to the development and diffusion of clean technologies. Many OECD governments are initiating partnerships to develop technologies that can contribute to both sustainable development and industrial competitiveness (Box 5.4.). Further evaluation is needed on the cost-effectiveness of such partnerships and on their influence on longer-term technology development and research-related linkages.

Box 5.4. Examples of environmental technology partnerships

Canada — Technology Partnerships Canada. Environmental technology is one of the three categories supported by this programme which provides repayable contributions for research on technologies for air pollution control; water and wastewater treatment; clean cars/transportation systems; climate change; and recycling.

Germany — Research for the Environment. A research programme intended to "support scientific initiatives aimed at developing, together with partners from industry, new environmental technologies and/or new concepts of environmental engineering and use".

Japan — Research Institute of Innovative Technology for the Earth (RITE). RITE has created a partnership scheme to develop technologies for reducing greenhouse gas emissions, using biotechnology in production processes, developing substitutes to ozone-depleting substances, and monitoring techniques for air, water and soil pollution.

United Kingdom — Foresight Vehicle Programme. A LINK scheme aims to develop a clean, efficient, lightweight, intelligent, lean vehicle which will satisfy stringent environmental requirements while meeting mass market expectations for safety, performance, cost and desirability.

United States — Industries of the Future Initiative. A collaborative effort between the Department of Energy and seven energy-intensive industries (steel, aluminium, metal casting, glass, chemicals, petroleum refining and forest products) aims to develop competitive technologies which fully integrate energy and environmental considerations.

Diffusing technology and know-how

174. As already mentioned, cleaner technologies exist that are not yet in widespread use because of their price, the lack of information on the part of firms or the need to adapt them to users. Diffusion of technology and know-how is essential to enhancing participation in the sustainable development process. To this end, OECD governments are implementing schemes to disseminate information about clean technologies and to promote enhanced use of these techniques (Box 5.5), although such programmes must be carefully designed and evaluated to ensure cost-effectiveness and avoid unfair subsidisation. Encouraging information flows is at the core of all diffusion programmes and this is increasingly being done through electronic networks such as the Internet. Also prominent are demonstration programmes that illustrate the technical feasibility and benefits of new environmental technologies, and benchmarking schemes that help firms compare their environmental performance to that of similar enterprises. Technical assistance programmes provide more hands-on advice in diagnosing environmental problems and recommending responses. Governments are also mounting "soft" diffusion activities focusing on workforce training and encouraging managerial and organisational changes within firms to improve their ability to assess and adapt clean technologies.

Box 5.5. Examples of environmental technology diffusion schemes

Australia — Cleaner Production Demonstration Project. This project aimed to promote implementation of cleaner production technologies and processes through hands-on demonstration of innovative techniques.

France — Agence de l'Environnement et de la Maîtrise de l'Énergie (ADEME). This specialised agency assists enterprises to reduce usage of energy and raw materials, to limit waste production and maximise recovery and re-use of waste, to reduce noise pollution and to prevent and/or treat soil pollution.

Ireland — Clean Technology Centre. This independent, non-profit corporation, supported by a combination of public and private sources, advises and assists industry and public authorities on the adoption of waste minimisation techniques, of clean technologies and of cleaner production methods.

Netherlands — Cleaner Production Programme. This programme disseminates information and stimulates the utilisation of clean technology in smaller firms, focusing on foods, wood and furniture, printing, chemicals, rubber and plastics, building materials, metal products and motor vehicle sectors.

Norway — GRIP Centre for Sustainable Production and Consumption. This GRIP (Green Management in Practice) centre aims to stimulate adoption of innovative environmental management practices in the public and private sectors, particularly in smaller firms, through information dissemination and demonstration.

United Kingdom — Environmental Technology Best Practice Programme. This scheme focuses on waste minimisation and the use of cleaner technologies through the dissemination of "good practice" guides in several industries, including foundry, textiles, paper and board, volatile organic compounds, glass, food and drink, chemicals, printing, metals finishing, ceramics, and plastics and packaging.

175. Fiscal incentives, in addition to public expenditure on R&D, may also be used for encouraging the take-up of environmental technologies. The scope for diffusing technology is often limited by low capital stock turnover rates, averaging 10 to15 years for many manufacturing processes. Businesses generally bring new technologies into play only when the existing capital equipment is replaced. To speed up this cycle, some countries are giving accelerated depreciation allowances or investment tax credits targeted to environmental investments. For example, Finland offers accelerated depreciation for investments in air and water pollution control. Canada allows certain energy conservation and renewable energy equipment to be written off at a 30 per cent declining rate. The Netherlands offers accelerated depreciation on expenditures that improve energy efficiency and on pollution prevention equipment. Regional governments are also experimenting with environmental tax credits. For example, Quebec offers a 20 per cent tax credit on investments in clean technology. In the United States, pollution control technology gets tax relief in Illinois, recycling equipment investments are eligible for tax deductions in Virginia, and Oregon has tax credits directed at specific pollution prevention technologies. However, such programmes are still too limited and recent to evaluate their effectiveness in stimulating environmental investments.

Addressing international issues

Assisting developing countries

176. Sustainable development depends on the application of clean technologies on a broad scale by non-OECD as well as OECD countries. A special challenge is to enable developing countries to take full advantage of energy-efficient and cleaner production options and to adapt them to their needs. The main constraints in many of these countries relate to a lack of human, institutional, technical, managerial and financial capacities needed to manage technological change (*see* Chapter 7). Support for the dissemination

of technological know-how, therefore, must concentrate first on capacity development to underpin the long-term application of new technologies. Since the private sector is the largest source of finance for cleaner production and a major actor in technology innovation, diffusion and application, policy efforts should also focus on providing the private sector with an open, competitive and sound policy environment.

177. In this context, development co-operation can act as a catalyst to foster public and private actions at the policy, sectoral and firm levels (*see* Chapter 7). While developing countries must take a leadership role, donors can assist in vital areas like capacity building and the formulation of policy frameworks conducive to increasing demand for cleaner technologies. This includes designing market incentives such as removal of inappropriate subsidies and the introduction of user fees and fiscal incentives and ensuring the necessary institutional mechanisms for their implementation. Official Development Assistance (ODA) in these areas aims to complement and leverage investments in cleaner technologies which depend primarily on domestic resource mobilisation and access to foreign direct investment. Special schemes have also been set up to assist developing countries in addressing specific environmental concerns, including the Global Environmental Facility (GEF), the Multilateral Fund for the Implementation of the Montreal Protocol, the Clean Development Mechanism established under the Kyoto Protocol, and the UNIDO/UNEP National Cleaner Production Centres Programme.

Enhancing international technology co-operation

178. Some problems are so global in nature that only concerted international action can resolve them. Addressing issues such as climate change, ozone layer depletion, desertification and biodiversity will require joint and coherent action by countries to develop and disseminate innovative technology. Large-scale and long-term, these issues require the insights of many disciplines and the efforts of many countries to be understood and addressed. Individual researchers and countries cannot solve these problems on their own. The world's most advanced science and technology resources are concentrated in the OECD countries and much more co-operation could occur in a wide variety of areas of research and development. Research co-operation and technical collaboration is crucial for attaining critical sustainable development goals, such as addressing climate change (Box 5.6).

Box 5.6. Climate Technology Initiative

Through the Climate Technology Initiative (CTI), countries are working together to support the objectives of the Framework Convention on Climate Change through joint science and technology programmes. The CTI provides a framework for countries to collaborate to accelerate the contribution of technology to addressing the problem of global climate change. The wider adoption of climate-friendly technologies and the development and deployment of new and innovative technologies are an important part of the climate response. The European Commission and 23 IEA/OECD countries launched the CTI at the First Conference of the Parties (COP1) in Berlin, Germany in 1995. The CTI has now evolved to include regional workshops and country-specific consultations on the best climate-friendly technology options.

In addition to sharing the experience and benefits of national climate technology research and programmes, the CTI promotes and sponsors joint research and development on climate-friendly technologies. Four multilateral research projects were launched at COP3 to investigate ocean sequestration of carbon dioxide, geological sequestration of carbon dioxide from fossil fuels, combustion in recycled CO_2/O_2 mixtures, and very large-scale photovoltaic power generation systems utilising desert areas. Collaborative research proposals are also being developed on: hydrogen production from fossil fuels; biological hydrogen production; chemical CO_2 fixation and utilisation; different pathways for methanol production; transportation fuels from biomass; CO_2 as a chemicals industry feedstock; and integrated supply of heat and CO_2 to the horticultural industry.

Source: International Energy Agency

Future work

179. Work, as part of the three-year horizontal project on sustainable development, will continue on deepening the analysis of the linkages between technology and sustainable development, based on horizontal activities and including a number of workshops and meetings. The 2001 reports for the Ministerial Council Meeting will present recommendations to Member countries for designing policies which can create a framework for stimulating cost-effective innovation to achieve sustainable development goals and for supporting such policies in non-member countries. The following are among the areas to be studied:

- Analysis will be undertaken to advance understanding of the concepts of eco-efficiency and resource efficiency and their relationship to sustainable development, including the development of indicators that can be applied to countries, sectors and technologies.

- Work will be pursued on how innovation systems can best provide the conditions and incentives needed to promote environment-related innovation and achieve eco-efficiency in a broad range of activities. This could explore how environmental policy instruments can best be combined to stimulate sustainable innovation in industry, particularly the role of economic instruments.

- More in-depth analysis will be undertaken on specific types of technologies and their contributions to sustainable development, including those relating to energy, nuclear power, agriculture and biotechnology.

- Joint activities with industry and the World Business Council on Sustainable Development (WBCSD), based on case studies, will seek to further understanding of how enterprises incorporate environmental objectives into their management strategies, including investments in clean technologies. A related activity could compare best practices in promoting environmental management in small and medium-sized enterprises (SMEs).

- Means for facilitating international collaboration in research and development on environmental problems and technologies will be investigated.

CHAPTER 6. MEASUREMENT: SUSTAINABLE DEVELOPMENT INDICATORS[84]

Introduction

180. The three pillars on which measurement of sustainable development ought to rest are economic, social and environmental data. In his Nobel lecture in 1984, Richard Store argued that: "By organising our data in the form of accounts we can obtain a coherent picture of the stocks and flows, incoming and outgoing of whatever variable we are interested in, whether these be goods and services, human beings or natural resources, and thence proceed to analyse the system of which they form part".[85] National accounting is well developed in the economic area, and the OECD is a major producer of a large number of economic data for international comparisons and economic analysis. Standard economic indicators like real GDP and inflation — often focusing on short-term issues — appear daily and represent a key base and focus for economic policy formulation. Important progress has also been made in the production and dissemination of social and environmental indicators, areas where the OECD has been in the forefront in developing statistics, mostly for sectoral needs and policies. In the environmental field the OECD has developed — in response to a mandate from the G7 in 1989 — a core set of environmental indicators covering a number of major environmental issues of common concern to OECD countries. Similarly, the OECD developed in the early 1980s a list of social indicators, most of which are now published in a number of OECD publications. Overall, however, these environmental and social data are younger, and we are still lacking a consistent and agreed upon measurement framework linking economic, social and environmental issues. One objective of the OECD three-year horizontal project on sustainable development is to explore how the present large number of existing economic, social and environmental data can be combined into sets of indicators that are useful for practical policies to enhance sustainable development.

Scope of sustainable development indicators

181. As noted in Chapter 1, sustainable development implies *inter alia* a medium- and long-term view of policies and developments in the economic, environmental and social fields. Such a view is important for assessing the scale of a number of threats to the environment, such as climate change, but also in the social areas, where for example long-term demographic developments may pose threats to the financial sustainability of pension and health systems. Selecting the most appropriate indicators is a function of the specific policy question being addressed. OECD work on indicators encompasses four categories of indicators, each responding to specific policy questions:

- Sectoral indicators, which may be used to integrate economic, environmental and social concerns at the sectoral level. These indicators describe how development and policies at the

84. The development of indicators for sustainable development was one of the main recommendations of the High Level Advisory Group on the Environment to the OECD Secretary General. In its Report of November 1997 it recommended that: "The OECD must now embark on the development of a ... set of sustainable development indicators ... well supported by reliable and comparable data sets".

85. R. Stone (1997), "The Accounts of Society", reprinted in *The American Economic Review*, December.

sectoral level impact on the environment and social conditions, as well as on economic efficiency.

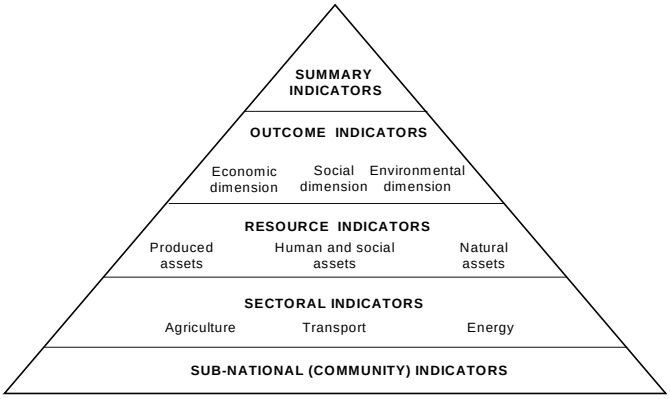
– "Resources" indicators, which may be used to describe the accumulation and depletion of capital (produced, natural, and social assets). These indicators provide information on how current patterns and activities are impacting on future opportunities.

– "Outcomes" indicators, in the economic, environmental and social fields, which may be used to characterise the direction and quality of the development that we are achieving.

– "Summary" indicators, which combine and/or select information from a number of areas and which aim to provide a broad picture of the current path towards sustainable development.

For each of these categories of indicators different spatial scales will apply. These various layers of indicators are illustrated in Figure 6.1.

Figure 6.1. A pyramid of indicators to answer different policy questions



The role of frameworks for measurement of sustainable development

182. Frameworks have an important role in organizing and relating existing data and information. To a large extent, the choice of a framework depends on the policy or analytical question under consideration. In all cases, however, a coherent structure is required to allow analysis of the relationships and trade-offs between different dimensions. Conceptual frameworks can guide in the selection of indicators needed to answer certain questions and, in some cases, may permit their aggregation. Two main types of framework may be distinguished:

– Accounting frameworks based on the national accounts approach. A first step in developing these frameworks is to extend the conventional range of assets to include natural and social assets as well as economic assets. [86] Economic development is driven by the use of assets and

86. The idea of extending the national accounts to cover environmental issues is long established. A suggested framework is that of the System of Environmental Economic Accounts (SEEA). However, while there is consensus on some of the basic principles, a large number of unresolved issues remains concerning

indicators of their evolution will help to assess whether the current development path is sustainable. This requires measures of assets stocks and of changes in these stocks brought about by investment, depreciation, degradation and depletion. A second step is to present other data relevant to sustainable development alongside conventional national account flows such as consumption expenditure and industrial output. Examples of such additional data include population changes, data on air and water pollution, and productivity changes. An accounting framework provides a powerful tool for structuring statistical data , and for linking economic, environmental and social data in both monetary and physical terms. A robust accounting framework allows the interaction of policies in different fields to be juxtaposed consistently, as well as permitting indicators derived from these accounting frameworks to feed into other, more detailed, sectoral frameworks.

– Frameworks based on the Pressure-State-Response (PSR) model, originally developed in the context of OECD work on environmental policies and reporting, provide a means of selecting and organising indicators in a way useful for decision makers and the public. They highlight the relationships between the different dimensions of sustainable development, and help decision-makers to design policies that address problems at the appropriate level. Depending on the purpose for which the PSR model is to be used, it can be easily adjusted to take account of greater detail and specific issues. Examples include the "Driving force–State–Response" (DSR) framework, used by the UN Commission on Sustainable Development in its work on indicators; the "Driving force- Pressure-State-Impact-Response"(DPSIR) model used by the European Environment Agency; and applications — also in the OECD — to detail major indicators at the sectoral level. A particular extension of the PSR model undertaken by the Wuppertal Institute focuses on the four dimensions of sustainable development as defined by the UNCSD (economic, environmental, social and institutional), and considers the role of linkage indicators[87]. Overall, these frameworks are targeted at in depth policy analysis of specific issues or sectors, in contrast to the broader alternative described above.

183. The OECD sees the development of appropriate frameworks for measurement as central to its work on sustainable development indicators. The OECD Statistics Directorate, in collaboration with other directorates, is working to develop an extended national accounts framework linking economic, environmental and social factors. An OECD workshop in September 1999 will focus on some of these issues.

Integration of economic, environmental and social concerns at the sectoral level: sectoral indicators

184. While data on economic, environmental and social conditions provide the foundation of any attempt to measure and assess countries' progress towards sustainable development, a first objective is to develop sets of indicators which allow integration of economic, environmental and social concerns for particular sectors within a country. There is considerable interest in developing indicators that consider how sectoral trends and policies may impact on the environment and on the well being of the population. Much of this work has focused on sectors or activities that play a key role in affecting the sustainability of a country's development and where government intervention is important. Examples are transport, energy

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valuation and appropriate recording of the flows in an extended set of accounts. A useful review of some of the issues is provided by P. Bartelmus (1999), "Greening the National Accounts: Approach and Policy Use", UN DESA Discussion Paper No 3.

87. J.H. Spangenberg, O. Bonniot (1998), "Sustainability Indicators: A Compass on the Road Towards Sustainability", Wuppertal Paper No. 81, February.

and agriculture. Sectoral indicators aim to describe: *i*) sectoral trends of environmental and social significance; *ii*) positive and negative effects of the sector on the environment and society; and *iii*) economic and policy aspects of these interactions.

- Agriculture. Improving environmental performance in agriculture is an important objective of reform programmes in many OECD countries. Environmental policies, as well as international environmental agreements such as the Kyoto Protocol, are also increasingly impacting on agriculture. To improve information on how agricultural trends affect the environment, the OECD is developing a broad set of agri-environmental indicators[88]. Preliminary results suggest a general improvement in the environmental performance of agriculture over the past 10-15 years for many OECD countries. The work is now moving into a more intensive data collection and measurement phase. As indicators are developed, the linkages between them will be analysed to improve interpretation of indicator trends. For example, changes in indicators of nutrient use (driving force) can be linked to changes in water quality (state) and related to changes in management practices (responses).

- Transport. Transport is a direct input into most economic activities and plays a significant role in the daily lives of households. The development of specific transport indicators is motivated by the complexity of the interactions between transport, on one side, and the economy, the environment and society, on the other, and by the significant role of government policy. Work at the OECD and ECMT aims to highlight the interface between transport activities and environmental and social issues, and to identify how different driving forces and policy instruments interact and affect the environmental and social impacts of transport. Relevant indicators need to consider a range of factors such as the various modes of transport, different energy efficiencies, types of fuel used, and the rates of increase in transport volumes (passenger, freight). A special focus of the OECD work programme on transport indicators is placed on road transport and road accidents.

- Energy. Energy is an essential input to many economic and household activities. From the perspective of an individual country, the structure of its energy supply and its energy intensity, along with changes over time, are key determinants of environmental performance. As the environmental effects of energy production and use differ greatly by energy source, detailed indicators are developed. The supply structure of the energy sector varies considerably among countries according to their relative endowments of energy resources, demand of energy from industry, transport and households, national energy policies and national and international energy prices. Work in the OECD, IEA, NEA is directed towards expanding energy indicators to better link energy-related activities and environmental issues and to better integrate the social dimension. Work at IEA is specifically targeted at compiling indicators at a very detailed level but which can be meaningfully aggregated. More generally, it is important that the relationship between energy and economic and human activity be described in both physical and monetary terms. This requires analysis of energy intensities and efficiencies and of specific environmental impacts such as radiological pollution.

88. These indicators cover primary agriculture's use of natural resources and farm inputs; the impact on soil and water quality, land conservation, greenhouse gases, biodiversity, habitats and landscape; and, the interaction between the environmental, economic and social factors.

Integration of economic, environmental and social concerns at different spatial scales: sub-national indicators

185. The challenge of integrating indicators of economic, environmental and social concerns also applies to different spatial scales. About half of the total OECD country population live in highly urbanised areas covering only five percent of the total surface of OECD countries. Around one quarter of the OECD population lives in four-fifths of the surface. This points to an uneven spatial distribution of the main economic, social and environmental challenges to sustainable development. A range of spatial units is hence required to best describe these different developments and to assess the adequacy of policy responses. In some cases, national boundaries may not cover the relevant zones of economic interaction and environmental impact (e.g. river catchments), and in other cases, the unit used may risk overlooking local "hot spots" of pollution or deprivation. In such cases, an assessment of countries' progress towards sustainable development will require a better matching of the spatial scales at which socio-economic driving forces operate, environmental impacts occur, and societal policy responses are organised. This is especially true for international comparisons of countries that differ in terms of size, endowment of natural resources, patterns of human settlements, levels of socio-economic development and political systems.

186. The development of basic economic, social and environmental data for comparable territorial units is an important component of OECD efforts. A differentiated territorial scheme for data collection, aggregation and area typologies has been developed through the OECD Activity on Territorial Indicators. Preliminary analysis has focused on spatial patterns of employment creation and social indicators. Work over the next two years aims at developing environment statistics on a sub-national level, moving in the direction of an integrated territorial information base on key aspects of sustainable development.

Measurement of assets: resource indicators

187. As stated in previous chapters, a necessary condition for sustainable development is preserving stocks of different types of assets, e.g. housing and machinery, skills and competencies, mineral and environmental resources. Relevant issues in the measurement of various types of assets include monetary valuation, estimation of the physical quantities of the various stocks, and measures of key flows, i.e. investment, depreciation, degradation and depletion. Some of the main measurement issues for the different categories of assets are discussed below.

Produced and financial assets

188. *Produced assets,* such as machines, factories, dwellings, computers and oil rigs, form the basis of much economic production and appropriate investment in these assets is essential to long term economic growth. Relevant indicators include measures of investment and depreciation, and values and volumes of these assets. While significant progress has been made in terms of concepts and valuation techniques for economic assets, only about half of OECD countries regularly release data on the stocks of produced assets. The OECD, in the context of its work on national accounts, is contributing to a forthcoming manual that aims to improve the estimation of data on produced assets.[89] *Financial assets and liabilities* can also have significant implication for sustainable development. Relevant instruments included are both external and domestic (such as cash, stocks and bonds). The statistical situation here is more developed and financial balance sheets are available for a large number of OECD countries, and are regularly published by the OECD.

89. *Manual on Capital Stock Statistics,* in conjunction with the Canberra Group on Capital Stock Statistics.

Natural assets

189. *Natural assets* include non-renewable assets, such as minerals, and renewable resources such as forests, land, air, water and biodiversity (see Chapter 4).[90] In contrast to economic assets, measurement issues are substantial, and they concern both the measurement of physical quantities of individual resources (both initial stocks and flows over time in terms of depletion and degradation) and their aggregation.

190. In some cases it may be possible to aggregate physical quantities to provide detailed information on resource use, emissions and pollutants by sectors. This type of information is often closely linked to input-output accounts, and provide information on physical flows of resources, such as energy, and the resulting physical flows of pollutants and emissions, such as CO_2, for each production sector and final demand component. In some cases, scientific knowledge provides a basis for aggregating different physical elements. For example, in the context of global warming, different gases may be aggregated according to a "global warming potential" based on their physical properties and persistence in the atmosphere. Measures that aggregate across resources with different environmental impacts, such as "total material requirement", have been developed for a number of OECD countries[91]. However, these measures have limitations, as resources differ in terms of their environmental impact.

191. Monetary valuation provides an alternative for aggregation but the measurement difficulties are considerable. For non-renewable resources that are only used as inputs to economic activities, such as coal, estimates of stocks and depletion can be based on observed market prices, but the use of different methods can result in large differences in results.[92] For renewable resources that have multiple uses the issues are more complex. For example, while the value of forests can, in part, be assessed using market valuations of timber, forests also have environmental values — in terms of climate change and biodiversity — and social values — where forests are used for recreation. For these resources, one must evaluate whether economic activity threatens: *i*) repeated economic use; and *ii*) non-economic use. Alternative valuation methods for *i*) give widely different results, while no consensus exists on *ii*).

192. In the light of these difficulties, practical progress is best achieved by focusing on the most important resources. OECD work in this area has been directed to measurement of the depletion and valuation of mineral assets and of some environmental assets such as water, forests and fish stocks. About six OECD countries have undertaken work to estimate national balance sheets covering produced, financial and some natural assets. A second workshop on depletion of natural resources is scheduled in September 1999. OECD work is also directed, in the context of the "London Group on Environmental Accounting", to the measurement of degradation of air and water. A significant issue in the measurement of natural resource assets is the measurement of resource productivity. Box 6.1 identifies some of the key issues.

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90. Renewable resources often have multiple-use as: *i*) inputs to economic activities; *ii*) key factors in ecosystems; and *iii*) sources of non-market utility such as recreation. The existence of multiple uses presents particular problems for valuation.

91. World Resources Institute *et al.* (1997), *Resource Flows: The Material Basis of Industrial Economies*, Washington D.C., April. The "Total Material Requirements" of an economy is an estimate of the total volume of materials – in physical terms – displaced or used by economic activities. These estimates consider both domestic and imported materials, and materials used either directly or hidden (e.g. the displacements of natural resources such as waste from surface mining).

92. Two methods are most commonly used. The first estimates the depletion of natural assets by multiplying the change in the stock by the rent (defined as the market price minus the marginal cost of exploitation) associated with the resource, an assumption that may be questionable for discoveries that are not yet exploited. The second, measures the depletion of the stock as the change in the expected net present value of the rent from the resource, which may lead to large fluctuations in values with changes in current prices.

Box 6.1. Measuring Resource Productivity

Productivity improvements are essential to improve economic welfare. Measures of productivity are straightforward in the case of a single factor of production, but require the use of economic assumptions and estimations in the presence of different factors. Estimates of "total factor", and labour and capital, productivity are common in economic debates and are published regularly by national statistical offices and the OECD. Labour and capital are not, however, the only factors in production. Natural resources are also used as inputs in the production of final goods and services; and the efficiency of their use is key in matching supply and demand, and in minimising negative environmental impacts. The Secretary General's High Level Advisory Group on the Environment therefore proposed that appropriate attention be paid to increasing resource productivity.

There is, however, little agreement on what constitutes the right measure of resource productivity, reflecting *inter alia* lack of relevant prices for several environmental inputs, and uncertainties on how to adjust outputs for the environmental impacts of resource use. Further, possible uses of such indicators differ. Governments may be particularly interested in aggregate indicators of performance, such as changes in resource use per unit of GDP. Businesses may be more interested in detailed indicators at the firm-level, such as the "eco-efficiency" indicators (including material and energy intensity, toxic dispersion, recycling of material, etc.) proposed by the World Business Council on Sustainable Development (WBCSD). These differences suggest that various indicators may be required for various purposes and levels of analysis. An exploratory note on the measurement of resource productivity, focusing on aggregate indicators, was recently discussed by the Statistical Working Party of the OECD Directorate for Science, Technology and Industry[1]. Work by the OECD Environment Directorate[2] is focusing on "eco-efficiency" trends and potentials in selected sectors and on the evaluation of government strategies to improve resource efficiency. Work on related indicators and conceptual frameworks has been postponed until 2000.

1. OECD (1998), *Measuring Resource Productivity: An Exploratory Note,* Directorate for Science, Technology and Industry, DSTI/EAS/SWP(98)5.
2. OECD (1998), *Increasing Resource Efficiency: Draft Work Plan*, Environment Directorate, ENV/EPOC(98)16

Social assets

193. *Social assets* include both *human capital*, which covers the health and education of the population, and *social capital*. Of the various types of assets, social assets are among the most difficult to measure, although they may well account for the largest share of national wealth in most OECD countries.[93]

194. Traditional measures of human capital have been based on completed years of schooling or on formal educational qualifications, with market values of each level of educational attainment based on the earnings accruing to individuals with that attainment. However, both assumptions are simplified approximations of reality. Neither takes into account the quality of education received, the possibility of depreciation of human capital over time, the education or training received in the workplace[94] and in government sponsored programmes, and the importance of factors different from educational attainment that influence earnings levels. OECD studies of adult competencies, through survey-based skill assessments, show that significant proportions of individuals over- or under-perform relative to formal qualifications, and that literacy skills, like other capital assets, can depreciate as a result of technological change if not maintained through regular practice at home and at work. On the investment side, the

93. According to World Bank estimates, social assets may account for between 65 to 80 per cent of total wealth in most developed countries. See World Bank (1997), *Expanding the Measure of Wealth*, Environmentally Sustainable Development Studies and Monographs Series No. 17, Washington D.C.

94. Hours-based measures covering all adults show an average of some fifty hours of annual training per adult in a number of OECD countries

national accounts treat as consumption most spending on education either by governments or by firms.[95] A recent major report on human capital by the OECD identifies the limits of existing measures of human capital, and the Organisation is working towards the development of a set of indicators.[96]

195. The challenges for measurement are even more complex for social capital. The concept of social capital does not lend itself to a neat representation in terms of stocks, investment and depletion, and rates of return. However, a number of social indicators may be used to highlight strains or fragmentation in the social fabric, so as to provide warning signals of a possible decline of social capital.

Assessment of progress towards sustainable development in the economic, environmental and social fields: outcome indicators

196. The identification of human well being as the goal of sustainable development requires indicators which point to how well policies in the economic, environmental and social fields are performing in relation to this overall goal. One first step in summarising existing information that focus on well being is to select a "core" set of indicators addressing key issues of sustainable development. This "core" set approach has the benefit of using indicators that are common to different countries, that respond to different uses, and that can be meaningfully compared across countries. The OECD core set of environmental indicators[97] and the OECD list of social indicators[98] are examples of this approach. The list of indicators of development progress developed jointly by the UN, the World Bank and the OECD is another example for developing countries (see Chapter 7, Box 7.5). Another similar approach, pursued in several OECD countries, is that of "headline" indicators, which are developed in small numbers, country specific, and often media-oriented.[99] A possible, and highly tentative, selection of such indicators for OECD countries covering economic, social and environmental issues is presented in Table 6.1. Despite the fact that the choice of indicators may be somewhat subjective, this approach does allow key aspects of sustainable development to be considered in a simple way. However, by not aggregating a variety of

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95. OECD governments spend on average around 6 per cent of GDP in education. Data for a number of countries also suggest that firms spend around 1 to 2 per cent of payroll costs in employees training. The OECD is working to assess the feasibility and value of improving information about firms' investment in human and intellectual capital. An OECD international workshop on this issues is scheduled for June 1999 in Amsterdam.

96. OECD (1998), *Human Capital Investment – An International Comparison*, Paris.

97. The OECD core set of environmental indicators cover 13 major issues: climate change; ozone layer depletion; water quality; acidification; toxic contamination; urban environment quality; biodiversity and landscapes; waste; water resources; forest resources; fish resources; and soil degradation (desertification and erosion). It further includes selected socio-economic and sectoral indicators having an environmental significance. See OECD (1998), *Towards Sustainable Development – Environmental Indicators*, Paris.

98. The 1982 list of social indicators covered 33 items, many of which were published in OECD (1984), *Living Conditions in OECD Countries*, Paris. More recently, developments in 24 key social indicators covering education, and labour markets, the family, ageing, health, expenditure on social policy and income distribution, have been presented in OECD (1998), *Sustainable Development Indicators – Proceedings of an OECD workshop*, Paris. The indicators included there were not intended as a finalised set, but rather to focus attention on the purpose and availability of these indicators.

99. Several OECD countries have pursued this approach, most recently the United Kingdom in *Sustainability Counts: Consultation Paper on a set of 'headline' indicators of sustainable development.* The proposed list includes 13 indicators covering economic growth and employment; social progress; protection of the environment; and natural resources.

indicators from the various dimensions, it becomes difficult to characterise whether overall economic developments are sustainable or not. As a result, questions about countries' progress towards or away from sustainable development are more difficult to answer.

Table 6.1. A possible set of core sustainable development indicators

Economic indicators	
1. Economic development	Gross Domestic Product (GDP) per capita ; Net National Income (NNI) per capita
2. Asset replacement	Net saving rate
3. Productivity	Total Factor Productivity (TFP)
4. Financial status	Net foreign debt/GDP; Net and gross government debt/GDP
Social indicators	
1. Work status	Unemployment rate; Employment-to-population ratio
2. Education	Participation; Attainment
3. Health status	Life (and healthy life) expectancy; Potential life years lost per 100,000 population
4. Income	Incidence of poverty; Disposable income per equivalent adult
Environmental indicators	
1. Climate change	Greenhouse gas emissions and emission intensities (per capita and per unit of GDP)
2. Air	SOx and NOx emissions and emission intensities (per capita and per unit of GDP)
3. Biodiversity	Share of threatened species (as per cent of species known); protected areas (as per cent of national territory)
4. Water resources	Intensity of use of water resources
5. Forest resources	Intensity of use of forest resources
6. Fish resources	Fish catch and consumption

General assessment of progress towards sustainable development: summary indicators

197. In order to develop indicators that describe countries' progress towards sustainable development, some degree of aggregation of existing information is required. However, the task of aggregation is a formidable challenge. Researchers and statistical agencies have suggested a number of approaches to this question, some of which are reviewed below. An OECD workshop on 2 – 3 September 1999 will provide a further opportunity for dialogue on some of these approaches.

Composite indicators

198. Having selected a range of key indicators one approach is to aggregate them into a single index of human well being. One such application is the "Human Development Index" developed by UNDP, which combines indicators of health (life expectancy), education (literacy and years of schooling) and economic welfare (per capita income) into a single measure. Another application takes household consumption expenditure as a point of departure and adjusts it for a range of "positive " and "negative" factors of economic (e.g. services from roads), environmental (e.g. costs of air pollution) and social (e.g. cost of commuting) nature to derive "Indicators of Sustainable Economic Welfare" (ISEWs)[100]. However, controversies are raised about the choice of the component indicators and their relative importance within an overall index.

100. A review of some of results for Australia, the United Kingdom and the United States is provided in "Composite Indicators of Sustainable Development", STD/NA(98)17. In the three cases, consumption expenditure is adjusted for factors such as "defensive" government and household expenditure, unpaid household production, income distribution and several environmental factors. In the United States and the United Kingdom the ISEWs have been growing more slowly than consumer spending, or even declining, since the mid-1970s, while in Australia the ISEW rose as fast or faster than consumption expenditure.

Adjusted national accounts measures

199. A different perspective on aggregate measures of sustainability is based on the concept of income defined by Hicks, i.e. the maximum amount that may be consumed in a given period of time without decreasing total wealth. To apply this perspective, existing national accounts measures, such as GDP, are adjusted for the depreciation and depletion of a wide range of produced and environmental assets. First, Net Domestic Product (NDP) is obtained by deducting from GDP the depreciation of produced capital. Second, "adjusted" or "green" NDP is derived by further deducting estimates of the depletion of natural capital (primarily mineral assets, land and forest) and environmental degradation. In a further elaboration of this approach, the concept of "genuine savings" deducts the value of consumption from "green" NDP.[101] "Genuine savings" allows a more straightforward assessment of "weak sustainability", as persistent negative values may be interpreted as an indication of a decline of the total capital stock.[102] However, the construction of adjusted national accounts still raises conceptual and practical problems, like uncertainty about future prices, discoveries of mineral assets, and valuation of environmental assets. While this is a promising approach, more work is needed before a conclusion can be drawn as to whether providing separate information on different types of capital would be preferable to aggregating it within an adjusted national account measure.

Future work

200. Key issues for further work are measuring the broad scope of sustainable development and interpreting and applying indicators to policy questions, i.e. specifying further how the different indicators can better inform practical policies to enhance sustainable development. These tasks are not straightforward. This chapter has outlined the key indicator areas and pointed to some of the problems in measurement and interpretation. Future work must utilise OECD's strengths and aim at filling specific knowledge gaps. To this end, a number of workshops and conferences are planned. Over the next two years work will aim to:

- Identify suitable frameworks for the analysis of sustainable development indicators with particular focus on extensions to the national accounts framework.
- Monitor the development and use of summary indicators in OECD member countries.
- Refine the OECD core set of environmental indicators to link it more closely to policy formation and to existing economic and social indicators.
- Continue work on measurement of environmental and social assets and the associated depreciation and depletion.
- Draw on the work on human capital and integrate it within the OECD Sustainable Development project.
- Expand the work on sectoral indicators to better cover links between the three dimensions of sustainable development and to other sectors.

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101. See Atkinson G., R. Dubourg, K. Hamilton, M. Munasinghe, D. Pearce and C. Young (1997), *Measuring Sustainable Development*, Edward Elgar, Chetenham, United Kingdom.

102. Estimates of "genuine savings" for a number of developed and developing countries are presented in World Bank (1997), *op. cit.*

- Integrate the spatial dimension into assessment and policy formulation.

- Enhance co-operation with other international organisations, research institutes and universities that are working actively in this area to achieve synergies and advance knowledge on measurement of sustainable development.

CHAPTER 7. ENGAGING NON-MEMBER COUNTRIES IN POLICIES TOWARDS SUSTAINABLE DEVELOPMENT

Introduction

201. Globalisation is leading countries into closer economic interdependence through intensified trade and investment linkages and rapid advances in technology. Within the next two decades, the non-OECD share of world GDP may rise from approximately 40 per cent in 1995 to more than 60 per cent, with the five largest non-member countries (Brazil, China, India, Indonesia and Russia) possibly accounting for more than one-third of world GDP.[103] The strengthening of co-operative programmes between OECD, Russia, China and Brazil builds upon these developments.

202. Globalisation has the potential to promote more efficient resource use and increase overall welfare, but it is also likely to amplify and/or redistribute existing social and environmental pressures. The increasing economic weight of non-OECD countries is likely to shift the locus of pressures on the global and regional environment. Establishing sound policies and institutional frameworks for sustainable development in non-OECD countries is therefore critical if the material gains from intensified trade and investment flows are not to be at the expense of social and environmental developments. However, many developing countries, and particularly the least developed, still lack the basic capacity to establish and enforce appropriate laws and regulations. Accordingly, the focus of development co-operation is increasingly on helping them to establish the economic, legal and regulatory frameworks necessary to provide a stable and attractive investment climate, while ensuring compliance with social and environmental rules and safeguards (Box 7.1).

203. To enhance strategies for sustainable development in developing countries as part of the three year 1998 Ministerial mandate, and as a contribution to advancing international co-operation, the OECD is engaged in identifying effective policies and collaborative approaches in the following areas:

- Strengthening coherence between trade, investment, development and environment policies.
- Formulating national strategies for sustainable development.
- Addressing global environmental concerns, such as climate change, biodiversity and desertification.
- Accelerating the diffusion of cleaner technologies.
- Measuring progress by developing countries towards sustainable development goals.

103. OECD (1997), *The World in 2020. Towards a New Global Age*, Paris.

Box 7.1. The OECD Development Partnerships Strategy

The approach to genuine partnerships between OECD countries and developing countries, as set out in the OECD/DAC *Shaping the 21st Century* strategy, emphasises the lead role of developing countries and their people in setting out their own sustainable development strategies. It looks to donor agencies to:

- Facilitate the strengthening of local capacities for managing sustainable development programmes.;
- Encourage local commitment, ownership and participation.
- Provide needed complementary resources.
- Carry out co-ordinated and coherent policies supportive of sustainable development.

Source: OECD (1996), *Shaping the 21st Century: The contribution of Development Co-operation*, Paris.

Strengthening the coherence between trade, investment, environment and development policies

204. The capacity of developing countries to reap the benefits of open trade and investment depend both on their own efforts towards policy reform and on the policies of OECD countries, which may not always be coherent with the objectives of sustainable development. Maintaining a development-friendly global economic environment is an important responsibility for OECD countries, which are increasingly taking into account the impact of their own policies on developing countries. The concept of sustainable development provides a useful guide to the ranking of competing policy objectives, in the light of a range of domestic and international factors. [104]

205. In a context of global economic integration, there is a strong need to improve the coherence of trade, investment, development and environment policies at national, regional and international levels so that they are complementary and mutually reinforcing. This need is reflected not only in debates about the inclusion of trade measures in certain multilateral environmental agreements,[105] but also in discussions about the use of environmental measures that could act as non-tariff barriers to trade by restricting market access (e.g. eco-labelling and packaging rules). This latter issue is particularly important for developing countries. On the one hand, the demand for "green" products could result in more opportunities and market advantages for developing countries in sectors where their traditional products and production methods are environmentally friendly. On the other hand, stringent and numerous environmental requirements, which do not take account of regional differences and local conditions, could hinder trading opportunities in the developing world.

206. Continuing efforts are being made to support the further integration of environmental and trade policies as called for in the 1993 Procedural Guidelines on this subject. The OECD Joint Working Party on Trade and Environment has identified the following issues for further examination:

- Mechanisms to promote transparency on trade and environmental issues.
- Environmental effects of trade liberalisation, including in the transport sector.
- Assessment of environmental and trade agreements.
- Processes and production methods.

104. See "Trade, Investment and Development: The Challenges of Policy Coherence in a Global Economy", SG/LINKS(99)1/REV1.

105. "Trade Measures in Multilateral Environmental Agreements. Synthesis Report of Three Case Studies" , COM/ENV/TD(98)127/Final.

- Multilateral environmental agreements.
- The Kyoto Protocol and its trade effects.

In addition, the role of environmental assessment has been under consideration in the context of the OECD Working Part on Export Credits and Credits Guarantees, a potentially significant development in view of the large volume of trade supported by such arrangements. In mid-April 1999, an Agreement was reached (except that confirmation is awaited from one Member) under which Members of the Working Party on Export Credits and Credit Guarantees will voluntarily share Environmental Impact Assessments for larger multi-sourced projects on a case-by-case basis. Under the Agreement, which draws upon their experience to date, Members undertake to share information, exchange views and co-ordinate their responses to exporters, lenders and borrowers to such projects.

207. An OECD conference on foreign direct investment and the environment, held in The Hague in early 1999, analysed key policy issues in the investment and environment relationship. The debate has moved beyond the sometime polemical discussion of pollution "havens" and "halos", and the issue of industry relocation. More emphasis is now being given to monitoring the environmental performance of foreign direct investments, including their aggregate environmental impacts. Future analysis will also concentrate on specific economic sectors, such as extractive industries. Further attention should be given to the policies and institutional arrangements that could help to better integrate investment and environmental policies. In view of the limited capacities in many developing countries to keep pace with trade and investment liberalisation, voluntary commitments by the private sector could help ensure that investment contributes to, and does not compromise, development objectives. The revision of the environmental chapter of the OECD *Guidelines for Multinational Enterprises*, presently under discussion, could contribute to this effort. Another important area for future work concerns the scope for public-private partnerships in the provision of environmental services such as urban water.

208. Important weaknesses in many developing countries include a lack of regulatory stability and transparency as well as a shortage of expertise in areas such as negotiating, contracting and competitive bidding. In some sectors, including mining, forestry or fisheries, this may make it more difficult to ensure the necessary balance of benefits between investors and host countries and may also result in increased pollution and unsustainable production patterns. Unpredictable regulatory regimes encourage short-term rent-seeking behaviour and act as a deterrent to long-term investment. Future work will review development co-operation initiatives to strengthen capacity in these areas and to help developing countries take advantage of the new opportunities provided by increased investment flows, drawing on past OECD work on regulatory reform.[106]

Formulating national strategies for sustainable development

209. In the wake of the Rio Conference in 1992, many developing and transition countries have formulated strategies for sustainable development as well as sectoral and sub-sectoral strategies. These include *National Strategies for Sustainable Development* (NSSD), *National Conservation Strategies* (NCS) and *National Environmental Action Plans* (NEAPs), as well as strategies for sustainable development at the regional level. The preparation of many of these national and regional strategies has been supported through bilateral and multilateral co-operation. Some of these efforts, however, have suffered from a narrow focus on environmental issues to the detriment of the social, economic and political dimensions of sustainable development. The formulation of many of them has also relied excessively on foreign experts, hindering national ownership. In many cases, the focus has been on the preparation of a document as an

106. OECD (1997), *The OECD Report on Regulatory Reform*, Paris.

end-product for formal governmental approval. This has detracted attention from the need for the all-important processes to mobilise public support and to forge supportive policies and institutions.

210. Experience to date points to a number of key characteristics of effective sustainable development strategies. These include a participatory approach, involving parliaments, local governments, civil society and the private sector in the definition of priority socio-economic development objectives. As stated in *Agenda 21*, National Strategies for Sustainable Development (NSSDs) should "build upon and harmonise the various sectoral, economic, social and environmental policies and plans that are operating in the country". This requires the active involvement of the line ministries responsible for the implementation of sectoral development plans, so as to ensure genuine ownership. In short, the key features of effective NSSDs are linkage, integration, social and institutional mobilisation, negotiation and conflict resolution, and capacity for thinking strategically and working across sectors to improve policy coherence. In this respect, the challenges involved in moving towards sustainable development are common to OECD and developing countries.

211. Future work will focus on identifying effective means for development co-operation to strengthen local capacities and participation in developing and implementing strategies for sustainable development. In line with the partnerships principles set out in the OECD/DAC *Shaping the 21st Century* strategy, this work will involve collaboration with developing country partners through in-country dialogues, in which partners are the main drivers and donors act as facilitators. This work will draw on experience gained from the UNDP Capacity 21 Programme, established in the wake of the Rio Conference to assist developing countries to build capacity for elaborating sustainable development strategies. Related work will focus on clarifying the linkages between the social, environmental and economic dimensions of sustainable development and their policy implications, in particular with regard to the integration of poverty, gender and environmental concerns. This will include the formulation of Guidelines for Development Co-operation in support of Poverty Reduction, taking such linkages into account (Box 7.2).

Box 7.2. Addressing the critical linkages between poverty reduction, gender equality and environmental protection

The complex linkages between the social, economic, environmental and political dimensions of development are often mutually reinforcing in the long run, but may sometimes be contradictory in the short term. For example, rapid GDP growth may sometimes be achieved at the cost of environmental degradation and rising socio-economic inequality, which may in turn contribute to political instability and sometimes to violent conflicts. The capacity of a society to balance social, economic and environmental development is a foundation of sustainable development.

In this regard, a critical requirement of sustainable development is a capacity to identify and address the many linkages between poverty reduction, gender equality and environmental sustainability. Many forms of environmental degradation — ranging from climate-related natural disasters to water and air pollution, deforestation and desertification — affect the poorest disproportionately. Efforts to maintain the integrity of key environmental resources such as water, soil and air will thus contribute directly to improving the immediate well being and long-term economic opportunities of the poor. Conversely, the poor and landless farmers or shepherds, who have to rely on unsustainable slash-and-burn agriculture, often on marginal land, or the exploitation of timber or wildlife for subsistence, often play an important role in resource degradation.

Strategies to protect fragile ecosystems must create the conditions whereby the communities who rely on these resources for their livelihoods have a stake in their sustainable management. It is also critical to recognise that in many situations men and women play different roles in the management of natural resources. This requires careful attention to their respective needs, constraints and vulnerabilities. Therefore, questions of governance such as those relating to land tenure and the allocation of rights to water resources and broader issues of socio-political empowerment assume a vital importance.

Coherent strategies and measures are needed at a global, national and local level, and in a variety of sectors and policy areas at the macro, meso and micro levels. Sound resource planning and management also requires the institutional and technical capacity to assess social, economic and environmental opportunities and constraints and to formulate appropriate policy responses. Development co-operation in these areas can, thus, play a central role in efforts towards a sustainable development that will benefit the poor and reduce gender inequalities.

Source: "Linkages between Environmental, Economic and Social Objectives of Sustainable Development", DCD/DAC/ENV(99)4.

212. In this respect, a number of important lessons may be drawn from the experience of countries in Central and Eastern Europe. While the environmental action plans in Central and Eastern Europe were often initially seen as short-term tools to deal with urgent problems and obvious "trouble spots", they have been instrumental in helping countries identify their priority challenges in a broader perspective. Many countries now see *National Environmental Action Plans* (NEAPs) as first steps towards long-term policies towards sustainable development (Box 7.3). In most countries of Central and Eastern Europe (CEECs), it is too early to assess the effectiveness of NEAPs in terms of their impact on environmental conditions. The pollution and resource-use intensities of these economies are still several times higher than in OECD countries. However, in several CEECs, substantial progress has been achieved in establishing the framework for effective environmental management. The key question is whether the systems of environmental management, which have been established, will be effective in de-coupling pollution and resource use from GDP over the medium and longer term.[107] Further work will focus on implementation

107. In this context, the process of enlargement of the European Union to ten countries from Central and Eastern Europe, as well as increased co-operation between the commission and the New Independent States, provides important incentives. In Central and Eastern Europe, the European Commission is currently providing substantial support for infrastructure investment and institutional strengthening which are necessary for the rapid adoption and implementation of EU environmental legislation — through the *Phare* Programme and other instruments). In the New Independent States, the EU *Tacis* Programme

of environmental policies at the national and sub-national levels, and increasing the effectiveness of policy and institutional frameworks, in particular in the water sector. Emphasis also will be placed on generating political and public support for integrating environmental, economic, sectoral and social policies.

Box 7.3. National Environmental Action Programmes (NEAPs): Experience from Central and Eastern Europe.

The collapse of communism in Central and Eastern Europe brought the region's serious environmental problems to the attention of the international community. The transition towards a market economy also provided a unique "window of opportunity" to tackle them. OECD countries and international organisations have provided assistance for the formulation and implementation of national environmental action plans to integrate environmental considerations in the economic reconstruction process in the Central and Eastern European Countries (CEECs). This includes the Newly Independent States of the former Soviet Union, most of which are developing countries. Key lessons from this experience are:

– *Successful NEAP development builds on the momentum of economic and political reform*. Overall, countries that have progressed most in macroeconomic stabilisation, and in introducing market and democratic reforms, have also been most successful in NEAP development. However, the pace of reform of governance — notably to ensure that the public service functions according to the rule of law — conditions the effectiveness of policy and regulatory reform towards improved environmental management.

– *High-level political support can be an important driver.* While a strong Environment Minister can help drive the process and mobilise political support, the wider involvement of political leaders and the formation of alliances with the public at the regional or local level is necessary to ensure successful implementation of National Environmental Action Plans. Participation by non-governmental organisations has been an important feature of NEAP development and has contributed to the strengthening of civil society, particularly in countries where the involvement of civil society in policy development had traditionally been marginal.

– *Effective NEAP development and implementation requires institutional capacity***.** Over-reliance on political or other leaders can leave the NEAP process vulnerable to changes. Capacities are needed to support both the analytical and participatory elements of the process.

– *External support is most helpful when it is well co-ordinated, when it facilitates processes in which the host country sets its own priorities, and when it fills gaps in local knowledge and capacity.* Donor programmes to build up local capacities may be slower than those which are product-driven, but they are probably more effective in the long term.

Source*:* OECD (1998), *Evaluation of Progress in Developing and Implementing National Environmental Action Programmes in CEEC/NIS. EAP Task Force.*

Collaborating to address global environmental concerns: climate change, biodiversity and desertification

213. Making meaningful progress in addressing key global and transboundary environmental issues such as climate change will not be possible without the involvement and commitment of major non-member economies in partnership with OECD countries (*see* Chapter 3). A major challenge is finding ways to implement within the framework of multilateral environmental agreements the principle of "common but differentiated responsibilities" endorsed at the 1992 Earth Summit.

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focuses on the strengthening of environmental policies, capacity building and improving environmental infrastructure.

214. The recent international focus on climate change, however, should not divert attention from equally or more urgent environmental concerns in many developing countries such as combating desertification and preserving biodiversity. These three challenges are closely related. At the global level, deforestation and desertification contribute directly to increasing the concentration of carbon dioxide in the atmosphere by reducing vegetative cover and its carbon absorption ability. The resulting degradation of natural habitats also implies direct losses in biodiversity. Conversely, climate change is expected to significantly affect the productivity and integrity of ecosystems reinforcing drought or floods in many parts of the world. Low-lying and small-island developing countries are particularly vulnerable in this respect. Efforts to address these concerns are similarly strongly related. Direct linkages and synergies can be found in areas such as forestry, watershed management, sustainable use of wetlands and coastal zone management. The need to address these issues in a coherent and integrated manner, taking into account developing countries' developmental priorities, requires that the challenges posed by the three Rio Conventions be tackled together. Work underway in the OECD aims to review simultaneously the implications of these Conventions in order to identify synergies between them and implications for donors.

215. As parties to the UN Framework Convention on Climate Change (UNFCCC), developing countries have both an important responsibility and a vital stake in global efforts to achieve the objectives of the Convention. Historically, most emissions of CO_2 and other greenhouse gases have occurred in OECD countries. For the future, while emissions from OECD countries — under a "business as usual" scenario — would increase to about 46 per cent above 1990 levels by the year 2020, those in non-OECD countries are expected to increase even more rapidly. Their share of global emissions could rise from around 45 per cent today to about 60 per cent by 2020, with India, China, East Asia and Latin America accounting for an overwhelming share of this growth.[108] Emissions from countries with less dynamic growth, in particular in Africa, are expected to play only a small role.

216. These possible future global emissions paths highlight the need for global co-operation to address climate change. Accordingly, assisting developing countries in meeting their development needs in the most energy-efficient manner will be an important element of co-operative partnerships for sustainable development and a critical component of efforts to control CO_2 emissions at the global level.

217. Projected emissions of greenhouse gases in developing countries, still relatively low given their share of the world population, reflect rapid increases in living standards and in energy use. Promoting economic growth is indeed vital for these countries, both to create employment for a rapidly growing work force and to improve the quality of life for their people, including through the provision of such basic services as lighting, heating and transport. Recognising that the objective of containing greenhouse gas emissions may compete with other priorities, including poverty reduction, international co-operative approaches should address global and national development priorities simultaneously and in a mutually reinforcing manner.

218. The scope for doing so is wide. Energy consumption, a major source of CO_2 emissions, is also a major cause of local pollution in many developing countries and a significant health threat in many cities. This implies that effort to improve energy efficiency, through policy reform, capacity development and investment in cleaner technologies, will have significant beneficial impacts locally as well as contributing to global reductions in greenhouse gas emissions. In key sectors such as energy, industry and transport, there is much scope for improving efficiency and reducing pollution while also improving the quality and reliability of service delivery.

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108. "Taking Action Against Climate Change: The Kyoto Protocol", ECO/CPE/WP1(99)6.

219. Many developing countries are already focusing on energy efficiency, as part of their long-term strategies towards sustainable development. The international focus on climate change and the establishment of instruments, such as the Clean Development Mechanism (CDM), to promote international co-operation could reinforce locally-driven efforts and co-operation activities by providing additional financial and technical support for priority investments in areas ranging from urban pollution control to rural electrification. At the same time, it is recognised that capitalising on the new opportunities offered by the CDM will require the development of human and institutional capacity in areas such as sector planning, project formulation and monitoring but also in fields such as emission verification and certification (Box 7.4).

Box 7.4. Making the CDM operational: Priority issues to be addressed

In 1998, the International Energy Agency (IEA) organised a series of regional workshops in Latin America, Asia and Africa, in co-operation with the United Nations Environment Programme (UNEP) and local co-sponsors. The Workshops helped identify priority issues to be addressed in order for the CDM to become operational by 2000. These include:

– The role and composition of the executive board will have to be clearly defined. Strong representation of developing countries will be critical.

– Consistent and transparent rules and operating systems for CDM project certification, monitoring and verification will have to be developed. At the same time, the making the CDM operational should not be delayed by attempts to define the "perfect" system.

– The establishment of baselines to calculate levels of greenhouse gas emission reductions, at the project or sectoral level, as well as rules for sharing resulting emission credits will be required.

Questions regarding the co-ordination of donor support for the development of the necessary human and institutional capacity for the making the CDM operational will have to be addressed. Important actors include the World Bank, the GEF and bilateral donors.

Accelerating the diffusion of cleaner production technologies

220. Cleaner production is an effective means for integrating environmental and economic goals in the move toward sustainable development (*see* Chapter 5). Compared with standard methods, cleaner production techniques allow enterprises to reduce pollution and wastes and to use energy and raw materials more efficiently. They represent cost-effective approaches for improving environmental performance while raising resource efficiency and profitability. A special challenge is to enable developing and transition countries to take full advantage of the existing cleaner production options, ranging from no cost/low cost measures to investments in cleaner technologies.

221. The main constraint to the rapid diffusion of cleaner production is the lack of human, institutional, technical, managerial and financial capacities needed to manage technological change. Co-operation with developing and transition countries should therefore concentrate on capacity development to underpin the wide-scale application of cleaner production methods and cleaner technologies.

222. To address these issues, the EAP[109] Task Force developed a *Policy Statement on Environmental Management in Enterprises* in CEEC/NIS which was endorsed at the "Environment for Europe"

109. Task Force for the Implementation of the Environmental Action Programmes for Central and Eastern Europe.

Ministerial Conference in Aarhus, Denmark, June 1998. The *Policy Statement* considers the obstacles to cleaner production in the internal and external environment of enterprises, and recommends action in four main areas:

- A coherent policy framework. This should address both the economic, social and environmental policies needed to promote efficient behaviour within enterprises.

- Information, education and training. Public support in these areas is needed to overcome the obstacles to implement cleaner production methods and technologies within enterprises.

- Institutional arrangements. Various institutions can help promote the dissemination of cleaner production methods. These include Cleaner Production Centres[110] and authorities to verify or certify compliance with environmental management systems such as ISO 14000.

- Financial mechanisms. Although many cleaner production investments have short payback times, opportunities are often constrained by the high cost of capital, the limited flexibility of domestic financing institutions and problems of linking viable projects with sources of finance. Work is underway in OECD and UNEP on how these obstacles might be overcome.

223. Overall, the experience from CEEC/NIS suggests that it is often more difficult to achieve "win-win" benefits than previously thought. The opportunity costs of implementing cleaner production methods are often underestimated. Equally, experience from Russia and the NIS underlines the importance of framework conditions. Macro-economic imbalances in these countries are creating a perverse set of incentives which do not favour efficiency, and which inhibit the implementation of "win-win" strategies. Finally, the biggest benefits will come from major investments to modernise the capital stock rather than no cost/low cost measures, emphasising the importance of establishing an appropriate investment climate.

224. Experience with technology co-operation for cleaner production in developing countries has highlighted the need to view capacity development as a long-term process. It is essential to involve local stakeholders in the definition of needs and thereby generate a genuine ownership of the resulting actions. Technology co-operation may stifle rather than build local capability if excessive use is made of expatriates for operational tasks. Only local experts can provide the necessary insight on cultural contexts, gender roles and local political and legal structures. At the level of firms, only once a basic cleaner production "culture" has been internalised and low cost "good housekeeping" measures exhausted should significant investments be considered. Future work in this area will focus on formulating guidance for donors based on a review of development co-operation programmes, policies and strategies in support of cleaner production.

225. The International Energy Agency (IEA) is developing a programme of practical technology co-operation activities aimed at increasing the application of cleaner energy technologies. Through these collaborative, multi-partner activities, IEA countries aim to avoid duplication and overlap. These activities are intended to be consistent with the development priorities of the host countries, to build on local knowledge and expertise, to include the private sector and the relevant stakeholders. A pilot project on "Best Practices in Coal-Fired Power Plants in China" will bring together power plant operators from electric utilities in several IEA countries to make a joint audit of power plant efficiency in Shanxi Province. IEA and Chinese contact points in the national and regional administrations will be involved in spreading information on simple methods to increase coal power plant performance throughout China. Further practical projects of this kind will be identified through IEA committees and technology

110. A review of experience with Cleaner Production Centres in CEECs is being prepared.

development programmes. As a complement to this bottom-up approach, the IEA provides the Secretariat for a trial programme of national "Technology Implementation Plans" — an effort to create a dialogue and support analysis on the best climate-friendly technology options in selected developing countries (as part of the Climate Technology Initiative, see Chapter 5).

226. The Nuclear Energy Agency (NEA) is carrying out a programme of co-operation with non-member countries from Eastern Europe and the former Soviet Union in the nuclear field. These activities aim at transferring experience, building capacity for operating and regulating safely nuclear power plants and fuel cycle facilities, and for developing research capabilities. They include assistance in establishing legal frameworks for civil energy applications, in particular in the field of liability and insurance for nuclear damage, and implementing adequate safety standards and controls.

Measuring progress by developing countries towards sustainable development

227. The OECD/DAC Development Partnerships Strategy reaffirms the commitment of the donor community to help developing countries achieve a number of key, representative and quantified goals by the year 2015 in the fields of economic well-being, social development and environmental sustainability. With a view to measuring progress towards these goals, a collaborative process jointly led by OECD members through the DAC and the major global development institutions, with participation from developing countries, has agreed on a working set of core indicators. These are presented in Box 7.5.

228. The objective of these indicators is: *i*) to help to integrate strategies and efforts throughout the international development community; and *ii*) to provide a standard information tool for improving public understanding of sustainable development challenges and progress. International agreement on a common set of indicators contributes towards implementing the Development Partnerships Strategy in several ways. First, it enables developing countries to better define their own national development strategies and goals. Second, it strengthens the possibilities of donor co-ordination in support of developing countries' own strategies. Third, it gives both national governments and donor agencies a tool for more informed decisions on the allocation of scarce resources. Fourth, monitoring development goals through the set of indicators will help identify the areas where additional (financial) efforts are needed. Last, it avoids subjecting developing countries to a plethora of donor-designed indicators, facilitates the development of local capacities for the collection and use of data, and enables harmonised reporting.

229. The World Bank and the United Nations have incorporated these indicators in their country assessment programmes to guide policy dialogue with partner countries. Efforts to refine the indicator set and improve data coverage and comparability continue, particularly to enhance the coverage and usefulness of environmental indicators and to identify suitable indicators for participatory development and good governance.

230. Much remains to be done to improve the quality of the existing data, including more systematic collection of data by gender. A number of multilateral and bilateral donors are already working with developing partners towards this objective. These activities focus on building long-term statistical capacity, rather than on *ad hoc* exercises to remedy specific data needs. They go beyond data requirements for indicators to address the broader information needs of countries to develop appropriate policies to achieve progress towards their national goals.

231. A joint review with OECD, UN, The World Bank and partner countries in Spring 2000 will examine progress towards the goals, take stock of the work in the international community to adopt a common set of indicators, and identify needs for further action.

Box 7.5: Measuring Development Progress: A Working Set of Core Indicators

GOALS	INDICATORS
Economic well-being	
Reducing extreme poverty The proportion of people living in extreme poverty in developing countries should be reduced by at least one-half by 2015. *(Copenhagen)*	1. Incidence of Extreme Poverty: Population Below $1 Per Day 2. Poverty Gap Ratio: Incidence times Depth of Poverty 3. Inequality: Poorest Fifth's Share of National Consumption 4. Child Malnutrition: Prevalence of Underweight Under 5s
Social development	
Universal primary education There should be universal primary education in all countries by 2015. *(Jomtien, Beijing, Copenhagen)*	5. Net Enrolment in Primary Education 6. Completion of 4th Grade of Primary Education 7. Literacy Rate of 15 to 24 Year-Olds
Gender equality Progress towards gender equality and the empowerment of women should be demonstrated by eliminating gender disparity in primary and secondary education by 2005. *(Cairo, Beijing, Copenhagen)*	8. Ratio of Girls to Boys in Primary & Secondary Education 9. Ratio of Literate Females to Males (15 to 24 Year-Olds)
Infant & child mortality The death rates for infants and children under the age of five years should be reduced in each developing country by two-thirds the 1990 level by 2015. *(Cairo)*	10. Infant Mortality Rate 11. Under 5 Mortality Rate
Maternal mortality The rate of maternal mortality should be reduced by three-fourths between 1990 and 2015. *(Cairo, Beijing)*	12. Maternal Mortality Ratio 13. Births Attended by Skilled Health Personnel
Reproductive health Access should be available through the primary health-care system to reproductive health services for all individuals of appropriate ages, no later than the year 2015. *(Cairo)*	14. Contraceptive Prevalence Rate 15. HIV Prevalence in 15 to 24 Year-Old Pregnant Women [1]
Environmental sustainability and regeneration	
Environment [2] There should be a current national strategy for sustainable development, in the process of implementation, in every country by 2005, so as to ensure that current trends in the loss of environmental resources are effectively reversed at both global and national levels by 2015. *(Rio)*	16. Countries with National Sustainable Development Strategies 17. Population with Access to Safe Water 18. Intensity of Freshwater Use 19. Biodiversity: Land Area Protected 20. Energy Efficiency: GDP per Unit of Energy Use 21. Carbon Dioxide Emissions
General Indicators	
Other selected indicators of development	GNP per Capita; Adult Literacy Rate; Total Fertility Rate; Life Expectancy at Birth; Aid as % of GNP; External Debt as % of GNP; Investment as % of GDP; Trade as % of GDP
For reference: *Population*; *Gross National Product*	

This list reflects progress to date in identifying core indicators that are relevant to the development goals selected from the series of UN Conferences held in the 1990s, and which now form a wide consensus on development priorities. The goals were selected because they were important in their own right and as meaningful proxies for broader development goals.

Like the goals, the indicators are inter-related and should be seen as a whole. It constitutes a core set reflecting key aspects of economic and social well-being and environmental sustainability. Thus some indicators address more than one goal, but for brevity are shown only once; for example, while freshwater is an environmental resource, access to it directly affects the quality of women's lives and the health of their children. Moreover, the majority of the indicators can be disaggregated by gender to measure the extent of inequality.

The set of indicators and background data are published at: http://www.oecd.org/dac/indicators

1. Until satisfactory data coverage is achieved on this indicator, the prevalence of HIV infection in all adults will be used.
2. Indicators for land use, marine environment and air quality will be added to the list later.

Future work

232. Future work will focus on further defining effective approaches to assist non-members in their efforts towards sustainable socio-economic development, in the context of a globalising economy and in the face of global environmental challenges. This will build on the work of several OECD committees and working parties as well as strengthened outreach, dialogue, and sharing of experience among OECD and non-member countries on key sustainable development issues. It will also involve collaboration with partners in developing and transition countries as well as international and non-governmental organisations. The 2001 Ministerial reports on Sustainable Development will present policy recommendations to Member countries based on analysis in the following areas:

- Identifying policies and institutional arrangements conducive to a better integration of trade, investment and environmental policies at the international and national levels.

- Helping non-members to formulate and implement strategies for sustainable development. This will include clarifying the complex linkages between the social, economic, and environmental dimensions of sustainable development, and reviewing the challenges involved in generating political and public support for necessary policy reforms.

- Helping non-members fulfil their obligations under the climate change, biodiversity and desertification conventions, building on the synergies between national and global objectives. This will include reviewing needs in terms of human and institutional capacity, as well as helping to deliver assistance and to build capacity for countries to fill these needs.

- Improving the co-ordination of international efforts to accelerate the diffusion of cleaner technologies in support of national and global sustainable development priorities.

- Monitoring progress and estimating trends for developing and transition countries towards achievement of sustainable development goals for 2015.

ANNEX I. THE OECD ROUND TABLE ON SUSTAINABLE DEVELOPMENT[111]

233. The achievement of sustainable development is a key priority for OECD governments, a priority which requires *inter alia* the integration of economic, social and environmental objectives in all areas of policy making. The importance of sustainable development was clearly recognised by Ministers in their meeting of the OECD Council at Ministerial level of April 1998[112]. In response to the mandate from Ministers, the OECD is engaged in an important horizontal effort over the next three years, which will lead to a major policy report to the OECD Ministerial Council Meeting in 2001.

234. To enhance international co-operation on work on Sustainable Development and to assist the Organisation in developing its work, an *OECD Round Table on Sustainable Development* has been established in the summer of 1998. The *OECD Round Table on Sustainable Development* gathers, on personal capacities, officials from Ministries of Finance and the Environment, the US President of the Council of Economic Advisors, the World Bank, the WTO, UNDP, UNEP, UNCTAD, World Wide Fund for Nature, World Resources Institute and the World Business Council on Sustainable Development. The main objective of the *OECD Round Table* is to provide intellectual stimulus to efforts by the OECD, and to advance analytic discussion on selected issues bearing on Sustainable Development outside negotiating fora. It will also provide an informal forum for better integration, international co-ordination and division of labour on sustainable development among different agencies represented, which are committed to support work on sustainable development through analytic documentation. Finally, it aims to foster informal dialogue at the top policy level between environmental and economic communities. A list of permanent members is provided at the end of this Press Statement. In addition to permanent members, others are invited to join the discussions on selected issues.

235. The *OECD Round Table* is dealing with issues involving policies and approaches of OECD governments. Some of these are of a global nature and involve the obligation of developed countries to work with developing countries. It therefore recognises the importance of seeking their advice in the discussion. It calls upon the organisations with a global membership to share the analysis provided to the Round Table with developing countries. The OECD will use its outreach activities to this effect and mechanisms will be put in place to seek the advice and views of developing countries representatives regarding appropriate OECD initiatives.

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111. This text was issued as an OECD Press Release in May 1999. [SG/COM/NEWS(99)50]

112. In the Communiqué of the OECD Council at Ministerial level of April 1998 "Ministers agreed that the achievement of sustainable development is a key priority for OECD countries"; they "encouraged the elaboration of the Organisation's strategy for wide-ranging efforts over the next three years in the area of climate change, technological development, sustainability indicators, and the environmental impact of subsidies.."; and asked "... the OECD to enhance its dialogue with non-member countries in these areas and to engage them more actively, including through shared analysis and development of strategies for implementing sustainable development".

List of Members of the Round Table

Mr. Simon Upton (chair), Minister of the Environment of New Zealand;
Mr. Gerrit Zalm, Minister of Finance of the Netherlands;
Mr. Martin Bartenstein, Federal Minister for the Environment, Youth and Family Affairs of Austria;
Ms. Janet Yellen, Chairman of the Council of Economic Advisers of the Unites States;
Mr. Joseph Stiglitz, Senior Vice President and Chief Economist at the World Bank;
Mr. Ian Johnson, Vice President of Sustainable Development at the World Bank;
Mr. Renato Ruggiero, Director General of the World Trade Organization (WTO);[113]
Mr James Gustave Speth, Administrator of the United Nations Development Program (UNDP);[114]
Mr. Rubens Ricupero, Secretary-General of the United Nations Conference on Trade and Development (UNCTAD);
Mr. Klaus Töpfer, Executive Director of the United Nations Environment Programme (UNEP);
Mr. Jonathan Lash, President of World Resources Institute (WRI);
Mr. Jørgen Randers, Deputy Director General of World Wide Fund for Nature (WWF);
Mr. Bjørn Stigson, President of World Business Council on Sustainable Development (WBCSD);
Prof. Tsutomu Tanaka, Mitsubishi Research Institute and former Vice Minister for International Affairs at the Japanese Economic Planning Agency;
Mr. Maurice Strong, Senior Advisor to the President of the World Bank;
Mr. Donald J. Johnston, Secretary-General of the OECD;
Mr. Thorvald Moe, Deputy Secretary-General of the OECD;
Mr. Robert Priddle, Executive Director of the International Energy Agency (IEA);
Mr. Ignazio Visco, Chief Economist and Head of the OECD Economics Department;
Mrs. Joke Waller-Hunter, Director of the OECD Environment Directorate.

113. Mr. Ruggiero and Mr. Speth, who have ceased their functions, will be replaced shortly.

ANNEX II. OVERVIEW OF ONGOING AND FUTURE PROJECTS

In the Executive Summary, the envisaged outputs to fulfil the 1998 three-year Ministerial Council mandate to the OECD and its affiliates were outlined, i.e. Background Reports in various areas, an Analytical Report and a Policy Report with recommendations for the OECD Ministerial Council meeting in 2001.

At the end of each chapter of this Progress Report, future work in the context of the horizontal project on sustainable development was outlined.

In this annex, a more detailed overview of work carried out in different OECD Directorates and affiliates, including planned meetings and workshops, is given. Some additional activities may be added over the next two years as inputs to the reports to the 2001 Ministerial Council Meeting.

The overall project on sustainable development is co-ordinated by a Director level Steering Group, chaired by the Secretary General. A separate co-ordination group for work on climate change in the OECD and its affiliates is chaired by Deputy Secretary General Thorvald Moe. Working groups with participants for from all relevant OECD Directorates and affiliates (IEA, NEA, ECMT, Development Centre) are set up to enhance coo-operation and integration at the working level.

ENHANCING FRAMEWORK CONDITIONS FOR SUSTAINABLE DEVELOPMENT

SUBJECT	DIRECTORATE/ TIMEFRAME	OUTPUT
Agricultural Policies	AGR (beyond 1999)	Measuring the impact of agricultural support on the environment through *a)* Policy Evaluation Matrix (PEM), using new PSE classification; and *b)* Agri-Environmental indicators. Pilot studies in 1999/2000, integrating results of production and trade impacts in PEM framework.
	(beyond 1999)	The use of AGLINK, to quantify selected environmental impacts (including nutrients balances and GHG emissions) of agricultural market scenarios. First results in *Agricultural Outlook* and *Environmental Outlook* (planned for 2000).
	(beyond 1999)	Study on policy principles and criteria to determine the appropriate remuneration for environmental benefits from agriculture. Outline of paper discussed in December 1998; revised paper in October 1999, planned completion in 2000.
	ENV (end 1999)	Case studies on the effect of prevailing agricultural support regimes on the diffusion of organic farming. Case studies of cereals production in France, and on diary production in the Netherlands. (first draft in May).
	ENV (to be defined)	Study on the positive environmental effects of agricultural support.
Fisheries Policies	AGR/FISH (end 1999)	Study of the impact on fisheries sustainability of government financial transfers. Draft synthesis report sent to COFI in April 1999; report to be finalised by end-1999
	AGR/FISH (ongoing)	Extension of OECD statistics on support to fisheries. Publication of the new data in the *Review of Fisheries in OECD countries* expected by fall 1999..
	AGR/FISH (end 1999)	Analysis of national experiences with applying various social insurance, structural adjustment measures and labour market policies in fisheries, drawing in part on case studies. Draft synthesis report sent to COFI in April 1999; report to be finalised by end-1999.

SUBJECT	DIRECTORATE/ TIMEFRAME	OUTPUT
Energy Policies	IEA (beyond 1999)	Pricing practices, including support, in IEA Countries. Ongoing work as part of the IEA review processes (in connection with energy demand, efficiency and climate change).
	IEA (2000)	Energy Prices and Subsidies in non-member Countries. Estimates of price gaps between domestic and world market prices, and their effects on economic efficiency, oil demand, GHG emissions and government budgets in major non-member countries (Project outline discussed in February 1999)
	ECH/ENV (ongoing)	Prevalence and Magnitude of Various Trade-Distorting Measures for Three Major Primary Energy Sources. Outline of the study and progress report
	NEA (1999)	Comprehensive assessment of total costs of nuclear electricity generation. Report "Low Level Waste Repositories: An Analysis of Costs", January 1999.
	NEA (1999)	Proceedings of a workshop on the management of funds accumulated for financing liabilities

SUBJECT	DIRECTORATE/ TIMEFRAME	OUTPUT
Transport policies.	ECMT (ongoing)	Extension of the work on "Financial and Fiscal Distortions in Road Freight Transport" to France, Germany, The Netherlands, Switzerland. Efforts to develop marginal effective tax rates on road freight transport (Experts Workshop in December 1998, expected report in May 2000) Seminar on Tax Changes, as recommended in the Report: "Efficient Transport for Europe" to be scheduled Study on the Implementation of the ECMT Resolution 98/1on internalisation of external costs (baseline report end-1999, full report expected in 2001/2)
	DSTI (2000)	Programme on "Road Transport Research". This includes: i) work on the development of inter-modal freight transport solutions (institutional aspects, benchmarking of relative efficiency of transport modes, economic instruments), first result expected in April 2000; ii) project on influencing road traffic demand (assessment of policies and strategies implemented in various countries), results expected in October 2000); iii) conference on Environment and Transport, to be held in June 2000.
Policies for Biodiversity	ENV (1999)	Publication of Handbook on Implementation of Incentive Measures for the Conservation and the Sustainable Use of Biodiversity.
	(ongoing)	Work to be started on an "Handbook on Techniques for the Evaluation of Biodiversity and Their Use for Policy Making".
	(ongoing)	Work to be started on a report on the creation of markets for biodiversity goods and services through certificates and labelling

SUBJECT	DIRECTORATE/ TIMEFRAME	OUTPUT
Domestic Tradable Permits	ENV (1999)	Lessons from experiences in OECD counties on the use of domestic tradable permits. Reports and Summary of the Discussions of an OECD workshop (September 1998)
	(1999)	Report of an OECD workshops on tradable permits and water pricing, including an update of overviews of water pricing in OECD countries
	(1999-2000)	Report on the implementation of domestic Tradable Permits for environmental protection (draft report discussed in November 1998)
	(1999-2000)	Development of guidelines for implementation of domestic Tradable Permits for environmental protection (draft report discussed in November 1998
Environmentally related taxes	ENV/DAFFE (1999-2000)	Gathering of comparable data. Preliminary results for 19 countries published in OECD (1999), *Consumption Tax Trends.* Analysis of environmental effectiveness, impacts on competitiveness, distributive impacts, administrative costs and practical implementation issues of environmentally related taxes. Study on the potential to use taxes to reduce non-GHGs (outline discussed at the November 1998 Joint Meeting).
Technical Options for GHG Reductions, Material Flows and Support/Taxation Regimes.	ENV (1999-2000)	The study investigates i) the importance of materials substitution for GHG reductions and for ancillary benefits, in particular waste management; ii) the most appropriate choice of instruments (pricing or regulation) to achieve a wide range of technical options. (Outline discussed in November 1998, draft to be discussed in November 1999)
Policies to Make Growth more Environmentally Sustainable in OECD Countries.	ECO (March 1999) (ongoing)	An agreed framework, including a tentative outline, for reviews of national policies impacting on environmental and resource-use outcomes. Economic Reviews planned: Norway (January 1999), Finland (June 1999), Germany (October 1999), United States (March 2000), Denmark (April 2000), Canada (June 2000)
Environmental Effects of Support, Taxes and Resource Pricing	ENV (ongoing)	Standardised Reporting of environmental effects of support, taxes and resource pricing in future Environmental Performance Reviews. Proposals to be presented in spring 1999.

CLIMATE CHANGE

SUBJECT	DIRECTORATE/ TIMEFRAME	OUTPUT
General issues	ECO (March 1999)	Report on taking action against climate change.
	IEA (May 1999)	"Provocative" paper for IEA Ministerial discussion.
International Issues and Strategies	ENV/IEA (15-16 March 1999)	Information paper on 'Experience with emission baselines under the AIJ pilot phase' Annex I Expert Group Work programme: proposals for 1999/2000.
	(September 1999)	Papers on: domestic systems for monitoring and reporting under the Kyoto Protocol; on emissions baselines for project-based mechanisms; on liability rules and eligibility criteria for international emissions trading; and on evolution of mitigation commitments
	(September 1999)	Workshop on the Kyoto mechanisms (tentative).
	(1999/2000)	Further analysis of monitoring, reporting and review requirements under the Kyoto Protocol, the Kyoto mechanisms and the evolution of mitigation commitments, with projected outputs for COP6 (end 2000).
	(1999/2000)	Workshop (April 2000) on monitoring, reporting and review and the Kyoto mechanisms.
	ENV (May, 1999)	Permit allocation methods, greenhouse gases and competitiveness.
	IEA (1999-2000)	Analysis of energy project baseline on Joint Implementation and the Clean Development Mechanism.
Assessment of Domestic Strategies, Policies and Performance	ECO (March 1999)	An agreed framework, including a tentative outline, for reviews of national policies impacting on environmental and resource-use outcomes.
	(ongoing)	Economic Reviews for selected countries (see above).
	ENV (November 1998)	Implementing domestic tradable permits for environmental protection
	ENV (June 1999)	Report on overview of domestic policies and measures to respond to climate change

SUBJECT	DIRECTORATE/ TIMEFRAME	OUTPUT
	IEA (ongoing)	Exchange of information on policies and measures in the energy sector and industry activities on climate change.
	ENV (December 1999 through 2000)	Report(s) on developing and implementing good practice in climate change policies
	ENV (May 2000)	Framework and preliminary assessment of ancillary benefits of climate change abatement
	ENV (December 1999)	First of biannual updates on key climate change policy development
	ENV (2000)	Work to develop an inventory of agricultural practices to reduce GHG emissions (possible workshop in 2000).
	ENV (ongoing)	Study on the use and potential of biomass energy from agriculture to reduce emissions.
	AGR (ongoing)	Estimates of the effects of agricultural projections on GHG emissions.
	AGR (ongoing)	A study on policies to achieve sustainable agriculture will include developing indicators of GHG emission and of carbon sinks in agriculture and analysis of the implications of climate change and of Kyoto for agriculture.
	DSTI (October 2000)	Project on the costs and benefits of strategies for air quality improvements, in the context of the "Road Transport Research" programme. This aims to establish an analytic framework to evaluate the effects of road transport on air quality.
	Development Centre (Oct. 99)	Preliminary assessment of ancillary benefits of climate change policies for Chile.
Modelling the quantitative effects	ECO (September 1999)	Second workshop on economic modelling of climate change.
	IEA (2000)	*World Energy Outlook* chapter on international CO_2 emission trading.
	IEA (1999)	Analysis of emissions data and forecasts, particularly in developing countries.

THE SUSTAINABLE DEVELOPMENT OF NATURAL RESOURCES

SUBJECT	DIRECTORATE/ TIMEFRAME	OUTPUT
Achieving Sustainable Agriculture: Policy Issues and Options	AGR (2000)	Outline of proposals discussed at December 1998 meeting; progress report planned for the spring of 1999; final report due in early 2001.
Farming Systems, Technology and the Environment	AGR (the Netherlands, 2000)	Workshop to explore the policy implications of the environmental effects of the changing nature of agricultural production, in particular in the context of technological developments. Outline of proposals discussed at December 1998 meeting; Steering Group meeting in October 1999, workshop planned in mid-2000; final report due in 2001.
Biological Resources for Sustainable Agricultural Systems	AGR (2000-2004)	Conference of Biological Resource Management: Connecting Science and Policy (March 1999); Workshops/ Conferences integrating socio-economic and scientific aspects of biological resource management.
Transition Towards Responsible Fisheries	AGR (April and October 1999)	This project consists of four main studies: i) costs and benefits of the transition. Analysis of economic, resource, and employment effects of a transition to sustainable use, with case studies from 6 to 8 countries; ii) the impact of government financial transfers of fisheries resource sustainability. Analysis of short- and long-term effects on natural resources and fisheries of financial support, including case studies; iii) social implication of sustainable fisheries. A study of social policies and programmes that Member countries have in place to support a transition towards sustainable fisheries; iv) responsible post-harvesting policies and practices. An analysis of post-harvesting policies and practices that underpin a move towards responsible fisheries. Progress reports have been discussed by COFI at its April 1999 session. Final reports will be discussed by COFI at its October 1999 session.
Policies to Make Growth more Environmentally Sustainable in OECD Countries.	ECO (March 1999)	An agreed framework, including a tentative outline, for reviews of national policies impacting on environmental and resource-use outcomes.
Valuation of Ecosystem Services	ENV and TDS (Autumn 1999)	Workshop
Workshop on Methods for Resource Evaluation	ENV (2000)	Workshop on methods for resource evaluation in autumn 1999, with proceedings in 2000

SUBJECT	DIRECTORATE/ TIMEFRAME	OUTPUT
Nuclear Resources	NEA (mid-1999)	Review and analysis of policies in uranium producing countries to address environmental concerns. (Publication "Environmental Issues in Uranium Mining and Milling: An Approach to Sustainable Development).
	(end-2000)	Investigation of policies and schemes for the environmental restoration of uranium mining and milling sites

TECHNOLOGY AND SUSTAINABLE DEVELOPMENT

SUBJECT	DIRECTORATE/ TIMEFRAME	OUTPUT
Science, Technology, Innovation and Sustainable Development	DSTI (22-23 June 1999)	Meeting of Committee for Scientific and Technological Policy (CSTP) at Ministerial Level. Discussion of sustainable development issues related to science, technology and innovation.
Energy Technologies	IEA (ongoing) (Dresden, September 1999)	A range of recent and planned workshops, conferences and studies to determine technology trends and diffusion needs and mechanisms, in the context of the development of climate-friendlier energy technologies. IEA workshop of financing cleaner fossil power generation in Central and Eastern Europe.
Biotechnology for Sustainable Industrial Development	DSTI (Seville, Fall 1999)	CSTP workshop to assess sectoral case studies of use of biotechnology in clean industrial processes.
Environment and Innovation	DSTI (1999/2000)	Proposed workshop of the CSTP Working Group on Innovation and Technology Policy (TIP) to explore relationship between innovation systems and sustainability.
Agriculture Knowledge Systems	AGR (January 2000)	Conference to convene officials from Agricultural Research, Education and Advisory Services to discuss aspects of agricultural sustainability.
Industry and Sustainable Development	DSTI (March 2001)	Proposed Industry Committee Policy Forum discussion with business on corporate strategies for sustainable development.
Farming Systems, Technology and the Environment	AGR (the Netherlands, 2000)	Workshop to explore the policy implications of the environmental effects of the changing nature of agricultural production, in particular in the context of technological developments. Outline of proposals discussed at December 1998 meeting; Steering Group meeting in October 1999, workshop planned in mid-2000; final report due in 2001.
Nuclear Technologies	NEA (United States, 2000) (2000)	Conference on the management and extension of nuclear plant lifetime (Proceedings to be published in early 2001). Publication of technologies to transmute long-lived waste to reduce the overall toxicity and potential impact of radioactive waste.

SUSTAINABLE DEVELOPMENT INDICATORS

SUBJECT	DIRECTORATE/ TIMEFRAME	OUTPUT
Conceptual frameworks	STD (Dec 1998)	Proceedings of OECD workshop on sustainable development indicators (http://www.oecd.org/subject/sustdev).
	STD,ENV,ELSA (Sept 1999)	Second OECD workshop on sustainable development indicators, Paris.
	ENV and others (Dec. 1999)	OECD Conference – Towards sustainable development – Indicators to measure progress (hosted by the Italian Government).
Indicators of sustainable development	ENV (April 1998)	Publication: *Towards sustainable development – environmental indicators.*
	ENV (April 1999)	Publication on sustainable consumption indicators (co-ordinated with UNCSD) already reviewed by Working Group on State of the Environment.
	ENV (Sept 1999)	1999 OECD Compendium of environmental data.
	ENV (1999)	Document on *Indicators for use in the second cycle of environmental performance reviews* (meeting of the WGSOE in October 1999).
	ENV (2000)	Document on biodiversity indicators. Publication on environmental indicators.
Measurement of assets Produced	STD (1999-2000)	Publication: *Manual on capital stock statistics* (in conjunction with the Canberra Group on Capital Stock Statistics).
Environmental	STD, ENV (Aguascalientes, 2000)	Seminar on environmental accounting.
	STD (1999)	Meeting on depletion of natural resources.
	STD, ENV (2000)	Results of the OECD seminar on environmental accounting.
	STD (2000)	Paper on environmental defensive expenditure.
Human and social	ELSA (CERI, Sept 1999)	Paper for the second OECD workshop on sustainable development indicators.
	(CERI, Oct. 1999)	Workshop on investment in human and social capital.

SUBJECT	DIRECTORATE/ TIMEFRAME	OUTPUT
Sectoral indicators Agriculture	AGR (June 1999)	Publication on *Measuring the Environmental Impacts of Agriculture: The York Workshop.*
	AGR (May 1999)	Publication "Measuring the Environmental Impacts of Agriculture" , in *Agricultural Policies in OECD Countries - Monitoring and Evaluation 1999.*
	AGR (early 2000)	Forthcoming publication: *Agri-environmental Indicators for OECD Countries: Issues, Methods and Results.*
Fisheries	AGR/FISH (2000-2002)	A study will seek to develop sustainability indicators (economic and social) for fisheries, to be used as tools in policy analysis.
Energy	ENV (early 2000)	Update publication on *Indicators for the Integration of Environmental concerns into energy policies.*
	IEA (ongoing)	IEA indicators efforts.
	NEA (1999)	Publications: *Uranium Reserves, The Red Book (*late 1998); *Low-level Radioactive Waste Repositories* (early 1999); *Comparative Risk Assessment and Management* (late 1999).
Transport	ECMT (mid 1999)	Forthcoming Publications: *Statistical Report on Road Accidents, 1996*; *Statistical Trends in Transport, 1996*; *Trends in the Transport Sector, 1997*; *Investments in Transport Infrastructures in the early 1990s*.
	ENV (April 1999)	Publication on *Indicators for the Integration of Environmental concerns into transport policies.*
Spatial indicators	TDS (late 1999)	Paper and workshop on *Conceptual bases for Territorial Indicators on Environment and Amenities*, Working Party on Territorial Indicators.

ENGAGING NON-MEMBER COUNTRIES IN EFFORTS TOWARDS SUSTAINABLE DEVELOPMENT

SUBJECT	DIRECTORATE/ TIMEFRAME	OUTPUT
Environmental aspects of globalisation	ENV (mid-1999)	Stock-taking report on the environmental implications of trends in trade and investment liberalisation. Proceedings of an OECD Conference on FDI and the Environment.
National strategies for sustainable development (NSSD/NEAP)	DCD (1999)	Report from informal dialogues with developing country partners to review practical experience in formulating and implementing NSSD processes in specific countries and regions.
	(mid 2000)	Guidance for donors in supporting NSSD processed in developing countries.
	CCNM (mid-1999)	Report on environmental management in the transition to a market economy.
	(end-1999)	Report on practical implementation of Sustainable Development in Central and Eastern Europe.
	(mid-2000)	Report on economic assessment of environmental degradation, problems and benefits from environmental measures.
	(mid-2000)	Conference and report on generating environmental awareness and stimulating public and political support for environmental improvement in the NIS.
	(mid-2000)	Survey of the use of economic instruments in the NIS.
	(end 1999)	Survey on strengthening enforcement and compliance with environmental regulations in the NIS.
	(end 1999)	Report on obstacles and opportunities for strengthening water management in the NIS.
	(mid 2000)	Case studies and methodology for developing environmental action programmes and Agendas 21 at the sub-national level.
Capacity and framework conditions for environmental management	DCD/ENV (2000)	Review of donor efforts to strengthen capacity for policies and institutional arrangements that could help to better integrate investment and environmental

SUBJECT	DIRECTORATE/ TIMEFRAME	OUTPUT
		policies.
Sustainable development goals	DCD (May 2000)	Report of a joint meeting with UN and World Bank on *Indicators for Measuring Development Progress*, to refine the *Working Set of Core Indicators* agreed in 1998 and to measure trends in progress during the 1990s towards the international development goals for 2015 set out in the OECD/DAC *Shaping the 21st Century* Strategy.
Linkages between poverty, gender and environment	DAC (end 2000)	Guidance for donors on the linkages between poverty, gender and environment in development co-operation.
Support for the implementation of the Rio Conventions on Climate Change, Biodiversity, and Desertification	DAC (2000) (2000) (1999-2000)	Review of practical means to integrate the implementation of conventions in bilateral programmes. Develop policy guidance for donors. Pilot Study on the statistical recording of aid targeted to the objectives of the Rio Conventions. Preliminary conclusions to COP5 for Climate Change (Oct. 1999) and final report to COP5 for Biodiversity (May 2000).
Climate change	CCNM (December 1999) IEA (ongoing)	Study on potential use of innovative environmental financing mechanisms (including Kyoto Protocol mechanisms). Capacity building and technology implementation plans under the Climate Technology Initiative.
Cleaner production and environmental management in enterprises	DCD (mid 1999) ENV (mid 1999) (end 1999)	Guidance to donors on supporting cleaner production in developing countries. Report on cleaner production centres in CEEC/NIS. Assessment of cleaner production programmes in NIS.
Development of transport infrastructure	DSTI/ECMT (October 1999)	Conference on Strategic Environmental Assessment in Eastern and Central European countries.
Environmental financing NIS-specific	CCNM (end-1999) (mid 2000) (mid-1999) (May 2000)	Analytical report on environmental financing in CEE/NIS. Analysis of environmental expenditures in the Russian Federation. Environmental Funds Sourcebook. Review of select environmental funds

SUBJECT	DIRECTORATE/ TIMEFRAME	OUTPUT
		operating in NIS.
Non-member countries, especially the Big 5, and OECD countries	ENV (2001)	This will include: experts' workshop to launch project (1999); case studies on specific issues (2000); workshop to examine case studies and draw policy conclusions (late 2000); synthesis report and policy recommendations (2001).
Co-operation with China	CCNM/ENV (1999)	Workshop on environmental monitoring: (April 1999) and proceedings. Possible workshop on environmental indicators.
	CCNM/ENV (1999)	Analytical work on environmental financing, particularly in the water sector in China, transition economies and OECD countries.
	ENV (2000)	Workshop on environmental financing, particularly in the water sector in China & OECD countries (2000) and proceedings (in 2001).
	IEA (ongoing)	Pilot activity on best practice in Chinese coal-fired power plants.
Co-operation with Russia	CCNM (late 1999)	Russian Environmental Performance Review (EPR). Workshop in Russia to disseminate EPR report and to discuss the conclusions (Nov/Dec 1999).