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Encouraging  
Environmentally Sustainable  
Growth: Experience in  
OECD Countries

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**ENCOURAGING ENVIRONMENTALLY SUSTAINABLE GROWTH:  
EXPERIENCE IN OECD COUNTRIES**

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**Paul O'Brien and Ann Vourc'h**

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## ABSTRACT/RÉSUMÉ

Clean air, clean water, fewer toxic emissions and less household waste are among the key environmental policy objectives that most OECD governments have been pursuing over the past three decades. This effort to take more account of the environmental costs of economic growth has been pursued in a variety of ways in different countries, and has evolved over time with policy instruments that may be technical standards, emission prohibition, tradable permits, taxes, voluntary agreements and many others. This paper surveys aspects of environmental and natural resource policy in a number of OECD countries paying particular attention to how countries succeed in conducting cost-effective and consistent policies in the environment and natural resource areas, not on environmental policy or outcomes *per se*. Four common themes emerged: attempts to design institutions or processes to achieve co-ordination across policies and sectors; certain sectors where policies make environmental objectives harder or more costly to achieve; a definite trend in recent years towards the use of market-based instruments; competitiveness and distributional issues as obstacles to policy implementation.

The analysis is based on a number of special chapters of OECD *Economic Surveys* on “enhancing environmentally sustainable growth”. It represents part of the OECD’s three-year programme on Sustainable Development.

*JEL classification:* H23, Q00, Q20, Q28, Q40, Q48.

*Keywords:* Sustainable development, environmental policy, natural resource policy.

\* \* \* \* \*

La qualité de l’air, la qualité de l’eau, le contrôle des émissions toxiques, la réduction des déchets ménagers et la conservation des ressources naturelles, ont été les principaux objectifs des politiques de l’environnement mises en œuvre dans la plupart de pays de l’OCDE pendant les trente dernières années. L’effort pour mieux prendre en compte les coûts environnementaux de la croissance économique a pris différentes formes dans différents pays, évoluant au cours du temps avec les instruments mis en œuvre tels que les normes techniques, l’interdiction d’émission, les permis échangeables, les taxes et les accords volontaires. Ce document étudie certains aspects de la politique de l’environnement et des ressources naturelles dans plusieurs pays de l’OCDE, et se concentre sur l’efficacité par rapport aux coûts et la cohérence des politiques dans le domaine de l’environnement et des ressources naturelles, et non sur la politique ou l’état de l’environnement en tant que tels. Quatre thèmes communs émergent: la tentative de concevoir des institutions et des processus pour établir une coordination entre les politiques et les secteurs; la réalisation des objectifs environnementaux est rendue plus difficile ou plus coûteuse par certaines politiques sectorielles; une tendance certaine ces dernières années à une plus grande utilisation d’instruments économiques; les questions de compétitivité et d’effets de répartition comme obstacle à la mise en œuvre.

Ce document présente une vue d’ensemble de l’analyse conduite dans des chapitres spéciaux des Études Économiques de l’OCDE intitulés « Pour une croissance écologiquement durable ». Il fait partie du programme de travail sur trois ans de l’OCDE sur le développement durable.

*Classification JEL :* H23, Q00, Q20, Q28, Q40, Q48.

*Mots-clés :* Développement durable, politique environnementale, politique des ressources naturelles.

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## **ENCOURAGING ENVIRONMENTALLY SUSTAINABLE GROWTH: EXPERIENCE IN OECD COUNTRIES<sup>1</sup>**

**Paul O'Brien and Ann Vourc'h<sup>2</sup>**

### **1. Introduction and summary**

1. Clean air, clean water, fewer toxic emissions, reducing household waste and conserving natural resources are among the key environmental policy objectives that most OECD governments have been pursuing over the past three decades. This effort to take more account of the environmental costs of economic growth has been pursued in a variety of ways in different countries, and has evolved over time with policy instruments that may be technical standards, emission prohibition, tradable permits, taxes, voluntary agreements and many others. This paper surveys aspects of environmental and natural resource policy in a number of OECD countries paying particular attention to how countries succeed in conducting cost-effective and consistent policies in the environment and natural resource areas. There is thus less focus on environmental outcomes themselves and hence critical remarks are sometimes made of countries that have “good” environmental records but where some policies seem unnecessarily costly.

2. The current paper is based on analysis conducted in a number of special chapters of OECD Economic Surveys on “enhancing environmentally sustainable growth” and forms part of the Organisation’s three-year programme on sustainable development.<sup>3</sup> It highlights a number of important issues and draws out some common themes and recommendations. Summary tables of the policy recommendations made in the Surveys are provided at the end of each section of this paper, and in more detail in Annex 2. It should be emphasised that, owing to the necessarily selective choice of issues treated for each country, the absence of a recommendation covering a particular issue for certain countries generally means that that issue was not covered in the corresponding Survey - not that the issue was discussed and found to merit no comment. It should also be noted that examples are drawn almost

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1. This paper was originally a document prepared for a meeting of a working party of the OECD Economic Policy Committee, finalised in February 2001.

2. Paul O'Brien and Ann Vourc'h are economists in the Economics Department of the OECD. We thank colleagues in the Economics Department, especially Jørgen Elmeskov, Mike Feiner, Jens Høj, Peter Jarrett, Grant Kirkpatrick and Deborah Roseveare, as well as Jean-Philippe Barde (who supplied Box 2), Niels-Axel Braathen and their colleagues in the OECD Environment Directorate, along with Christopher Heady from the Directorate for Financial, Fiscal and Enterprise Affairs and Marco Mira d'Ercole from the General Secretariat. Thanks are also due to Veronica Humi and Anick Lotrous for secretarial and statistical assistance.

3. See OECD (2001a), of which a shortened version of this chapter forms Chapter 9, and OECD (2001b). See [www.oecd.org/subject/sustdev](http://www.oecd.org/subject/sustdev) for a description of this OECD project on Sustainable Development.

exclusively from those countries surveyed up to early 2001, although good and bad practice is certainly present in other OECD countries.<sup>4</sup>

3. Despite the desirable properties of economic instruments in reducing the cost of reaching environmental objectives (see Box 1), much of the environmental legislation in the OECD countries is still based on command and control regulation. Hence, the main focus of the Surveys has been the extent to which countries are implementing or extending the use of economic instruments and this paper provides little information on regulation *per se* and how it can be made more cost-effective.

**Box 1. The focus of the surveys: the cost-effectiveness of policies**

In focusing on cost-effectiveness, environmental policy objectives *per se* are not called into question, except perhaps if they appear to conflict with other environmental or sectoral objectives. The aim is to evaluate whether countries are achieving their environmental objectives in the least costly way.

Minimising the overall costs of achieving a given environmental goal means that all activities that affect the goal should face, as far as possible, the same incentives. This increases the importance of policy *co-ordination* - ensuring that the environmental effects of sectoral and other policies, and the economic impact of environmental policies, are properly considered. Effective co-ordination requires that *cost-benefit analysis* should play a central role in assessing different approaches and objectives.

The use of *economic instruments*, such as pollution taxes, which by their nature should equalise marginal abatement costs across all sectors of the economy (provided they apply to all relevant polluters) ensures - under ideal conditions - that least-cost solutions are found: by letting individual agents decide upon how much and in which way to reduce pollution, they allow the agents with the lowest abatement costs to contribute the most to the total reduction in pollution. Such instruments thus have an advantage over the more usual "command and control" type of regulation. There are many instances where command and control measures are necessary, however, frequently where technical or measurement problems make it difficult to continuously monitor the externality attributable to individual agents, or where "corner solutions" (*e.g.* optimal emissions being zero) seem likely - for instance in the case of hazardous chemicals. In these instances, optimisation requires the use of cost-benefit analysis to find least-cost solutions.

In addition, economic instruments promote "dynamic efficiency" by providing permanent incentives for reducing emissions through technological improvement, whereas command and control type regulations would need to be updated, possibly quite frequently, depending on their design. Finally, as economic instruments work through the price system, they more effectively co-ordinate economic and environmental policies by using the incentives provided by normal market mechanisms to induce behaviour that takes environmental considerations into account.

4. The second section of this paper examines how countries are dealing with policy co-ordination and formation in the environmental domain. Given the wide range of activities that affect, or are affected by, any particular environmental problem, co-ordination is particularly important. However, sectoral policies often tend to ignore or even accentuate a number of environmental problems. This is perhaps most clear in the agricultural sector, where support still generally takes the form of strong incentives to keep output high through output price support or input subsidies, thereby contributing to a number of pollution problems, in particular for water quality associated with intensive agriculture and use of pesticides and fertilisers. At the same time, agriculture is generally exempted from taxes and other measures applied

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4. Countries for which chapters have so far been published are: Belgium, Canada, Denmark, Finland, Germany, Norway, Sweden, and the United States. Economic Surveys this year of Australia, Austria, France Ireland and Poland will also cover this topic. OECD Environment Performance Reviews survey environmental outcomes themselves and provide descriptive detail on these and on many policies that could not be discussed here.

elsewhere to deal with these problems, and benefits from much less stringent regulations. In many countries, the agricultural sector receives important subsidies for water use, even in areas where water is scarce. *Removing the special treatment of the agricultural sector - concerning especially its effects on water pollution and the price it pays for water - would be a major step towards improved policy consistency.* Fisheries policies are progressively being reformed to remove incentives to over-exploitation, although the required contraction of the sector can be hampered by measures designed to mitigate the social consequences of the contraction. Another area where subsidies, generally in place for social reasons, have had negative environmental consequences is the non-renewable energy sector; subsidies to this sector remain in many countries, though they have diminished over the last two decades.

5. In the transport sector, one issue is subsidies which directly encourage pollution. However, the main problem is that externalities are not properly addressed, as shown in the example of lower taxation of diesel than gasoline, and the exemptions provided to a number of sectors (international air and sea transport, public transport in some countries, and the agricultural sector). It is difficult to be precise about the level at which fuel taxes should be set to internalise externalities, but it is clear both that *the gap between diesel and petrol taxes needs to be reversed in most countries, and that many fuel tax exemptions should be removed.*

6. To improve policy co-ordination, countries have put specific mechanisms in place. All countries reviewed check the environmental consequences of infrastructure projects through environmental impact assessment procedures. Such analysis is less frequently applied to the consequences of on-going or planned *policies.* In either case, legislation rarely makes formal cost-benefit analysis (CBA) obligatory. As part of the overall regulatory assessment framework, the economic costs of environmental regulations are usually evaluated, but also generally without formal CBA. In fact, more systematic use of CBA in all these contexts would be one way to improve policy integration. Its under-use is in part due to measurement problems, but also to some extent to the unwillingness to put monetary values on certain things such as, for example, human life. Valuations are often uncertain, or even thought to be impossible, but it is possible to present ranges of valuations in the case of uncertainty, and to make explicit the nature of costs or benefits which cannot be valued. *Increased and more systematic use of cost-benefit analysis is needed in all countries; this would provide useful information to policy makers and the public, and improve the transparency of the decision-making process.* This is true for any kind of policy; however, the surveys identified a number of particular areas where increased use of CBA seems especially needed. The legal system can also facilitate implicit valuations, or encourage the use of explicit valuations, and play a role in ensuring even application of environmental legislation, but its use of course depends on the legislative background and varies enormously across countries.

7. Using economic instruments applying to all sectors to internalise environmental externalities when possible is also a means to improve policy integration, as they provide the same marginal incentives to all. The third section of the paper looks at how economic instruments are used in the environmental and natural resource policies and where their use could be extended or improved. OECD governments have indeed increased their use of economic instruments over past decades; this has mostly concerned taxes, but tradable permit schemes are increasingly being considered. Tradable permits have been quite successfully employed in some countries to reduce air pollution problems, in particular those associated with sulphur dioxide and nitrogen oxide emissions from stationary sources. Taxes and pricing policy have also been increasingly used in waste management, although identifying the proper tax base is difficult. Economic pricing of water has progressed, although water prices still vary considerably across various uses in most countries. Trade in water rights is being used in some countries to increase the efficiency of water resource allocation in areas where water is scarce. Individual transferable quotas introduced in some countries have also improved fisheries management.



8. *In all countries, environmental and natural resource policies should continue to make more use of economic instruments rather than command and control regulation.* Notable examples where scope exists for further use include climate change and acid rain policies, but also water pollution from agriculture where nutrient accounts provide a tool for targeting pollution more directly with economic instruments than has perhaps been thought possible hitherto. Establishing markets for property or use rights would also help improve natural resource management, in particular for fisheries and water. Generally these rights should be auctioned, to capture the resource rents.

9. Some links between economic instruments and regulatory targets are also discussed. While in some cases, such as for waste management, regulatory targets in place tend to undermine or override economic instruments, in others economic instruments and regulations can supplement each other in a cost-effective manner. Where the nature of the problem means that a regulatory approach is necessary, governments should follow the advice in the 1997 report to OECD ministers on the principles of good regulation (OECD, 1997a).

10. After two decades where command and control regulations dominated, OECD governments have recently made increased use of voluntary agreements in a variety of domains. *Purely voluntary approaches are rarely a very effective substitute for legislative action, tend to result in a piecemeal approach and frequently impose administrative costs that are high for what is achieved.* While the direct involvement of firms and trade associations can be a good way to reduce the costs of meeting an environmental target in principle, in practice voluntary approaches are often found to suffer from a number of defects, in particular unambitious target setting and poor monitoring and enforceability. In many instances, the problems would be much more efficiently addressed by using economic instruments.

11. Some obstacles to implementation of economic instruments are discussed in the fourth section. As economic instruments modify prices, they affect the structure of production and the level and distribution of income. Prospective losses of competitiveness in some sectors - notably energy-intensive industry in the context of CO<sub>2</sub> and energy taxes - lead to sectoral lobbies arguing for exemptions or reduced tax rates. Concessions frequently result, partly due to the strength of the lobbies, partly (notably in the case of greenhouse gases) for fear of emission "leakage". Governments also modify environmental taxes to take account of the consequences for income distribution. While poorer households generally tend to spend a higher share of their revenue on energy products, the overall effect of an increase in energy taxes on income distribution is difficult to determine; often, other measures are introduced in parallel to offer some compensation for lower income groups. Regulatory policies also affect production structures and income distribution but meet fewer open objections, in part because the effects are less transparent and in part because the process is more prone to capture by interest groups. *Concessions reducing marginal incentives made for competitiveness reasons are frequently unjustified, and household income distribution concerns are usually better addressed through normal income support policies or other policies that do not undermine the environmental objectives.*

## 2. Policy co-ordination

12. Attempts to increase the degree of co-ordination and coherence<sup>5</sup> of policy across industrial sectors have increasingly become a priority in all OECD countries. Although not confined to environment-related issues, such co-ordination is particularly important here because of the wide range of activities that affect, or are affected by, any particular environmental problem. If things were simple, co-ordination could be achieved almost automatically by use of taxes and subsidies set equal to the difference

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5. What really matters is policy coherence, with co-ordination being a means to achieve it. To avoid repeated use of both words, "co-ordination" is taken to mean co-ordination that achieves coherence.

between prices and social costs, with redistribution where necessary to compensate those who suffer from more than their fair share of otherwise optimal levels of environmental impact or from the policies to achieve it. Expanding the use of economic instruments can help to move in this direction, but lack of homogeneous and measurable tax bases, indivisibilities, market structure and other obstacles place limits on the extent to which economic instruments can be used. Regulations will thus always be necessary in many areas of environmental policy, and other policies always need to be evaluated to ensure their compatibility with environmental objectives.

13. This section first looks at some of the areas where discrepancies between sectors seem to be particularly striking - generally where it is clear that environmental externalities that are recognised as important in environmental policy are being ignored or even accentuated in sectoral policies - and then surveys the different ways in which countries are trying to improve co-ordination.

## 2.1 Sectors

14. The following paragraphs illustrate how sectoral policies covering agriculture, transport, energy and fisheries<sup>6</sup> can distort resource allocation with adverse environmental side-effects.

### 2.1.1 Agriculture

15. Agricultural policies in most OECD countries deliver substantial subsidies (Figure 1). The specific aims of policies vary, but major objectives are frequently concerned with income support in rural areas and security of supply; in some countries, agriculture's role is also perceived as the guardian of nature and the landscape even while it exploits and alters them. Despite reforms, agricultural support still mostly takes the form of strong incentives to keep output high, through output price support and input subsidies.

16. Although agriculture contributes to a number of pollution problems, most notably of surface water, it is often exempted from the taxes and other measures that are applied elsewhere to deal with these problems. A major water user, agriculture generally benefits from subsidies for water use, usually implicit, often in the very areas where water is scarce. Most Economic Surveys made recommendations for policy changes in these two areas.

17. Getting direct quantitative cross-country comparisons in respect of these problems is difficult, but some illustration is possible for water pricing, where the price of water supplied to agriculture is almost always substantially less than that supplied to households or to industry (Figure 2). Differences in the quality and quantity of water supplied to households, industry and agriculture make the direct comparisons of prices shown in Figure 2 hazardous.<sup>7</sup> Nevertheless the difference in the cost of water to industry and to agriculture is almost certainly greater than could be explained by quality differences. Among the countries

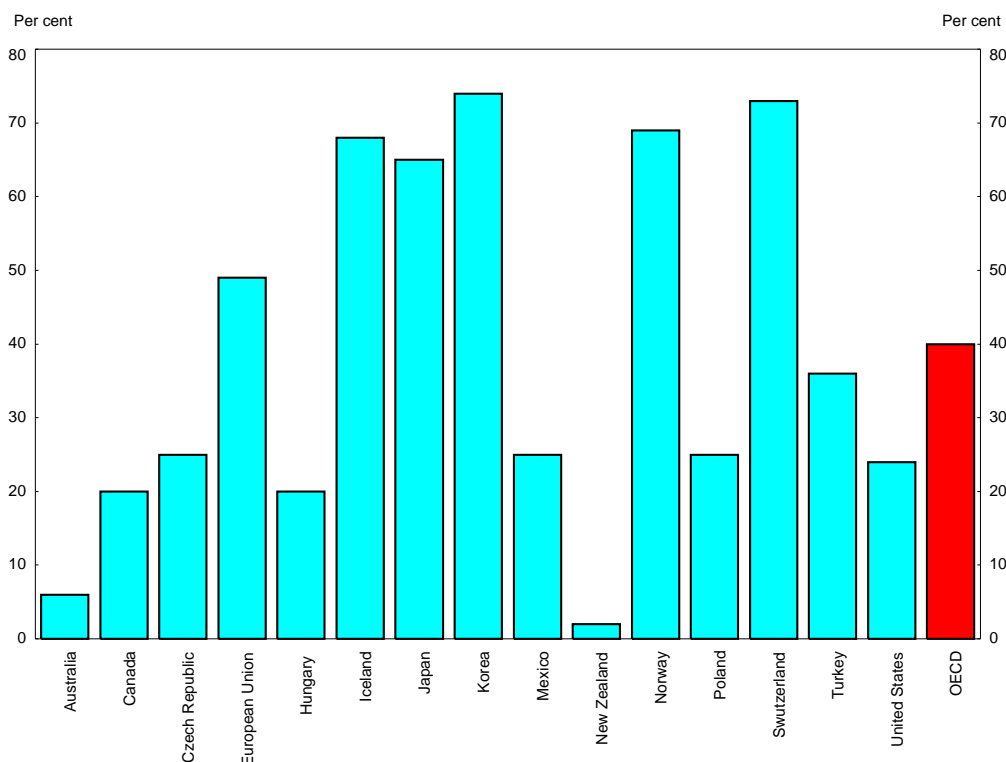
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6. The chemicals sector does not appear in this list, not because policy was found to be beyond reproach but because related policy is largely that on hazardous substances which tends to be rather specialised and has been difficult to cover in the context of OECD Economic Surveys.

7. Systematic data on the cost of water supplied to industry and, even more so, to agriculture are sparse. The countries shown in Figure 2 are the only ones where volumetric prices were available for both as well as for households. In Austria the water price shown is that for supplies of drinking water for animals, whereas in other cases it is generally water for irrigation where quality standards can be much lower than for water supplied to households.

shown, only in the Netherlands and Austria is there no clear implicit subsidy to agriculture through water pricing.

**Figure 1. Subsidies in agriculture: Producer Support Estimates (1)**  
1999



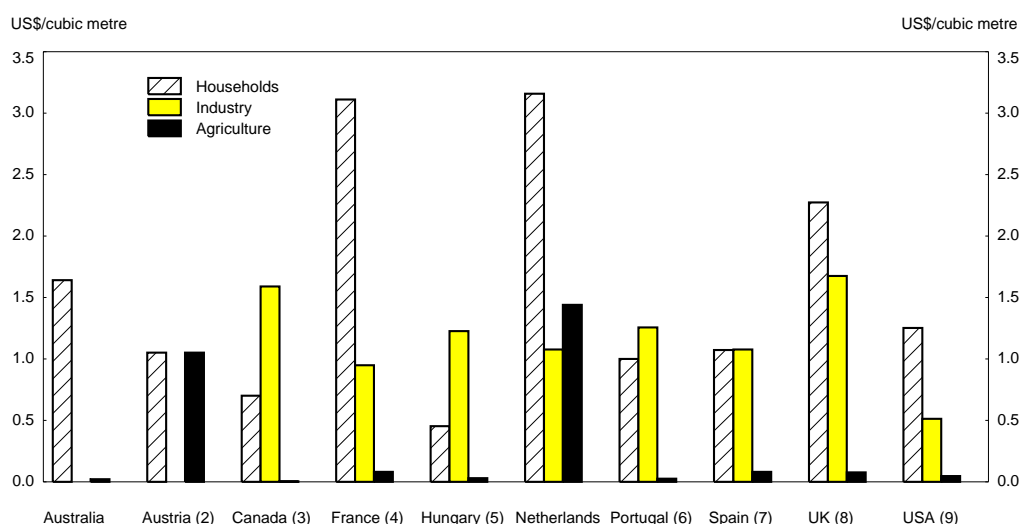
1. Annual monetary value of gross transfers from consumers and taxpayers to support agricultural producers arising from policy measures. The percentage PSE is the ratio of the PSE to the value of total gross farm receipts, measured by the value of total production plus budgetary support.  
Source: OECD (2000), "Agricultural policies in OECD countries: monitoring and evaluation 2000".

18. The environmental externalities arising from agriculture are also frequently subject to a different regime from those for other industries and households. This is particularly the case concerning water pollution by nutrients - phosphates and nitrates - that leach into ground water or run off into surface water, from applications of mineral fertiliser or from animal manure. Most countries have had increasing problems with such water pollution<sup>8</sup> which has been tackled initially by concentrating on point sources of nitrates and phosphates in industry or public sewage treatment works, where discharges can be measured directly. This kind of water pollution from industry has diminished in many countries, and among those surveyed, Denmark, Finland and Germany have used regulation and higher charges and taxes, and the Flanders region of Belgium introduced a tax on industrial nitrate discharges. In all these countries,

8. It causes two main problems: eutrophication whereby nutrients stimulate growth of plants which reduce light penetration and whose decay absorbs oxygen; and, where affected water is used as a source of drinking water, it creates a health risk unless additional resources are devoted to purification.

however, the regulation and subsidies used in the agricultural sector have not achieved the reductions in discharges expected in that sector.

**Figure 2. Water prices in selected OECD countries (1)**  
mid 1990's



**Notes:**

1. For agriculture, industry and households, prices are the median values for the range of prices for each category.
  2. Water used for livestock activities is obtained from municipal systems and priced at households rates.
  3. Industry: these rates apply to commercial establishments only. While this may include small industries, the rates do not apply for major industrial operations.
  4. Agriculture: data refer to the regions of Adour-Garonne and Côteaux de Gascogne; industry - the value refers to 1990-93 and excludes taxes, pollution and abstraction fees.
  5. Agriculture: the value refers to 1998 water abstraction charges; households and industry : the values refer to 1998 maximum and minimum user charges for public water supply.
  6. Agriculture: data refer to the regions of Sorria and Vigia. When it is a two-part tariff, the values were based on the estimated water volumes and the value per cubic metre.
  7. Agriculture: data refer to the regions of Andalucia, Castille and Valencia. Industry: the values refer to 1992:94.
  8. Agriculture: data refer to Northumbria and Wales.
  9. Agriculture: data refer to the regions of Sacramento River and Tehama.
- Source: Environmental Indicators for Agriculture - Volume 3: Methods and Results, OECD, 2001 and "The Price of Water", OECD, 2001.

19. One reason for the slow progress in addressing environmental externalities in agriculture could in principle be that abatement costs in agriculture are much higher than in industry, but it is also the case that environmental targets for agriculture are often much less stringent than those for other sectors and economic incentives have been barely used. Frequently, where fertiliser taxes are used, agriculture is either exempted (*e.g.* in Denmark a fertiliser tax applies to household use but not for agriculture) or subject to very low rates (*e.g.* nutrient taxes in Belgium are implemented at a low rate for applications below a relatively high level, the rate being multiplied by over 40 for "excess" application above the threshold). Nutrient discharges to surface or groundwater cannot be observed directly, but it is nevertheless possible to apply economic incentives in the case of agriculture, as discharges can be calculated indirectly using nutrient accounts; such accounts are used in the Netherlands to tax nutrient surplus from animal husbandry and are maintained, though not used for fiscal purposes, in Denmark and Belgium.<sup>9</sup>

9. See O'Brien and Høj (2001) and O'Brien (2001b) for more details.

20. Most agricultural subsidies tend to encourage more intensive farming and hence - other things being equal - encourage pollution. With most subsidies eventually being capitalised in land prices or rents, individual farmers, especially small ones and tenants, do not feel that their farms are particularly profitable so resistance to economic instruments such as taxes is strong; farming lobbies have generally succeeded in persuading the authorities to use a regulatory approach, perhaps in the hope that it would allow them to claim for subsidies. As pointed out elsewhere (see Section 4.1), however, economic instruments can easily be designed to moderate the net burden by allocating tradable permits or tax credits through grandfathering insofar as that is thought necessary for social reasons.

### 2.1.2 *Transport*

21. Transport policy is frequently implicated in the context of greenhouse gas and other air pollutant emissions. As transport is rapidly growing, its contribution to the associated environmental problems is increasing. The objectives of transport policy are varied. As an important intermediate input an efficient low-cost transport system is desirable; regional and social objectives may also influence the provision or subsidisation of infrastructure and services. However, although some subsidies to transport may directly encourage pollution, the problem in transport is more often that pollution or congestion externalities are not properly priced. Indeed, policy measures that alleviate the environmental impacts of transport (not all of which necessarily owe their origin to environmental concerns - notably in the case of fuel and vehicle taxes) appear a long way from equalising marginal abatement costs for the main emissions, either across different forms of transport or between transport and other sources of these emissions.

22. In some cases this lack of consistency is difficult to avoid because it is not possible to use the same policy instruments in all sectors. Economic instruments can rarely be used to deal with environmental externalities caused by emissions from mobile sources not directly related to the use of fuel, such as, for example, NO<sub>x</sub> emissions, as measuring these emissions would be prohibitively expensive and a variety of policy measures has to be used.<sup>10</sup> The inability to use economic instruments in certain cases obviously makes it difficult to ensure that marginal abatement costs for particular pollutants are equalised across activities. However, the Economic Surveys highlighted a number of areas where, even though economic instruments - fuel taxes - are available and used, they are often deliberately set in ways that appear to undermine the environmental incentives. Two in particular stand out: the relative size of taxes on diesel and petrol (gasoline); and exemptions of certain kinds of transport.

23. In almost all countries, the fuel tax on diesel is lower, per litre, than that on petrol (Figure 3). This differential has usually existed for some time and appears to take its origins partly in intuitively attractive but mistaken reasoning that diesel is more economical so its use should be promoted<sup>11</sup> and partly in successful lobbying from transport enterprises. In terms of pollution externalities, however, a litre of diesel almost always pollutes more than the same quantity of petrol (Figure 4). Petrol and diesel taxes are

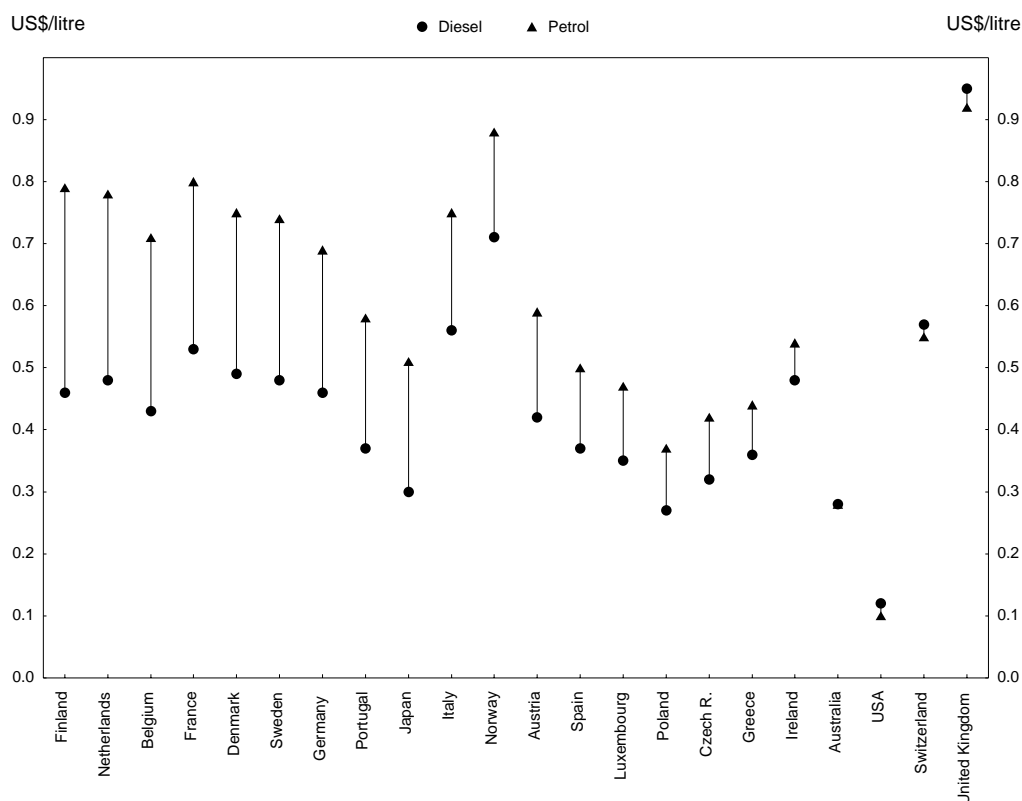
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10. See Degraeve et al. (1998), for a method of calculating an optimal combination of regulatory and economic instruments. See also Section 3.1 on economic instruments

11. Mistaken because there are no externalities in fuel economy per se - the benefit from using less fuel per distance travelled is the same for society as for the individual so there is no justification for differential taxation. The relative fuel economy of diesel versus petrol engines is irrelevant as far as an environmental tax is concerned. It is true that greater economy reduces emissions per kilometre, but it will reduce tax per kilometre in the same proportion, without any discrimination in the tax rate per litre. Such a tax should be set in direct proportion to the environmental damage per litre consumed, which generally implies a higher tax, per litre, on diesel. If diesel is more efficient, it may still be used even if it is more expensive -- but the consumer would only do this if the relative efficiency (i.e. lower fuel consumption) were enough to make the cost (including tax) per kilometre lower.

thus the wrong way round from the environmental point of view and no other considerations appear to justify this.<sup>12</sup>

**Figure 3. Taxes on diesel and petrol**  
1999

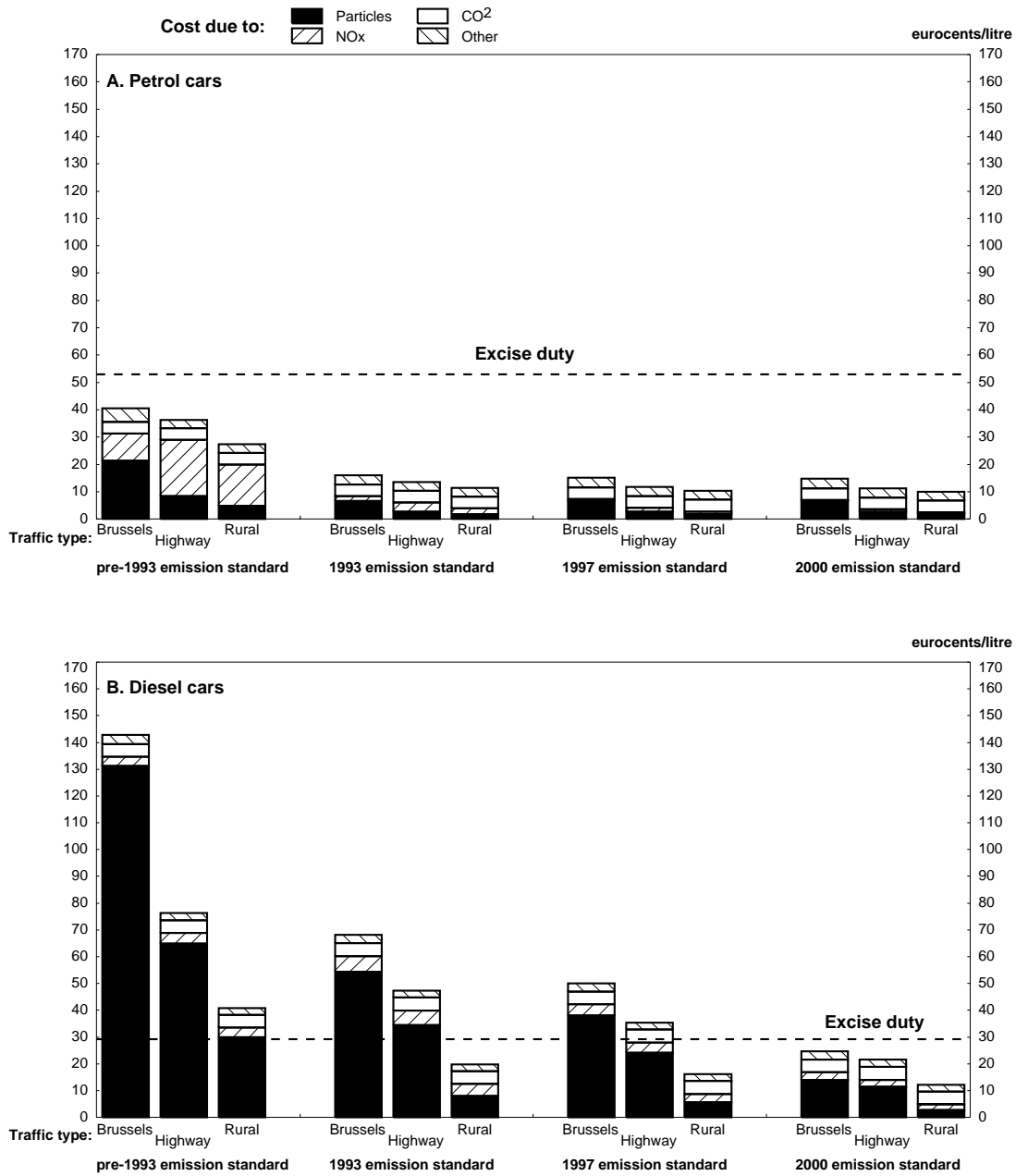


Source: OECD, IEA (2000).

24. Insofar as fuel taxes are designed to internalise environmental externalities, exemptions are inappropriate, since all fuel combustion produces harmful emissions (though it is true that the environmental costs, at least health costs, vary substantially according to where they are emitted, as Figure 4 shows). Fuel taxes could also be thought of as, in part, pricing wear and tear on road infrastructure. Thus, exemptions on this part of fuel taxes for public transport - which degrades the road infrastructure and should therefore pay the relevant marginal costs - are in effect a subsidy, whereas

12. There are many other aspects of systems of fuel and transport charges and taxation which are anomalous, a wide-ranging review of the logic behind them is needed in most countries. The petrol-diesel example is perhaps the easiest to demonstrate but may not be the most serious.

Figure 4. Air pollution externalities due to motor car fuels, Belgium



Note: The figures are based on estimates of emissions under certain typical driving conditions. Brussels: urban centre of a large city; highway: highway in a rural location ;rural: a Flemish village and certain types of car, corresponding to successive European emission standards, for new cars: pre-1993; 1993 (directive 91/441/EEC), 1997 (directive 94/12/EC), 2000 (directive 98/69/EC).

Source: Leo De Nocker, Luc Int Panis, Rudi Torfs: "Environmental damages from transport in Belgium: trends and comparison with excises on petrol and diesel." Contribution of the Flemish Institute for Technological Research (VITO) to EU report, DGXII (2000) "External costs of Transport, Final Report, Office for Official Publications of the European Communities, Luxembourg.

exemptions on fuel for agricultural machinery (in fact more widespread than for public transport) - which impose few costs on public road infrastructure - may be partially justified.<sup>13</sup>

25. It is perhaps easier to point to unjustified variations in tax rates or exemptions than to assess appropriate *levels* of taxation. As Figure 4 shows, successive regulations have enormously reduced the levels of air pollution externalities caused per volume of fuel burnt in new motor cars (standards in North America, not shown in the figure, improved earlier).<sup>14</sup> Other externalities, such as uninsured accident costs, noise, congestion and costs of wear and tear on infrastructure, are becoming more important relative to those due to fuel combustion. Taxation will need to shift to tax bases more closely related to all these problems. New technologies make it increasingly feasible to conceive better targeted systems of charges, which can be related to road use, environmental and other characteristics of all kinds of vehicle (European Conference of Ministers of Transport, 2000).<sup>15</sup>

26. Another area where incentives are poorly aligned with externalities is international air and sea transport, which pay no fuel taxes.<sup>16</sup> This exemption has some basis in administrative convenience - deciding in which jurisdiction to pay taxes to compensate for aircraft emissions would require a considerable international co-ordination effort - but is increasingly unreasonable as taxation comes to be used to deal with a number of problems that are cross-border or global in nature. This is notably true in the case of sulphur taxes (especially for shipping) and carbon taxes. While it might be difficult for a country to impose a tax on fuel for international travel unilaterally, and domestic transport companies might argue that they would unfairly lose competitiveness *vis-à-vis* foreign companies, these arguments are not altogether convincing.<sup>17</sup>

### 2.1.3 Energy supply

27. Energy is a key intermediate input and an important expenditure item for consumers. An essential objective of energy policy is to ensure a stable supply, which implies the diversification of energy supply sources and a reluctance to rely exclusively on imports. In a number of countries, energy supply produces a

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13. Emissions from agriculture presumably generally occur in areas of low population density, so that immediate health effects are also low. Location makes no difference for greenhouse gas emissions such as CO<sub>2</sub> and methane, however.

14. Regulations that forced these improvements probably pass a cost-benefit test; an interesting question is whether it would have been significantly more cost-effective to use a corresponding economic instrument, such as a tax on new cars as a function of the relevant emission characteristics. While no answer is available to this question, the methods used in Degraeve et al. (1998) could be used to analyse it.

15. For example, Iceland, which has no diesel tax, imposes a tax on diesel vehicles based on the weight (and other characteristics affecting road wear) of vehicles and the distance travelled. See OECD (2001g).

16. In the case of aviation fuel, there is a binding agreement on such exemptions under the Chicago Convention. However, take-off and landing charges in many countries already include components related to environmental effects.

17. Ships, aeroplanes, trains and road vehicles making cross-border journeys are generally free to refuel wherever they wish. If a country taxes aviation fuel sold within its borders, all aeroplanes refuelling there pay the tax, regardless of their "home" country, resulting in no competitive advantage for anyone. An exception might be that refuelling facilities are complementary to aircraft maintenance facilities, for example, disadvantaging companies with their base in the taxing country; but this may not be a major difficulty in practice, and would not apply very strongly to means of transport other than air. The transport sector has a strong incentive to lobby policymakers to convince them otherwise, of course. The non-inclusion of emissions from bunker fuel - through lack of agreement on how to allocate them - in the Kyoto Protocol is another example of the special treatment received by international transport.



number of the most significant pollutants and is often treated differently from other sectors causing similar externalities.

28. In Canada, depreciation rules until recently had the effect of treating investment in resource-based activities, notably oil and gas, more favourably for tax purposes than investment in most other sectors (Vourc'h, 2001). The effective marginal rate of taxation on investment in most industrial sectors was several times higher than that for oil and gas - even agriculture faced higher taxation. The authorities argued that such favourable treatment was to take account of greater risk, but this is not generally a matter for the tax system, and does not imply a lower average tax *rate*, though special treatment of “lumpy” income and expenditure might be warranted. More recently, depreciation rules in Canada are being revised to reduce or eliminate this bias. Similar favourable treatment for resource-based activities also exists in the United States and quite probably in other OECD countries. This treatment is likely to encourage overuse and depletion of exhaustible resources as well as associated harmful environmental effects.

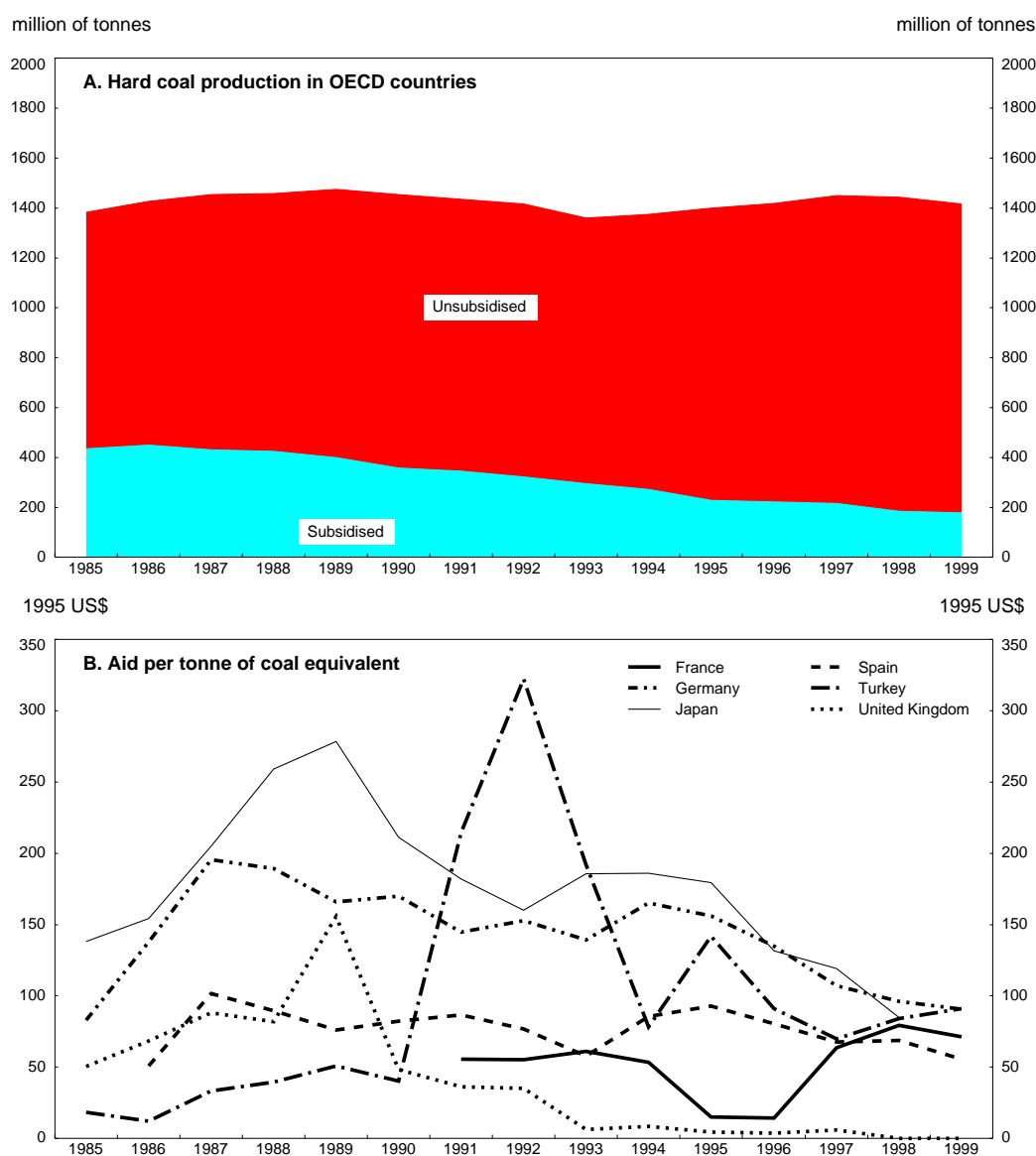
29. Coal extraction has traditionally been subsidised in a number of countries, where its decline creates regional or local unemployment problems. These subsidies have diminished quite considerably over the past 15 years, and the share of total production that is subsidised has declined markedly, too (Figure 5). One reason - although certainly not the principal reason - for their reduction may have been the increasing realisation that coal is a very “dirty” fuel compared with oil - its carbon content is higher and so, generally, is its sulphur content - and even more so with gas, which has much less carbon and practically no sulphur.

#### 2.1.4 Fisheries

30. Managing fisheries is an extremely difficult problem. Although fisheries are a renewable resource, their rate of renewal - and therefore the sustainable harvest - is dependent on the stock, which is in turn dependent on the rate of harvest (although this relation is not known with precision). In most cases, unconstrained competitive fishing would all but destroy most stocks of fish in the sea, and certainly deplete them far beyond the level at which an optimal yield is achieved. Maintaining stocks around such a level requires not only sophisticated scientific analysis of fish biology and behaviour but also tools for managing total catches while retaining incentives for efficiency, as well as often balancing issues of support for remote regions. Most national fisheries are regulated, but international fisheries are more problematic to manage, due to the lack of property rights over the stock. In the European Union, negotiations over national quotas are difficult, with agreement usually being made at levels higher than “scientific” proposals; EU policy uses transferable quotas in a number of fisheries.

31. The experience of the Atlantic fisheries of north-east Canada illustrates the difficulty of separating regional policy from fishery management, to the detriment of the latter. Inappropriate capacity-expanding subsidies in the 1980s - motivated partly by concern to promote regional development in a remote part of the country - contributed to the collapse of groundfish stocks (as did overestimates of the size of the stocks themselves, along with the activity of foreign fishing fleets), and the fishery was closed in 1992, when it was clear that certain fish stocks had been practically wiped out. At the time, measures were taken to compensate workers and boat owners but these have tended to prevent its capacity contracting, and have had the effect of retaining people in a region largely dependent on a fishing industry that can no longer sustain the local economy (Vourc'h, 2001). Part of the problem has stemmed from the unemployment benefit system, which tends to act as a subsidy to labour resources remaining, even if on a part-time basis, in the fishery sector.

Figure 5. Subsidised coal production in the OECD



Source: IEA .

## 2.2 Co-ordination

32. It is not a new idea that environmental policy needs to be co-ordinated across sectors and with other policies. Greater use of economic instruments applying to all sectors,<sup>18</sup> where feasible, is a way to improve co-ordination. More generally, the effective co-ordination of environmental policy across sectors requires assessment of the economic effects of environmental policies, to ensure cost minimisation, and of the environmental impact of other policies. Countries have implemented procedures for such assessment, some of which are discussed in this section (Table 1).

18. So that incentives to abatement at the margin are everywhere equal.

Table 1. Environmental impact and regulatory assessment in selected OECD countries

	Environmental effects		Economic effects of Environmental policies	Public domain
	of projects	of policies		
<b>Australia: federal</b>	Required for actions that significantly impact on matters of national environmental significance. Economic and social matters must also be considered.	No requirement.	Regulatory Impact Statements may apply	Yes
<b>Australia: Queensland</b>	Required, under defined procedures, for major projects. More limited EIA for others, can depend on risk and local government provisions. No CBA required.	None	Regulatory Impact Statements required for "new and revised regulations and other subordinate legislation likely to impose appreciable costs..." CBA of regulatory options	Yes, for EIAs and RISs, with mandatory period for public comment.
<b>Austria</b>	Yes No CBA	<i>Ad hoc</i> . Some sectoral laws require it.	No (Fiscal impact only)	Yes
<b>Belgium: Flanders</b>	85/337/EEC implemented	Legislation for Strategic Environmental Assessments under preparation.	No (Some <i>ad hoc</i> examples)	Where 85/337/EEC applies, yes.
<b>Canada: Alberta</b>	Yes, with exemptions (list of exemptions includes oil wells). CBA required. Assessment often done even when EIA not formally required.	Part of normal inter-ministerial consultation	Fiscal implications only	Yes
<b>Canada: Federal</b>	Yes, when they have important environmental effects. Can be delegated to Provinces.	Strategic Environmental Assessment required (1999 Cabinet Directive) when policy proposal may have important environmental effects. No CBA required.	Regulatory Process Management Standards recommends cost-benefit analysis regarding health, social, economic or environmental risks; CBA guide. 1999 Regulatory Process Statement requires that benefits of regulations exceed costs, and that impact on economy is minimised.	Database of EIAs in Canadian Environmental Assessment Agency. Environmental Commissioner's reports
<b>Denmark</b>	Obligatory for projects which may have significant environmental impact. Done by agency sponsoring the project. No CBA required.	Environmental Impact Statements No CBA required. Checklist approach	Regulatory impact statements required for all bills. "The evaluation of the business economic consequences [of any bill presented to parliament] should as a minimum discuss the immediate effect of the bill on the costs for trade and industry, including administrative consequences."	Yes. Annual "Environmental Assessment of the Budget" reviews costs of environmental policy, with some evaluation of the environmental impacts of the national budget. Cost-benefit framework, but few formal analyses presented

Table 1. **Environmental impact and regulatory assessment in selected OECD countries**  
(*contd.*)

	Environmental effects		Economic effects of Environmental policies	Public domain
	of projects	of policies		
<b>European Union</b>	1985 Directive 85/337/EEC, modified in 1997, requires Member states to carry out EIAs for certain kinds of project. Defines minimum standards for all EIAs. No CBA required.	85/337/EEC specifically excludes legislative action.	No EU provisions	Where 85/337/EEC applies, yes.
<b>Finland</b>	Obligatory for projects which may have significant environmental impact. Done by the agency sponsoring the project. No CBA required	Yes. No fixed procedures.	Legislative proposals are required to include "economic assessments."	Yes, for projects
<b>Germany</b>	EIA required for federal and Länder projects. No CBA required	Generally required for all laws and regulations. Specific procedures in some cases. No CBA required	All proposed laws must include analysis of effects on private interests. EIAs must present the economic impact of environmental measures.	Yes
<b>Norway</b>	Required under several laws, for major projects: 85/337/EEC implemented. No CBA required.	Assessment required by Administrative Order.	Assessment required by Administrative Order (for economic, administrative and environmental effects).	Yes, for EIAs under 85/337/EEC. Yes, with some modifications, for assessments required by Administrative Order.
<b>United States</b>	Required for "policies, regulations, and public laws of the United States," which includes private entities seeking a federal permit. Most often associated with Federal Infrastructure and permitted projects. No CBA required, but larger projects will typically include an economic impact analysis and CBA.	Environmental Impact Statements. No CBA required.	Economic Assessments (formerly Regulatory Impact Assessments) required for any "significant" regulatory measure (e.g. economic impact of over \$100 million). Includes inter-agency review and CBA. (Conclusions of CBA not binding). Annual publication of costs and benefits of regulations (OMB) since 1998. New legislation is pending in Congress to make this a more permanent requirement. "Regulatory flexibility analysis" (RFA), for regulations that have a "significant economic impact on a substantial number" of small entities. Numerous provisions also in the authorising environmental legislation.	Yes

Source : OECD Secretariat.

Note: The information in this table was compiled on an *ad hoc* basis through bilateral contacts. The coverage and accuracy of the information presented is not uniform.

### 2.2.1 *Environmental impact assessment*

33. One basic tool that governments have practically universally introduced is the environmental impact assessment (EIA). Initially, and it is still the case in many countries, the use of EIAs was restricted to infrastructure projects undertaken by government departments or agencies; the environmental impact of such projects has to be assessed, so that the decision to implement the project can take into account these impacts alongside the other costs and benefits of the project. Unfortunately, a comparative assessment of how well these procedures work in different countries is not available. Two universal aspects of the procedures stand out, however: (i) the EIA is always drawn up by the department or agency that is proposing the project, and (ii) cost-benefit analysis of the environmental impacts is never obligatory and rarely undertaken.

34. As a practical matter it is probably inevitable that the sponsoring agency do the EIA. In Denmark, the Environment Ministry issues guidelines on how to carry out EIAs. Each ministry has an environment division with the responsibility to ensure that that ministry's EIAs meet the standards; the Environment Ministry itself does not carry out any central quality control. In other countries quality control may be centralised in the environment ministry or agency - systematic information on this is not available. The absence of quantitative cost-benefit analysis in EIAs - it is not required in any of the countries surveyed - is less justifiable: it is a more accessible tool than it is often thought, and useful even when information is incomplete, as discussed in Section 2.4.

35. Less frequent are systematic procedures for assessing the environmental impacts of *policies*. However, such procedures - for *new* policy measures - are spreading, under names such as Strategic Environmental Assessments. Again, the ministry sponsoring the legislation is responsible for carrying out the assessment. And again, cost-benefit analysis of the environmental effects is not mandatory and rarely, if ever, included. Experience with such assessments of policies is relatively limited.<sup>19</sup>

### 2.2.2 *Economic impact assessment*

36. Analysis of the economic costs of regulations, which generally covers all regulations, not just environmental ones, is becoming a general requirement for the introduction of new policies in most countries (Table 1). It is perhaps most developed in the United States, where regulatory impact assessments (RIAs) do include explicit cost-benefit analysis,<sup>20</sup> although there is no requirement that identified benefits exceed identified costs, and not all benefits and costs are presented in monetary terms. Where there is uncertainty over environmental impacts or their valuation, a range of estimates, which can be very wide, is frequently presented. A significant feature of the US procedures is the regular report to Congress from the Office of Management and Budget, that compiles and tabulates the expected costs and benefits of recently introduced regulations, based on the RIAs. (Note that these are based on the *ex ante* estimates, not an *ex post* assessment, though the latter are done in some cases, as recently for the Clean Air Act.) On the other hand, attempts in the United States in the early 1990s to take the logical step and try to direct policy actions to those areas where the benefit:cost ratio was highest were abandoned (O'Brien, 2001a).

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19. A 1998 report on experience in Denmark suggested that early strategic environmental assessments on two bills introduced in parliament were not very helpful. See O'Brien and Høj (2001). The report said that the EIA's influence on Parliament's decision to adopt legislation was "murky and vague," and that claims in the bills that they would bring substantial environmental benefits were unsubstantiated. See Elling and Nielsen (1998).

20. Although procedures are not entirely uniform, for example the values attached to particular health impacts vary from agency to agency.

37. Other types of economic impact may be important, for example that on competition. In Australia, the National Competition Authority is monitoring the implementation of the 1995 water reform (the National Agenda for Water Reform), both for its effects on competition and as a means of ensuring that the inter-state agreement, and associated fiscal transfers are being implemented as agreed.

### 2.2.3 *Other tools for policy integration*

Apart from variations on environmental and regulatory impact assessment, other approaches are also being tried in certain countries. Increasing attention to policies to promote sustainable development, with its emphasis on policy-interdependence, is a potential source of improved co-ordination. In Belgium a long process of public consultation and discussion led to the publication in late 2000 of the Federal Sustainable Development Plan. The plan announces measures to be implemented by the government in the future, rather than being an Act which implements them, and its practical effect on policy remains to be seen. In Denmark the Finance Ministry publishes an annual environmental assessment of the Budget law, which is in practice more oriented towards economic analysis of environmental policy. Interministerial committees on environmental issues also exist in a number of countries including Norway and Belgium.<sup>21</sup>

38. Another interesting approach was the establishment in Canada in 1995 of the Commissioner of the Environment and Sustainable Development. Established in the office of the Auditor General, the Commissioner is specifically charged with promoting the “integration of the environment and the economy”. The Commissioner operates as an auditor of federal policies in these areas. Without any direct powers over policymaking or implementation, the office’s influence is limited to the publication of an annual report on progress in implementing announced policies, including recommendations on policy reform in various government departments. This is nevertheless a very valuable source of information and promotes public debate on these issues.

39. In Norway, a number of commissions have been set up in the 1990s to evaluate policies that affect the environment. For example, the Green Tax Commission, made up of representatives from all parts of society, provided precise recommendations on how to reform the tax system to internalise environmental externalities.

## 2.3 *The legal system*

40. A potential mechanism for improving coherence is the legal system. An extreme position might be that since most issues of environmental damage are similar to personal injury or damage, setting a general framework in which individuals can make claims in the courts for damages against polluters would remove much of the need for specific legislation and regulation - the threat of litigation would force enterprises to limit pollution to levels where the cost of further abatement exceeded what would be awarded against them in courts. However, with some of the main pollutants, establishing a link between specific cause and effect is practically impossible; considerations of information, cost and interdependencies make this an unworkable approach on its own. Nevertheless, the court system can play a role in, for example, ensuring that environmental legislation is evenly applied.

41. Use of the courts varies enormously among OECD countries, partly because of differences on liability law and standing, that is, who has the right to take court action (Table 2). Where compliance with the law by a polluter provides a defence against actions for damages, the ability of this kind of action to establish some consistency of treatment is limited, except as provided for anyway in the relevant law.

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21. See van den Noord and Vourc’h (1999) and O’Brien (2001b), respectively.

Legal tradition may be as important as the letter of the law. For example, continued violation of European law (enforceable in national courts) in Belgium, with respect to Brussels sewers, resulted in no legal action from Belgian citizens - the European Commission started legal proceedings in the European Court which appeared to accelerate the process of taking serious measures to establish appropriate sewage treatment in Brussels (O'Brien, 2001b).

42. In the United States, where the courts are most active in environmental issues, compliance with the law is generally a defence, but not always a complete one - provisions amounting to a duty of care can allow damages to be obtained even when the letter of the law was respected. Such provisions may be reinforced by being written into the relevant environmental legislation itself. In Belgium, where compliance with regulations is generally a complete defence, the Flemish authorities have passed a law to change this in the case of groundwater pollution, establishing a regime of absolute liability. This is similar to the Superfund regime in the United States, under which contaminated but abandoned sites are the joint and several liability of any enterprise which used the site in the past. The Superfund regime, however, was not noted for producing particularly cost-effective responses, even if many evaluations of this cleanup programme exaggerated its economic costs.<sup>22</sup>

#### **2.4 Cost-benefit analysis**

43. The use of cost-benefit analysis (CBA) in environmental policy varies considerably from country to country; it is increasing, but is rarely mandatory, and in many countries formal quantitative analyses are still rare. CBA may perhaps have been unnecessary in many cases in the past, as some environmental problems were so severe that it was clear that almost any action would have benefits far exceeding costs (even if those costs could have been lower). Now that many of the most obvious environmental problems have been significantly alleviated, the likelihood is that the balance between costs and benefits is much narrower, so the gains from using CBA to get closer to optimum policies are greater.<sup>23</sup> Indeed, all Economic Surveys have made recommendations for increased or more systematic use of CBA.

44. This section surveys briefly the variety of practices for the use of CBA in environmental policy in different countries and suggests how it can be used even where there are disputes over the degree of confidence it merits.

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22. See O'Brien (2001a) and Probst, et al. (1995).

23. Although, in some acute problems which have moved to the fore in recent years - notably climate change and biodiversity - the use of CBA is more than usually restricted by problems of uncertainty and valuation.

Table 2. Legal liability and standing in selected OECD countries

	Can polluted individuals take court action against polluters?	Compliance with the law a defence?	Can NGOs take court action against polluters?	Can citizens/NGOs take action against government agencies for non-enforcement or non-implementation?	Specific legislation
<b>Belgium</b>	Yes	In some cases.	Yes	Yes	There are specific liability rules in the Flemish region for damage as a consequence of e.g. groundwater extraction and soil pollution.
<b>Denmark</b>	Yes. Damages only for monetary loss or compensation for actual remedial expenditures undertaken	Basic test is negligence. Compliance with law likely to be a defence.	Yes (they must have "fixed structure" and have objectives that are relevant to the case.)		Danish Society for the Conservation of Nature has statutory right to make complaints against certain administrative decisions
<b>Finland</b>	Yes	No (except certain types of water pollution)	No (except for destroying or impairing nature, under the NCA)	No	Environmental Damages Act (1994). NCA: Nature Conservation Act (1996)
<b>Ireland</b>	Water and air: Yes (except for discharges by local authorities) Other: No	Water and air: Yes	Yes (at least for water, air and planning)	Yes, under judicial review of actions, not clear for in action	
<b>Norway</b>	Yes	Usually	No	No. Specific decisions can be contested.	
<b>EU</b>				Individuals and NGOs can take action in national courts to require implementation of EU provisions if incorporated in national legislation.	
<b>UK (England and Wales)</b>	Yes	Probably no	Yes	Yes, under judicial review of actions, not clear for <i>in action</i>	
<b>United States</b>	Yes	No (may mitigate)	Yes (under specific citizen suits provisions in environmental laws)	Yes (where agency has statutory duty to act, and where plaintiff can show "injury")	Administrative Procedures Act Various Executive orders

## Sources:

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- US: Richard Stewart, NYU Law School.



### 2.4.1 *The use of cost-benefit analysis*

45. It is difficult to make meaningful comparisons, but CBA seems to be more widely used in the United States than in Canada and European countries such as Germany and Belgium, though Denmark, for example, is rather more active. On the whole CBA plays a rather small part in determining or quantifying the *targets* of environmental policies in most countries, as well as in assessing the impact of other projects or policies on the environment (Table 1). In the United States, where explicit and quantified CBA is probably used most extensively, some legislation explicitly requires that CBA *not* be used for such purposes<sup>24</sup>, though it is often equally explicit that once an objective has been decided, it should be pursued at least cost. In the United States, and indeed in most countries, the pursuit of least cost solutions is much more systematically embedded in general mechanisms (which generally have their origin in governments' procedural rules rather than in specific legislation) to review all regulations or legislation for their economic impact - frequently known as regulatory impact assessment (see above Section 2.2).

46. In the European Union, national environmental policies are partly preoccupied with the need to implement EU directives and it seems that, at least until recently, these have largely been developed and implemented without formal cost-benefit analysis.<sup>25</sup> Although under some circumstances there might be EU-wide advantages in implementing common standards even if in certain places costs exceeded benefits, the implicit assumption seems to be that benefits exceed costs in all countries. Once EU directives have been issued, they are binding on the member states, so the latter have little incentive to assess the balance of costs and benefits (though they should still aim to implement directives in a least-cost manner). This was clear, for example, in the cases of Denmark and Belgium, who are both falling short of their targets for surface water standards either because of agricultural discharges or (in parts of Belgium) household sewage. For example, despite evidence - admittedly circumstantial - that the costs of meeting the standards of the EU bathing water directive in the Walloon region of Belgium, are high relative to the benefits to be expected, no explicit analysis of this issue is being undertaken.<sup>26</sup>

47. On the other hand, in some cases, CBA has been used to illustrate the costs of environmental externalities and thus support the case for introducing environmental policy measures, as did for example the Swedish Committee on Environmental Objectives in 2000 and the EU directive on emission standards.<sup>27</sup>

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24. In the United States, the rules that govern the use of CBA are not entirely transparent, and their interpretation in the courts can give absurd results. For example, following an unusual challenge to new air quality standards that had been proposed by the Environmental Protection Agency (EPA), a court ruled that the EPA had not in fact been given the power to set such standards because it had been given no objective rule to follow in deciding what standards were appropriate; the court suggested that a cost-benefit standard could be such a rule, but that the legislation (as interpreted in previous rulings of the same court) forbade the use of CBA in setting standards. In fact, in the inter-agency discussion that had preceded the EPA proposals, there had been criticism of the estimation of the expected health benefits for part of the new standards. This case, in the Washington D.C. Circuit Court, was appealed by the EPA to the federal Supreme Court. Previous air quality standards had been set under essentially the same legislation.

25. In the last few years, the European Commission has devoted much more efforts to analysing costs and benefits of environmental policies, but it is yet to have much effect on the implementation of existing directives.

26. See O'Brien, (2001b). This is not to argue that costs do exceed benefits in this case, but that it might be easier to implement the policy if there were stronger evidence that it is fully justified locally.

27. In Sweden, the economic costs of ongoing environmental damage (excluding global warming) were evaluated at around 1 per cent of GDP per year. The preamble to EU directive 98/69/EC on vehicle emission standards notes that external costs due to motor vehicle may be equivalent to as much as 3 per cent of EU GNP.

#### 2.4.2 How should cost-benefit analysis be used?

48. Valuation of environmental externalities raises a number of problems; they are not generally traded, so market prices are not available as proxies for social value. There are a number of ways of estimating alternative proxies (Box 2). There is always room for dispute over these valuations, however, since they are only estimates and always based on a number of difficult-to-verify assumptions; furthermore there are those who argue that certain things - notably human life, and some aspects of biodiversity - cannot be valued, and even that it is morally wrong to attach a monetary value to them.

### Box 2. Valuation techniques for environmental impacts

#### *Revealed preferences or "surrogate markets"*

Since markets do not directly reveal environmental values these can be derived from observing consumers behaviour in "surrogate markets" which indirectly reflect their preferences (willingness to pay).

The *hedonic price method*, is based on the fact that the price of a private good is based on a bundle of attributes, some of which are external to the market. An example is the housing market where the price of a house is not only based on its "physical" characteristics, (size, equipment, etc.) but also on a bundle of environmental "attributes" such as the noise level or exposure to air pollution. *Ceteris paribus*, a house located in a noisy and polluted site will be less expensive than a similar house in a quiet and clean environment. This price differential reflects the willingness to pay for peace and quiet (or clean air). This method applies econometric techniques requiring a large volume of data on housing markets and attributes.

The *travel cost method* uses differences in travel and other costs to experience an environmental resource (a natural park, a fishing or swimming area etc.). Different individuals incur different costs to visit different sites; travel costs are used as a proxy for the individual's willingness to pay for using a specific site. Demand curves can be derived and the area under the demand curve will reflect the total value of the site. If the site deteriorates (e.g. water pollution preventing fishing and bathing), the visitation rate will decrease and/or the travel cost to another area will change. These variations in consumers surplus will reflect the cost of environmental damage.

#### *Stated preferences or "hypothetical markets"*

Instead of indirectly deriving values from the observation of existing markets, the "contingent valuation method" (CVM) simulates hypothetical markets in which individuals are asked to participate. This is a survey-based technique where, for instance, individuals are asked how much they would be willing to pay for a given environmental improvement or what compensation they would require to accept a given deterioration. Complex techniques have been developed, in particular to put individuals "in situation" (e.g. noise levels or picture of different pollution levels) and make the hypothetical payment as concrete as possible by using "vehicles" or representation such as tax payments. CVM requires sophisticated survey techniques and the results are heavily dependent upon the degree of information and awareness of the surveyed sample. While the values derived from this method must be interpreted with judgement and precaution, CVM has become increasingly elaborate and is extensively used to evaluate non-use values.

#### *Avertive behaviour*

This method consists in evaluating the willingness to pay of people to protect themselves against environmental hazards. This can comprise "defensive expenditures" (e.g. noise insulation, water filters and purifiers, anti-soil-erosion measures), the purchase of environmental surrogates (purchase of mineral water), or relocation to other areas. The advantage of this method is its relative simplicity, but avertive behaviours do not provide perfect substitutes for environmental quality; for instance, noise insulation of houses does not remove outdoor noise and implies constraints such as living with closed windows.



**Box 2. Valuation techniques (contd.)**

*Benefits transfer*

The “benefits transfer” approach is not a valuation technique as such, but an application of “borrowed” estimates from existing studies to new cases. For instance, the willingness to pay for using one site or a whole benefit function can be transferred to another comparable case. This requires of course, specific protocols and precautions for a thoughtful adaptation of existing estimates. The main advantage of benefit transfer is that it avoids the cost of carrying out original estimates, which are often complex and expensive: it saves time and money. Since the body of experience in valuation has grown considerably over the past decade, this valuable database is more and more “taped” for benefits transfers. For instance, databases designed to facilitate benefits transfers are developed.<sup>1</sup>

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1. The “Environmental Valuation Reference Inventory” (EVRI), has been developed by the European Commission, Environment Canada, US EPA, the World Bank, Comision Nacional del Medio Ambiente, Mexican Ministry of Environment and Natural Resources, Ministère de l’Environnement du Québec, Economy and Environment program for South-east Asia. It is accessible at: <http://www.evri1.ec.gc.ca/EVRI/>. The UK Department of the Environment Transport and the Regions recently set up a bibliography of environmental valuation in the UK ([www.environment.detr.gov.uk/evlist/index.htm](http://www.environment.detr.gov.uk/evlist/index.htm)).

49. None of these difficulties should mean that CBA is ignored. The fact that CBA cannot always provide complete answers does not prevent it providing useful information. It implies that CBA will not in many cases be suitable as the sole decision criterion for governments, and that it should not be a requirement that only those policies whose monetised benefits exceed cost can be implemented. However, a reasoned justification of why non-quantifiable or impossible-to-value benefits are sufficient to tip the balance should be required. In fact, there is an implicit cost-benefit analysis undertaken whenever a project, regulation or policy is proposed - whoever is proposing it presumes that the benefits exceed the costs. Formalising such analysis means that assumptions that may otherwise be hidden have to be made explicit and can thus be checked for their validity, or at least for consistency of use. It is important, in this respect, that the presentation of the results reflects the status of the data used.

50. Where precise valuations are uncertain but upper and lower bounds are known with reasonable certainty, ranges for costs and benefits that reflect the range of uncertainty about the underlying parameters, along with sensitivity analysis, can be presented. It may be that the range of values for net benefits lies entirely to one side of zero - there is no ambiguity about whether the project or policy is beneficial, even if the exact level of benefits is uncertain.

51. Where it is felt that some objectives or costs cannot be valued, whether in principle or due to practical difficulties, the quantitative or qualitative information available should be presented for example under the form of cut-off points (*e.g.* the value of a parameter which makes benefits just equal to costs) and trade-offs. If, for example, there is a reluctance to put a value on human lives, a figure for the cost per life saved can be useful information when comparing alternative policies to achieve certain objectives; or even when comparing policies which appear quite distinct, *e.g.* clean-air versus hazardous substances, comparing costs per life saved can suggest where incremental policy or expenditure priorities should be directed.

52. Of course, the resource costs of CBA itself may be high. There is little information available on these aspects, but the supply of people competent to carry out this analysis may be a (short run) constraint, and smaller or poorer countries might therefore have more difficulties in undertaking systematic CBA. It is, however, increasingly feasible to “borrow” methodologies and even results from work done in other

countries.<sup>28</sup> In its evaluation of waste disposal policy, for example, the Danish government used estimates of environmental benefits done in the United Kingdom.<sup>29</sup>

53. One area worth mentioning is the use of the precautionary principle. This is held to apply when there is insufficient information - usually on the behavioural or scientific side, rather than on valuation - to permit a complete analysis of costs or benefits. Developing a systematic rule for cases where there is little information is hard. As a minimum, any decision to invoke the precautionary principle should be accompanied by (or immediately followed by) a programme of research to acquire the necessary information, and procedures and timetable for revising the decision should be established.

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28. See footnote to Box 2.

29. See Danish Ministry of Finance (1999), p. 50.

### Recommendations<sup>1</sup> concerning policy co-ordination and formation

	Belgium	Canada	Denmark	Finland	Germany	Norway	Poland	Sweden	United States
Clarify objectives		•			•		•		
Increased use of CBA	•	•		•	•	•	•	•	
More systematic CBA			•						•
Improve information collection And dissemination		•							
Facilitate legal action by NGOs, persons	•								
Tax resource rents		•				•			•
Remove special tax treatment of non-renewable resource sectors		•			•				
Remove exemptions and reduced rates in energy taxation or waste-water fees			•	•	•	•	•	•	
Better environmental assessment of transport policy			•		•	•			
Remove special treatment of/or eliminate perverse incentives in agriculture (water pollution and supply)	•	•	•	•	•	•	•	•	•
More systematic use of scientific information in setting total allowable catches in fisheries		•							
Remove disincentives to regional mobility in unemployment insurance scheme`		•							
Promote action in neighbouring countries				•					

1. Some of these recommendations are found or implied in the text but not necessarily highlighted in the Introduction and Summary or Annex 2.

*Note:* The absence of an entry indicates that there was no specific recommendation made for the particular country/issue, but this is more frequently because the issue was not discussed for that country than because it was considered and felt not to warrant any recommendation.

**Specific areas where use of Cost Benefit Analysis recommended<sup>1</sup>**

	Belgium	Denmark	Finland	Germany	Norway	Poland	Sweden	United States
Health risks in water	•							
Biodiversity			•					
Waste treatment		•		•	•		•	
Public transport		•			•			
Setting air quality standards								•
Assess costs of "leakage-avoidance" in energy and CO <sub>2</sub> taxation		•						
Consequences of agricultural policy								•
Costs of environmental damage caused by mining						•		
Voluntary agreements				•				

*Note:* The absence of an entry indicates that there was no specific recommendation made for the particular country/issue, but this is more frequently because the issue was not discussed for that country than because it was considered and felt not to warrant any recommendation.

1. For all countries, a general recommendation was made to use more CBA in all the domains reviewed; this table notes particular sectors that were discussed.

### 3. Choice of Instrument

#### 3.1 *Economic instruments*

54. In an attempt better to internalise environmental costs and manage natural resources more efficiently, OECD governments have increased their reliance on economic (or market-based) instruments over the past two decades. While this has been documented in previous OECD work, (OECD, 1999*a* and OECD, 2001*d*) this section discusses the use of economic instruments using illustrations mostly drawn from the recent series of Economic Surveys, trying to identify areas where they are working well and others where it is more difficult. The relation between economic instruments and regulation is also looked at, in particular how they may conflict or, conversely, strengthen each other.

55. A relatively wide array of economic instruments is now in use in an increasing number of OECD countries, such as taxes or tradable permits for polluting emissions to the air, taxes on toxic products and various types of waste (Tables 3 and 4). In terms of revenue, environmentally related taxes still represent a rather small share of total tax revenues - less than 6 per cent on average in the OECD in 1998, a share which has not increased since 1994 (Figure 6). Motor fuel and motor vehicle taxes, which pre-date the wave of green tax reform and usually have been introduced for fiscal rather than environmental reasons, account for the bulk of these revenues (more than 90 per cent<sup>30</sup>). Other taxes on energy represent about 7 per cent of total environmentally related taxes on average in the OECD, while more directly environmentally based taxes<sup>31</sup> represented only about one per cent of the total. These averages obviously embody differences across countries, with some countries making much more use of environmental taxes than others - Denmark probably has the largest number of such taxes. In any case, revenue is not in itself a good measure of the role played by environmental taxes, since it depends on the elasticity of the tax base; in fact, as an environmental policy measure, a successful tax may significantly reduce the polluting activity, and therefore the tax revenues, over time.

##### 3.1.1 *The advantages of economic instruments*

56. The advantages of economic instruments have been summarised in the Introduction (see Box 1) and are discussed more fully in Chapter 7 of the OECD report on sustainable development (OECD, 2001*a*). In addition to their efficiency advantages, there may be circumstances - whose extent is somewhat controversial (see Box 6) - under which part of the revenue raised can be used to reduce distortions in the overall tax system. In order for economic instruments to be effective tools for environmental policy, an appropriate tax or permit base - relatively homogeneous in terms of its environmental effects - must be available. Furthermore, market structures must be effective in transmitting incentives.

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30. Figure for 1995 (see OECD database on environmentally related taxes). The picture has probably not changed much since that date.

31. Comprising taxes paid on measured or estimated emissions to the air, taxes on ozone-depleting substances, charges on water effluents or non-point sources of water pollution and taxes on waste.



**Table 3. Main tradable permits systems in force in 1998-1999 or proposed in OECD countries**

Country/ area / agents	Programme	Commodity	Effects	Savings
<i>Air protection</i>				
US / Air Quality Control Region	EPA emission trading (1975-)	Emission reduction credits	Mixed	1-12 B\$ (until 1986)
US / refineries	EPA lead-in-gasoline (1983-1987)	Lead additives	Elimination of lead	226 M\$
US / firms	EPA Ozone Depleting Substances (1986-1998)	ODS allowances	Compliance with Montreal Protocol	49% ?
US	SO <sub>2</sub> Allowance (1990 -)	SO <sub>2</sub> allowances	Early reductions	225-375 M\$ (25%-34%) 1995
US / Los Angeles area	RECLAIM (Regional Clean Air Incentive Market, 1994 -)	NO <sub>x</sub> and SO <sub>2</sub> allowances	8.3% and 6.8% annual reductions planned for NO <sub>x</sub> and SO <sub>2</sub>	Over 40 M\$
US / engine producers	Averaging, Banking, Trading	Emission cap for each engine model produced for hydrocarbons and NO <sub>x</sub>	75% reduction planned for HC	?
US / Northeast / stationary	Ozone Transport Commission, NO <sub>x</sub> Budget (1994-2003)	NO <sub>x</sub> allowances	75% reduction planned	80 M\$/y (30%)
Switzerland	Basel Canton (1993 -)	Volatile Organic Compounds	Very few trades	?
Poland / Chorzów	Demonstration project (1991-1992)	Emission reduction credits	Speeding up abatement plans	?
Denmark	New scheme Being developed	CO <sub>2</sub>		
Norway	New scheme Being developed	CO <sub>2</sub>		
United Kingdom	New scheme Being developed	CO <sub>2</sub>		
<i>Water resource management</i>				
US and Australia	Tradable Water Abstraction Rights (since 19 <sup>th</sup> century)	M <sup>3</sup> /y	Stability of use	?
Germany / Hamburg	Groundwater Abstraction Fee (1989 -)	Retiring water rights	Transfer of Water rights	?
<i>Water protection</i>				
US / Wisconsin	Fox River (1980-)	Biochemical Oxygen Demand	Ambient quality	?
US / Colorado / Point-non-point	Dillon Reservoir (1984-)	Phosphorus	Reduced eutrophication	1370 \$/kg of Phosphorous (hypothetical)
US / North Carolina / Point-non-point	Tar-Pamlico River (1989-)	Phosphorus and nitrogen	Nutrient discharges reduced by 28%	?
Australia / New South Wales	Hunter River salinity trading (1992)	Salt allocations for coal mines	Reduced salinity	?
<i>Fisheries</i>				
Australia, Canada, Iceland, the Netherlands, New Zealand, US	Selected fish species	Individual Transferable Quota (ITC)	Conservation, efficiency, rents	

Source : Based on "Implementing domestic tradable permits for environmental policy", OECD, 1999.

Table 4. Use of economic instruments in OECD countries  
2000

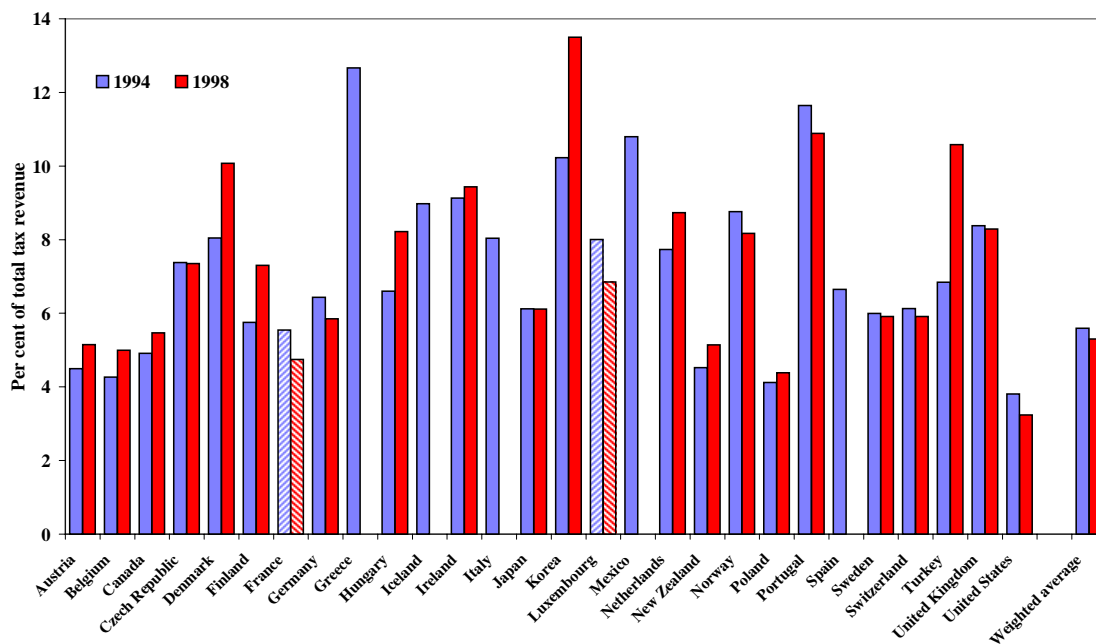
Tax base	Australia	Austria	Canada	Belgium	Denmark	Finland	France	Germany	Greece	Iceland	Ireland	Italy	Japan	Luxembourg	Netherlands	Norway	Portugal	Spain	Sweden	UK	US
Energy																					
CO2																					
NOx																					
SO2																					
Transport																					
Environmentally differentiated annual car tax																					
CFCs																					
Water effluent	3		4																		
Fertilisers and minerals <sup>1</sup>			5																		
Pesticides																					
Dangerous waste																					
Solvents			6																		
Lubricating oil																					
Batteries																					
Tires																					
Waste disposal																					
Beverage containers			6																		
Raw materials																					
Packaging																					
Various consumer items <sup>2</sup>																					
Paper, board																					
PVC																					
Polyethylene																					
Aviation noise																					

Trading scheme  
 Tax

1. Minerals are phosphorus and nitrates.
2. Such as disposable razors, disposable cameras, bags, disposable tableware, light bulbs.
3. Hunter river salinity
4. Quebec.
5. British Columbia.
6. New Brunswick and British Columbia.
7. Rhode Island.

Source : OECD (1998), European Environmental Agency (2000); OECD Countries: OECD database on environmentally related taxes.

**Figure 6. Revenues from environmentally related taxes in per cent of total tax revenue**



Note: Shaded bars are low-end Secretariat estimates.

Source: OECD database on environmentally related taxes.

57. This requires that emissions are not too costly to measure and monitor. Taxes and caps are easily applied to pollutants emitted by large stationary sources, for example, but less so when there is a large number of mobile emitters or diffuse pollution, such as in the case of pollution from transport or agriculture. If there is a direct link between the quantity of a taxable product used and emissions, taxing or capping the product itself can substitute when the emissions themselves are hard to measure. This is the case for carbon dioxide emissions, which are linked to the carbon content of fuels: a tax (or corresponding cap-and-trade system) on the carbon content of fuel is a well-targeted instrument; the same is true for sulphur dioxide emissions, largely linked to the sulphur content of fuels.<sup>32</sup> By contrast, as noted above, emissions from nitrogen oxides, for example, originate mostly from mobile sources, and there is only a weak link between emissions and the amount of fuel burnt.

### 3.1.2 Taxes versus cap-and-trade systems

58. In principle, a tax is the “dual” of a cap-and-trade system - the former fixes the price of emissions, the latter fixes the quantity - and the choice between them depends on which of these

32. Combustion or “end of pipe” technologies also affect emissions. Refunds may be provided on fuel-based sulphur taxes where scrubbing technology has been employed to reduce SO<sub>2</sub> emissions, making the fuel-based tax resemble an emission tax in this case.

policymakers prefer to set. In practice, the choice is blurred - a tax is rarely introduced without some estimate of the effect it will have on emissions, and the introduction of cap-and-trade systems is accompanied by estimates of likely permit prices.<sup>33</sup> However, despite this blurring, a number of factors can influence the choice between them:

- With the shape of marginal abatement cost curves often unknown, both the quantitative targets of cap-and-trade systems and the levels at which environmental taxes are set are likely to be changed as experience elicits information about both abatement costs and environmental costs. Which is more easily revised and which is more expensive if a mistake is made needs to be considered.
- The monitoring costs involved in taxing or capping-and-trading emissions are equivalent, but when an environmental tax can be easily included in already established tax systems, as for taxes on fuel, administrative and enforcement costs will be lower than for establishing a cap-and-trade scheme.
- Both instruments can deal with adjustment costs at their introduction. In a trading system, permits can be grandfathered (*i.e.* freely distributed based on past emissions) instead of being auctioned, or in a tax system, tax credits equivalent to the tax payable on past emissions could be issued. To avoid discrimination against new entrants with grandfathering under either system, tax credits or free permits could be issued on some proxy basis, *e.g.* in proportion to output.
- If there is a limited number of polluters, a market for tradable quotas may not work efficiently: liquidity may be limited; possible market power may raise the costs of emission reduction since large potential suppliers, or buyers, of permits would restrict supply, or demand, so as to cause prices to diverge from marginal abatement costs. Also, where there is a limited number of large emitters, grandfathering of quotas may adversely affect incentives to innovate, as firms developing, implementing and licensing out abatement technology would cause the quota price to fall and therefore suffer a loss in the value of their grandfathered emission rights.
- When the creation of an international market for quotas in the same type of emission is envisaged, a national quota system may be preferable to a tax to facilitate integration with the international market. The experience of domestic trading would also facilitate the use of international trading systems by firms.

59. In some countries the choice may be influenced by idiosyncratic factors: in the United States, one factor behind the preference for cap-and-trade systems in recent years may be the general unpopularity of tax measures in that country. In any case, the number of these systems in operation has grown in recent years (see Table 3).

### 3.1.3 *Economic instruments in use*

#### 3.1.3.1 Air quality

60. A number of countries have used economic instruments in their set of tools to reduce SO<sub>2</sub> emissions. Denmark, Norway and Sweden have taxes in place, while the United States implemented a

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33. Generally with restrictions on those prices, either implicitly through specifying a fine for non-compliance or setting explicit limits.

cap-and-trade scheme. Tax levels (or the price of permits) vary across countries<sup>34</sup> - which is not surprising given differences in environmental costs associated with emissions and abatement costs - and coverage also differs. In the United States, the cap-and-trade scheme applies only to major electricity utilities. It has been quite successful at reducing sulphur dioxide emissions, and it is estimated to have provided considerable savings compared with the previous command and control approach; permit prices have fluctuated but this does not seem to have impaired the usefulness of the system, and the presence of intermediaries and the large number of transactions indicate a smoothly functioning system (Box 3). While it was probably wise initially to start with a scheme restricted to electricity utilities,<sup>35</sup> the more their emissions are decreasing, the more cost-effective it will become to include other emitters in the scheme. In Denmark and Sweden, industrial processes are exempted from the tax, as are a number of types of transportation. In Norway, where industrial processes were also previously exempted, they are now taxed, though at a rate less than one-fifth of that for other activities.<sup>36</sup> This discrepancy in treatment is motivated by fear that heavy energy-consuming industries may lose competitiveness.

61. As discussed above, dealing with nitrogen oxide emissions is more complex, because the link between the amount of fuel burnt and the amount of emissions is weaker - an input tax is not a simple substitute for an emission tax - and emissions originate mostly from mobile sources. However, the Swedish and US examples show that economic instruments are cost-effective in dealing with NOx emissions from large combustion sources. While Sweden has used a charge and the United States a cap-and-trade scheme,<sup>37</sup> the two instruments provide quite similar incentives to polluters. The Swedish charge is not referred to as a tax, since the revenue is returned to the payers in proportion to their share of energy produced, hence providing net benefits to any producer with emissions lower than the industry average, and conversely net costs to those with higher emissions.<sup>38</sup> The Swedish charge has been in place since the early 1990s for large stationary combustion plants, and smaller installations have progressively been integrated into the scheme. The NOx trading scheme in the United States (see Box 3) seems to have allowed emission reductions to be achieved where they were less costly.<sup>39</sup> In Ontario, Canada, part of the same airshed as the north-eastern United States, there are plans to create trading schemes for NOx and SOx emissions.

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34. The tax rates, in Euro per kg of sulphur are: Denmark, 2.7; Sweden, 3.4; Norway, about 4 and (reduced rate) 0.7. In the United States, emission permits trade at around \$0.6 per kg (equivalent to \$0.3 per kg of sulphur dioxide).

35. In 1980, electric utilities generated about two-thirds of US SO<sub>2</sub> emissions.

36. The tax rate applied to industrial processes was doubled in 2000, but was brought back to its initial level after six months.

37. The US NOx scheme covers only 12 states, but will be extended to cover 22 states as from 2004 (van de Noord and Vourc'h, 1999). The scheme is targeted at ground level ozone, rather than acid rain. The acid rain programme, which uses a cap-and-trade system for SO<sub>2</sub>, retains a command and control style approach for NOx - performance standards limit emissions per energy used, with limits that vary by type of boiler. Participation in the trading scheme does not exempt emitters from meeting these standards.

38. A potential danger of such compensation scheme may be that, if there is a relatively small number of firms, they may agree on fixing emissions at a relatively "easy" level. This should be monitored by the government or the competition authority.

39. See Krolewski and Minst (2000). The NOx charge in Sweden is 4.54 Euro per kg of nitrogen oxide and the price of a current permit in the US varied between \$500 and \$1 000 per ton during 2000.

### Box 3. Transactions and prices in US emission trading

Two major emission trading schemes are currently operating in the United States, the SO<sub>2</sub> trading scheme, part of the acid rain program, and the regional NO<sub>x</sub> trading scheme, aimed at reducing ground-level ozone.

The SO<sub>2</sub> emission cap was foreseen in revisions to the Clean Air Act in 1990, and was effective from 1995 onwards, with trading beginning two years earlier. In 2000, the scheme was significantly tightened, through a reduction in the size of installations subject to the cap and a reduction in the overall limit. These changes passed without any obvious perturbation in the market. The NO<sub>x</sub> cap was effective as from 1999, with some trading beginning the previous year.<sup>1</sup> The penalty for non-compliance is \$2 000 per ton for SO<sub>2</sub>, whereas for NO<sub>x</sub> the penalty is payable in permits, at a rate of three tons for each ton of overrun; individual states retain the power to fine non-compliers up to \$25 000 per ton in their own state.<sup>2</sup>

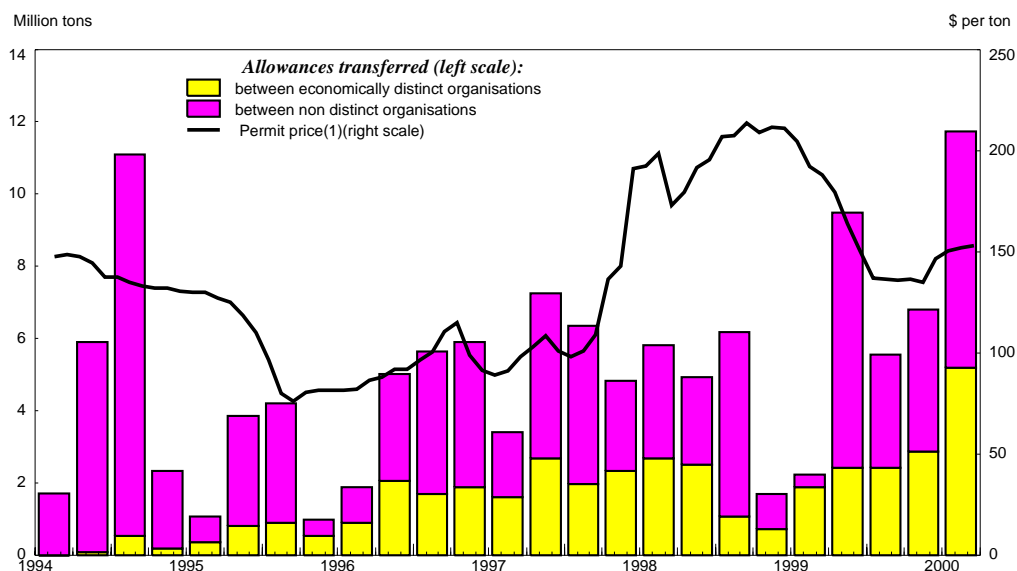
In both schemes, actual emissions are running below the level of the cap. SO<sub>2</sub> permit prices are somewhat below levels expected before trading began (\$400-500 was thought to be a reasonable guess). That they are not zero is due to the possibility of "banking" - the constraint may become tighter in the future, and emission permits not required for current emissions can be held over for future use. The rise in SO<sub>2</sub> permit prices in 1998 might have been due to anticipation that supply would be tighter in 2000, when the overall cap was reduced and the number of emitters included within it increased. A similar tightening is due in the NO<sub>x</sub> regime in 2003<sup>3</sup>. (See Figures 7 and 8).

Banking provisions differ between the two programmes; in the NO<sub>x</sub> scheme banked permits are discounted to avoid emissions exceeding the overall target in any one year by more than 10 per cent. Hence permits of a different "vintage" trade at different prices; prices in the NO<sub>x</sub> market seem generally to be more volatile than for SO<sub>2</sub>. In the SO<sub>2</sub> scheme, there are no restrictions on banking.

Much of the early SO<sub>2</sub> trading occurred within enterprises - transfers between generating units owned by the same firm. These remain in the majority, but the share of trades between distinct organisations has tended to grow. Brokerage transactions are a minority of the total - perhaps 20 per cent of those in NO<sub>x</sub> and 10 per cent in SO<sub>2</sub> - but are a higher proportion of those that occur between distinct organisations; price data is from transactions through brokers, there is no statutory requirement to report prices.

Two facts may have been important in the success of both programmes. First, the targets appear to have relatively easy to meet. Second, the absence of any charge for issuing the permits has prevented any serious profitability problems. Further tightening of the constraints (either through economic growth or absolute reductions in allowable emissions) and a shift to charging for permits (which would be desirable although not currently planned) will provide a more severe test of this approach.

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1. The NO<sub>x</sub> cap covers emissions from May to September, the months in which the ozone risk is significant. The SO<sub>2</sub> cap applies to annual emissions.
  2. In 2000 there was one case of an overrun, by 1 ton.
  3. The NO<sub>x</sub> scheme will also be extended to cover a further ten states, from 2003-4 onwards.

Figure 7. Trading in the US SO<sub>2</sub> market

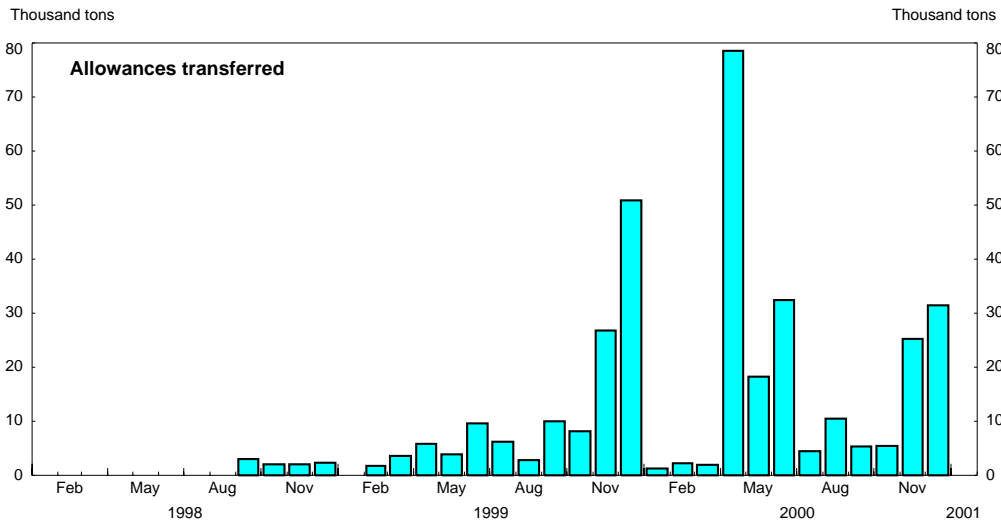
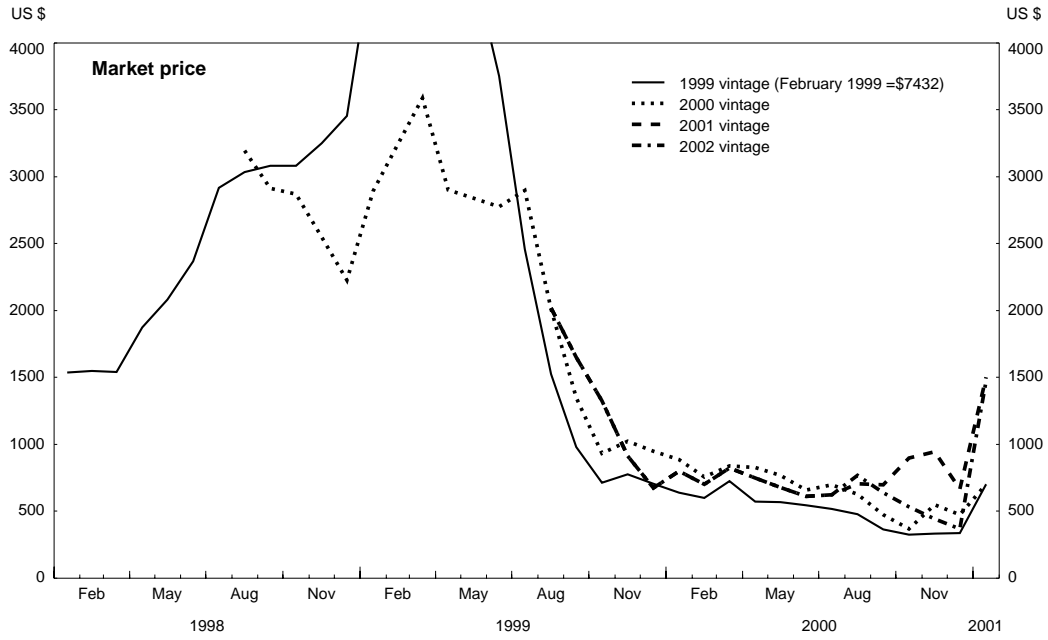
1. Average of Cantor Fitzgerald EBS and Fieldstone Publications.  
Source: Environmental Protection Agency.

62. The Swedish NO<sub>x</sub> charge and the US NO<sub>x</sub> trading scheme show how to avoid grandfathered permits or tax credits being a barrier to entry: Swedish refunds (equivalent to tax credits) are allocated on the basis of hypothetical emissions - what they would have been on the basis of average industry emissions per unit of energy consumed. In the US SO<sub>2</sub> scheme, by contrast, allowances are also allocated on the basis of hypothetical emissions, but these are calculated from *past* energy use; new entrants have to buy permits on the open market.

63. Although taxes on CO<sub>2</sub> are probably the most efficient and easy to apply, they have been used in a few OECD countries only, namely the Scandinavian countries, Finland and the Netherlands, since the early 1990s. In all these countries, policies are excessively costly - for a given reduction in domestic emissions - because the tax structure implemented provides partial or complete exemptions to large sectors of the economy, in particular those which are most pollution intensive. This special treatment is motivated by concerns about the consequences that a CO<sub>2</sub> tax may have on the competitiveness of energy-intensive industries (see Section 4.1). An initial proposal for extending the French general tax on polluting activities to cover CO<sub>2</sub> emissions from fossil fuels took a better approach to this problem, but has been abandoned for the moment.<sup>40</sup>

40. Under a government proposal in 2000 to extend the French tax générale sur les activités polluantes (TGAP, "general tax on polluting activities") to fossil fuels and electricity, it was planned to issue tax credits based on a percentage of past emissions. The percentage would have varied according to emission intensity. Substantially modified in parliament, among other things through the addition of further exceptions and exemptions, the bill was subsequently ruled unconstitutional by the Constitutional Court in early 2001.

Figure 8. Trading in the US NOx market



Source: US Environmental Protection Agency.



64. A number of countries, such as Belgium, Denmark, Finland, Germany, Norway and Sweden, also have energy or electricity taxes in place, which generally pre-date environmental concerns. Such taxes are not well targeted on the environmental problems caused by energy use, because these problems do not generally depend on energy use *per se*. Furthermore, industries and electricity generation are generally partly or completely exempted from these taxes, so that the burden falls mainly on households, as in the case of the carbon tax. SO<sub>2</sub>, NO<sub>x</sub> and CO<sub>2</sub> taxes or tradable permit schemes are more efficient instruments. When emission-free energy sources are in fixed supply, the taxation of emissions from other energy sources will create a rent in the emission-free sector. If this rent cannot easily be taxed away, a more general energy tax may be a better instrument than a tax on emissions.

65. Many countries are pursuing air quality targets partly through a push to increase the share of electricity produced by renewables, frequently with specific targets. There is rarely a solid cost-benefit analysis behind these targets, and they do not always seem consistent with the view of externalities implicit in the presence or absence of taxes on polluting emissions. However, given the targets, there are better and worse ways to achieve them; moves to introduce a system of tradable green certificates, as done or planned recently in a number of countries such as Australia, Belgium and Denmark, promise a more cost-effective implementation than earlier approaches - which still exist in most countries - involving direct subsidies to renewables producers (Box 4).

#### Box 4. Renewable electricity programmes

In general, policies to promote renewable energy in electricity generation have provided examples of unco-ordinated - and frequently high-cost - pursuit of targets. Many countries are pursuing quantitative targets for renewable energy use, generally - though with an increasing number of exceptions - using an array of instruments unlikely to minimise the costs of reaching the targets (Table 5). It is rare that the main pollution problems that are tackled by increased use of such electricity generation - those due to emissions of NO<sub>x</sub>, SO<sub>x</sub> and CO<sub>2</sub> - are themselves taxed or subject to quantitative constraints, although NO<sub>x</sub> and SO<sub>x</sub> emissions are frequently the subject of regulations on technical standards.

The advantage of renewable sources of energy for electricity generation is principally that they avoid emissions of SO<sub>x</sub>, NO<sub>x</sub> and CO<sub>2</sub>.<sup>1</sup> These emissions are easily measured (at least in electricity generation) and thus can either be taxed or subject to cap-and-trade regimes. Setting taxes equal to the estimated cost of externalities, or using a tradable permit regime to establish the marginal abatement cost of meeting quantitative targets, would give a more appropriate incentive structure. Specific NO<sub>x</sub>-, SO<sub>x</sub>- or CO<sub>2</sub>-motivated subsidies to renewables would be unnecessary and inefficient: unless supplemented by other measures, such subsidies give no incentive to reduce energy use - an important way of abating emissions.

As the table shows, targets for renewable energy supply are in practice pursued in a number of different ways, and some countries have moved considerably in the direction of more cost-effective approaches. An example is Denmark, where an expensive wind-turbine subsidy scheme (O'Brien and Høj, 2001) was in use during the 1990s, but is now being phased out in favour of a system of tradable permits for renewable energy, known as "green certificates."<sup>2</sup>

In this system, generators of renewable electricity will be issued with green certificates for each unit of electricity generated; electricity distributors will be required to obtain a quantity of these certificates equivalent to a certain percentage - the national target - of their electricity sales each year. In addition there will be upper and lower limits on the certificate price. The upper limit caps the cost imposed on the economy by capping the implicit subsidy to renewable generation, effectively allowing the outcome to fall short of the target if the costs of reaching it turn out to be too high, and the lower limit guarantees a certain level of subsidy even if the target is easily fulfilled. Once a target has been decided upon, such a system should be both an efficient means of meeting it and a means of revising it automatically if necessary. The floor on the price is less useful; in Denmark it serves to maintain some continuity with the previous scheme ensuring a subsidy even if it is unnecessary to meet the target. Australia and Belgium are also planning to develop similar "green certificates" systems to reach renewable electricity supply targets.

Another way of avoiding the excessive levels of subsidy that can arise from price guarantees used to support output targets<sup>3</sup> is the Irish approach of using competitive tenders. Bidders compete to supply renewable energy, where competition on the level of subsidy should drive it down to the level just necessary to make the investment profitable. This approach of using competitive bidding to meet specified environmental targets has potential applications in many areas - it is used in the US Conservation Reserve Program (see below), for example, and is proposed as a tool for action to reduce water salinity in Australia.

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1. Through diversification they may also contribute to security of supply. Some governments believe that support for renewable energy technologies is worthwhile in itself, as countries acquire exportable technological expertise. This is true for wind turbines in Denmark, for example. This "infant industry" argument is dubious. Denmark is indeed a major world supplier of wind turbines (generally depending on subsidies in other countries' renewables programmes) and is an example of a government having guessed right (at least about other countries' future policies), but governments may equally guess wrong; in any case, although the level of Danish wind turbine exports can be easily measured, whether the industry earns sufficient excess profits to justify the subsidies that have been expended is harder to assess.
  2. This is not to be confused with the proposed EU system of green certificates intended to certify particular methods of electricity generation as renewable.
  3. This has been the case in the late 1990s in the Danish wind-turbine scheme. Real rates of return of between 10 and 17 per cent were in effect being guaranteed to investors in new wind-turbines. See O'Brien and Høj (2001).

Table 5. Incentives for electricity from renewable energy in selected OECD countries

	Share of renewables in total electricity generation	Target, date	Instrument	Obligation on	CO <sub>2</sub> SO <sub>x</sub> NO <sub>x</sub> tax on emissions from electricity generation in place?	Notes
<b>Australia</b>	9.8% of which 1.7% non-hydro (1996)	Additional 2% of non-hydro by 2010	Tradable "green certificates" R&D subsidies, some state based promotion through publicity.	Distributors	No	
<b>Belgium</b>	1.8% (1998)	3% 2004 (Wallonia, 5 % of total energy, 2010 Flanders, 5 % of total energy, 2020)	Green certificates (tradable?) Plus fines. Operating and capital cost subsidies and tax reductions.	Distributors	No	"Privileges" for combined heat and power (CHP)
<b>Canada</b>	63% (1996) of which 0.7% non hydro	No quantified target			No	
<b>Denmark</b>	10.4% (1998)	35% 2030 (12-14 per cent 2005)	R&D subsidies Operating cost subsidies Tradable "green certificates" from 2003	Distributors	CO <sub>2</sub> SO <sub>2</sub> CO <sub>2</sub> cap & trade in electricity as from 2001	Green certificates to replace system of subsidies; upper and lower limits on certificate price.
<b>Finland</b>	26% (1996) of which 8.9% non-hydro	No quantified target	Tax reductions		No	Almost all renewable electricity is from biomass (wood)
<b>Germany</b>	5.8% (1996) of which 1.8% non-hydro	No quantified target	Cross-subsidy through guaranteed access with favourable pricing.	Distributors	No	
<b>Ireland</b>	4.1% (1996) of which 0.3% non-hydro	Approx. 8% 2005 Specific targets for wind and hydro 2000-2010	Cross-subsidy through guaranteed access with favourable pricing	No obligation	No	Subsidy determined endogenously through competitive tendering. 1999 target share was 10%, achieved approx. 6%
<b>Norway</b>	99.8% (1996) of which 0.2% non-hydro	7 TWh of non-hydro, 2010			CO <sub>2</sub>	
<b>Sweden</b>	39% (1996) of which 2.1% non-hydro	No quantified target	Subsidies, tax exemptions		NO <sub>x</sub> SO <sub>2</sub>	1996 share exceptionally low due to low rainfall. More normal share near 50%
<b>UK</b>	2.7% (1996) of which 1.7% non-hydro	10% 2010	Exemption from climate change levy	Generators	No	Privileges for CHP
<b>US</b>	11.9% (1996) of which 2.3% non-hydro	No quantified target	Subsidies, tax exemptions	Generators	SO <sub>2</sub> cap & trade NO <sub>x</sub> regional Cap-and-trade	

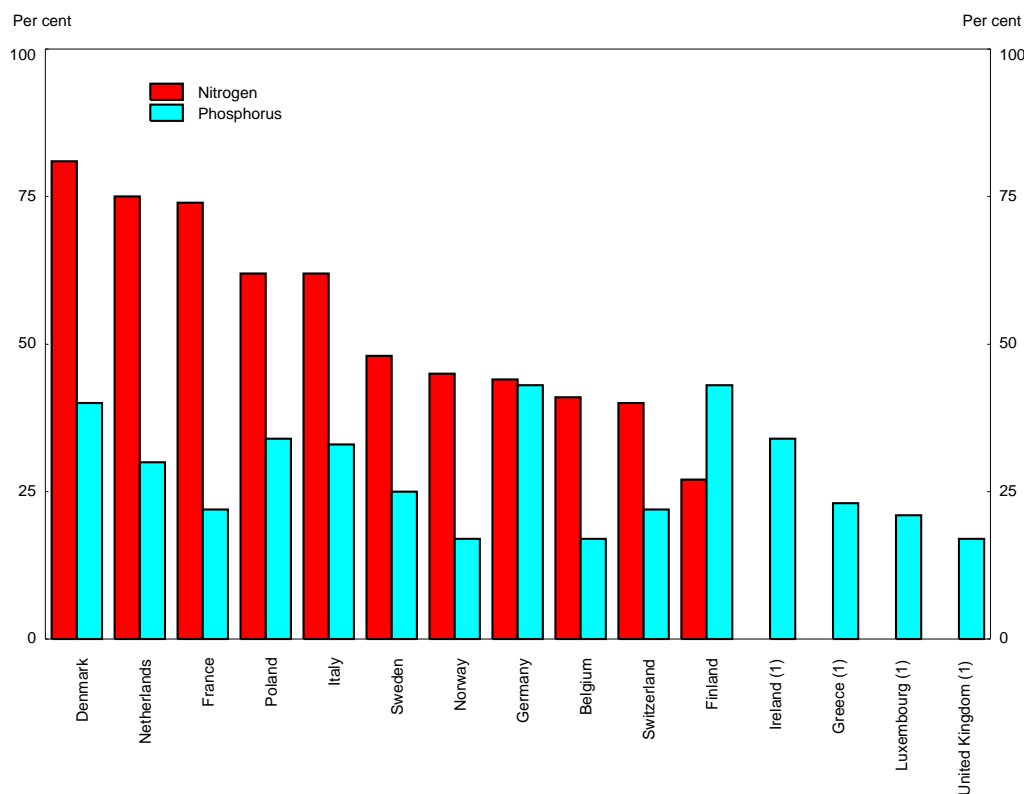
Source : IEA (1997) and OECD Secretariat.

### 3.1.3.2 Water quality

66. Economic instruments could also play a greater part in reducing water pollution from agriculture, an area in which much less progress has been made than for pollution from households or industry (Figure 9). As discussed above, the lack of progress is particularly apparent in leaching of nitrates, present in fertilisers, manure and animal feed, into ground and surface water. The main approaches to dealing with leaching are regulation and voluntary measures. Some countries have taxes on fertilisers, including Italy, the Netherlands, Norway and some US states. However, they are not well targeted, since the link between fertiliser use and nitrogen leaching is complex, depending very much on agronomic practices, as well as on livestock production. Other countries, such as Belgium and Denmark, have introduced systems equivalent to a fine on “excess” use of nutrient, but with strong non-linearity - “excess” is frequently defined so that only very few farms face a penal rate, while charges on nutrient use below the “excess” threshold are very low or even zero, so that very few farms actually face effective incentives to reduce application levels.

67. An instrument more likely to be effective would be a tax on the overall nitrogen surplus, measured as the difference between the total quantity of nitrogen inputs entering, and the quantity of nitrogen outputs leaving, the soil (nitrogen can leave embodied in crops, animals or animal manure). A tradable permit scheme could also be applied. The tax (or the number of permits required per kilogram of nitrogen surplus) could be differentiated according to the local marginal damage. Countries with important water pollution from agriculture, such as for example Belgium, Denmark and the Netherlands, already have nutrient balance accounts in place at the farm level, so that there would be no additional data-gathering costs to implement such a tax. However, once it is used to calculate tax liabilities, administrative costs associated with verifying the data, may increase, and would need to be weighed against the expected benefits.

**Figure 9. Share of agriculture in total emissions of nitrogen and phosphorus into surface and marine waters**  
Mid-1990s



1. Data for nitrogen emissions are not available.  
Source : OECD (2001), "Water Quality", Part IV, chapter 2, in OECD, Environmental Indicators for Agriculture Volume 3: Methods and Results, OECD Publication Service, Paris, France.

### 3.1.3.3 Waste

68. For reasons also partly related to "non-homogeneity" of the commodity - where it is difficult to identify the proper tax base - neither the use of economic instruments nor a regulatory approach is straightforward for the management of household waste. Ideally, waste costs would be internalised by a tax at the source, *i.e.* on the products which generate the waste. It is however particularly difficult to assess the environmental externalities associated with a given product at that point, as it is unknown how it will be disposed of.

69. Deposit-refund schemes are a way to solve the incentive problem for certain products, as the refund gives an incentive for the product to be returned and the producer is then required to treat the waste. Careful cost-benefit analysis is nevertheless required for the whole range of concerned products. In Denmark, for example, there is a deposit/refund scheme on glass bottles which successfully encourages recycling; but metal cans are simply banned altogether - and the implicit tax on non-recycled glass bottles is extremely high (compared with, for example, the tax on other glass when disposed of in a landfill site). The extended producer responsibility approach, adopted in Germany and Sweden, which obliges producers of some products to take them back is another way to solve the incentive problem. If producers were then free to dispose of returned products as a function of waste treatment taxes taking environmental costs into

account, this could provide a cost-effective waste management method. In practice, however, it is combined with an obligation to recycle a certain proportion of the products, a policy which is generally shown to be inefficient when subjected to cost-benefit analysis (Roseveare, 2001).<sup>41</sup>

70. In some countries, including Australia, Canada, Denmark, Sweden and the United States, certain municipalities have implemented weight- or volume-based charging for household waste, and there is some evidence that this has resulted in reduced waste generation, but these charges involve rather high collection costs. Increasingly also, taxes on the treatment of waste based on its weight have also been introduced. Some countries, like Finland, the United Kingdom and Sweden, have taxes on waste delivered to landfill, while others have introduced differentiated rates according to the type of disposal (Denmark) or the efficiency of the landfill facility (Austria) and/or the incineration plant (Norway). These taxes are an efficient way to take into account the externalities associated with the various waste treatment methods for given amounts of waste and to favour waste recycling, but they do not automatically provide appropriate incentives to the households producing waste - that depends on how waste collection charges are designed and in particular whether taxes are passed on to consumers. One drawback of waste taxes in general is that they increase the incentives to illegal dumping.

71. Product-specific excise duties, which could internalise environmental costs associated with waste disposal, are often used more to support recycling or other targets than with the explicit aim of internalising a calculated externality. They are generally associated with a small number of specific items, notably plastic bags and drinks containers, batteries, paper and packaging. In Belgium, for example, the “ecotaxes” introduced on batteries, disposable cameras and disposable razors, for example, were deliberately set at levels thought sufficient to induce very big changes in behaviour, while producers recycling the products were exempted from the tax, rather than with reference to any estimate of the level of the externalities. The tax on disposable razors was so “successful” that sales fell to zero, and the tax was subsequently removed.

#### 3.1.3.4 Resource management: water supply

72. While water rights have historically been granted for free in most OECD countries, in a period when water was relatively abundant, the pressure on water resources has increased with population and economic growth, and the need for more efficient water allocation systems based on economic instruments is becoming greater. In principle, an efficient system would provide the same price and thereby the same incentive to economise to all users, and would allow water to be used where it is most valuable by making water rights transferable. In practice, this is not the situation: there are large gaps between the prices for agriculture, industry and households (see Figure 2). In many countries (for example in Australia, Belgium and Denmark), water price levels and structures are being reformed towards full-cost recovery and pricing based on marginal costs, using combinations of fixed and variable charges. Despite the low estimated price elasticity of residential water demand,<sup>42</sup> consumption-based tariffs have been effective in reducing individual consumption significantly.<sup>43</sup> In other countries, such as Canada or the United Kingdom,

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41. Another possible problem associated with the extended producer responsibility approach is that co-operation among firms to deal with their responsibilities may cause risks to competition. It should be also noted that when firms are grouping at the sectoral or other level to deal with waste collection or treatment, the incentive to reduce individual waste generation is diluted.

42. For a review of the literature on the price elasticity of water demand, see Nauges and Thomas (2000). Their own estimate for France is -0.22. Hansen (1996) found -0.1 for Denmark.

43. In Denmark, household water consumption decreased by 13 per cent between 1993, date of introduction of the new tariff, and 1998. Water use in Brisbane, Australia, has been reduced by 20 per cent between 1995-96 and 1997-98, after the adoption of metering and use-based charges.

metering is far from general and residential water consumption is still subsidised at the margin to a large extent. Increasingly, in countries where industrial water used to receive favourable treatment relative to households, this difference is being eliminated, although some cross-subsidisation from households remains in Denmark. As discussed in Section 2, pricing reform of agricultural water is generally lagging behind that of municipal and industrial water in all these countries.<sup>44</sup>

73. Water trading (either of water rights, or of water itself) can introduce some flexibility to increase the allocative efficiency of water use and allow a smooth structural adjustment in mature water economies (*i.e.* when water entitlements are fully allocated). Up to now, only Australia and the United States have developed such markets, mostly in areas with significant agricultural water use. Alberta, Canada, is planning to do so as well,<sup>45</sup> but a number of other OECD regions where water is relatively scarce (or intensively used) would benefit from such markets. Combined with a cap on total diversion, as in Australia, it is also a cost-effective way to protect the environment when needed. Nevertheless, markets are certainly not “perfect”, in the sense that diversion of water at one point of a river is not equivalent to diversion at another point. Moreover, trade in water has potential effects on the security of supply of third parties (for example, the further upstream a water entitlement is moved, the greater the reduction in security of downstream supply), as well as on the environment. Hence, in Australia, for example, water transfers are subject to approval by water authorities, and in some cases “exchange rates” incorporating the difference in external effects of water use according to its location are used. Differences in the specification of water entitlement across states may also restrain possible exchanges.<sup>46</sup> However, despite these limitations, the volume of trading has been increasing, and water is moving from lower to higher value agricultural use. In Australia and in the United States, most trading is still taking place within the agricultural sector, sometimes because transfers to commercial or municipal use are not allowed, although these latter may be assumed to provide the most valuable use in many cases.

### 3.1.3.5 Resource management: fish

74. Fisheries management is another area where the use of economic instruments, in particular individual tradable quotas, can make an important contribution. Pressures on fish resources are significant in many OECD fishing areas, and allocation rules are agreed internationally for only few of the stocks. Domestic management strategies relying exclusively on command and control regulations, most common in OECD countries, have shown their limits.<sup>47</sup> Regulations aiming at limiting entry in fishing fleets and the length of fishing seasons and at restricting gear have generally not succeeded, as fishers have usually

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44. The Australian water reform includes provisions for agricultural water, but implementation has been slower than anticipated. It is interesting that in Canada, at the same time as subsidised irrigation water is supplied to agriculture, there is firm opposition to bulk exports of water to other countries (see Vourc'h, 2001). Although it is right to be concerned about the effect that bulk water exports might have on ecosystems, an absolute ban on exports suggests that keeping water entirely in its natural state is valued extremely highly, which on the face of it is inconsistent with allocating it to agricultural irrigation - which affects both the overall flow of rivers and water quality - at very low cost.

45. All the legal necessary reforms have been legislated. There is no certainty, however, as to the effective implementation of transferability.

46. Given the high variability of water supply, differences in water right specification correspond to different security of supply. In South Australia, for example, the required adjustments to entitlements in period of low water supply would often represent a proportional re-allocation of entitlements. In other states, like New South Wales, rules for adjusting allocation have been incorporated in the entitlements through a priority system, with “high security” rights, in general for permanent crops, and “low security” rights for annual crops mostly.

47. For an analysis of fisheries management regimes in OECD countries, see OECD (1997b).

responded by increasing the use of unrestricted inputs and turning to other fisheries, as illustrated, for example, by the Canadian Atlantic fisheries. By contrast, individual quotas provide fishers with a right to a specified share of the total allowable catch and encourage more orderly harvesting by stopping the “race for fish” and removing the incentives for over-investment.<sup>48</sup> When transferable, individual quotas also allow a rationalisation of the sector, as quotas can be acquired by the most efficient producers, and a maximisation of the resource rent. In Norway, stocks are managed through individual quotas, but transferability is restricted. In Iceland and New Zealand most fisheries are managed with individual transferable quotas, and these also cover part of the fisheries in Australia, Canada, the Netherlands and the United States, and some EU fisheries. In other cases, countries rely almost exclusively on command and control regulations (OECD, 1999a). Great scope remains, therefore, for extending the use of tradable quotas, which would help to deal with the over-capacity currently existing in most fisheries. To extract the resource rent, quotas should be auctioned, as was recommended in the Economic Surveys of Canada and Norway.<sup>49</sup>

### 3.1.4 *Economic instruments and regulation*

75. Policies to deal with specific environmental and natural resource issues generally combine various instruments and can rarely rely exclusively on economic instruments - regulation will always be a necessary component of environmental policy for a wide range of issues. When there is no possible tax base, as for example for NOx emissions from mobile sources (which could be measured only at very high cost with current technology), regulations are necessary to complement economic instruments in some way. The catalytic converter is still to date the only effective way to reduce NOx emissions from cars. Hence a cost-effective policy for total NOx emissions combines regulations for mobile sources and taxes or trading scheme for point sources.

76. Regulations are also sometimes used in parallel with economic instruments, where local variations in the external costs of emissions make it difficult to align the incentives of a tax or trading scheme with the externality. In the United States for example, local air quality standards have been retained after the introduction of the SO<sub>2</sub> and NOx cap-and-trade schemes, to avoid possible “hot spots.”

77. In some cases, however, regulations in place undermine the effectiveness of economic instruments, or at least render them irrelevant. This is particularly notable in the field of waste policy, where quantitative targets for the share of waste to be recycled, incinerated or landfilled and regulations which embody the concept of extended producer responsibility can prevent households and firms from responding fully to the incentives provided by waste taxes. Denmark, for example, is one of the OECD countries making the largest use of economic instruments in managing non-hazardous waste, with a system of differentiated waste taxes. At the same time, however, waste policy is strongly influenced by quantitative targets, which are not set so as to be consistent with the landfill and incineration taxes, and outright bans (such as that on landfill disposal of any waste that can be incinerated) reflect a reluctance to rely completely on economic instruments. This is also the case in other European countries applying the EU waste and packaging directives.

78. These directives are based on the principle of the “waste hierarchy”: after giving preference to waste prevention, this principle asserts that re-use and recycling are best, while landfill or simple

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48. To work effectively, systems of individual tradable quotas require a strong monitoring and enforcement system, in particular to prevent fishermen from discarding the least valuable fish in order to maximise the value of the catch against the quota.

49. Auctioning is still very rare in OECD countries. Russia held its first auction of its fish quotas, for two species, in February 2001.



incineration are only to be used where incineration with energy recovery is impossible. The approach assumes that this is true regardless of the environmental and economic costs of transporting waste for re-use or recycling, or the type of incineration technology or landfilling, and can thus produce inefficient policies. In Sweden, the regulations underlying extended producer responsibility oblige each producer to take back certain products and recycle a certain proportion of them, preventing the landfill tax from playing its proper role.

79. In some cases, economic instruments can be used to improve the cost-effectiveness of existing regulations, usually when these regulations specify quantitative targets or ceilings. An example in the United States is found in the Conservation Reserve Program, where subsidies for “set aside,” *i.e.* agricultural land taken out of production to reduce crop surpluses, are allocated by comparing bids made by farmers with a calculation of the value of environmental benefits to be obtained from the set-aside (O’Brien, 2001a).<sup>50</sup> Another US example is the Total Maximum Daily Load programme. Existing procedures for allocating permits for industrial discharges to surface water allow little flexibility once the permits are issued; the intention is to allow some trading in permits within an overall cap on discharges to particular bodies of water (through an “offset” scheme), although this approach is in its infancy (O’Brien, 2001a). As mentioned at the outset, country surveys have not dealt extensively with different approaches to regulation. Nevertheless, one aspect deserves mention: in terms of incentives provided to producers, regulations based on performance standards are always preferable to those based on particular technical specifications since the latter leave little scope for increased cost-effectiveness.

80. Finally, economic instruments can be used as an alternative to introducing regulations progressively - a number of countries tax motor cars according to their emission characteristics; if such taxes are differentiated so as to reflect different environmental costs they can give incentives to migrate towards new technologies without this having to be programmed (though information and transactions costs may mean that specific standards should be defined nevertheless). Denmark is modifying its system in this direction (augmenting one previously based on only weight) and other countries intend to follow suit.

### 3.2 *Voluntary agreements*

81. Voluntary agreements (VAs) have been increasingly used in all OECD countries in the 1990s. They occur in all environmental domains and economic sectors: examples can be found in waste policy in Germany, greenhouse gases in Australia and Canada, energy efficiency programmes in most countries, and toxic waste in Canada and the United States. In principle, VAs can be useful if they reduce the cost of meeting environmental targets, and they may also help to reveal information on abatement costs and disseminate information on environmental impacts and costs. In practice, there is some evidence that VAs are not very effective, since their effect on reducing costs is often brought about by reducing the environmental benefits.<sup>51</sup>

82. Industry generally has a central role in the target-setting process, with the result that targets are frequently ill-defined, or are defined relative to a baseline “business-as-usual” path that is itself not clear. Hence Krarup (1999), who provides an evaluation of VAs in the energy sector for a number of EU countries (Denmark, Germany, France, the Netherlands and Sweden), suggests that the majority of reductions in energy use claimed to result from voluntary agreements would have occurred anyway in the absence of any such agreements. Voluntary agreements aiming to reduce greenhouse gas emissions in

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50. A by-product of this approach is to highlight the environmental and economic inefficiency of the agricultural subsidy system.

51. See OECD (1999b), which provides more detail on what follows.

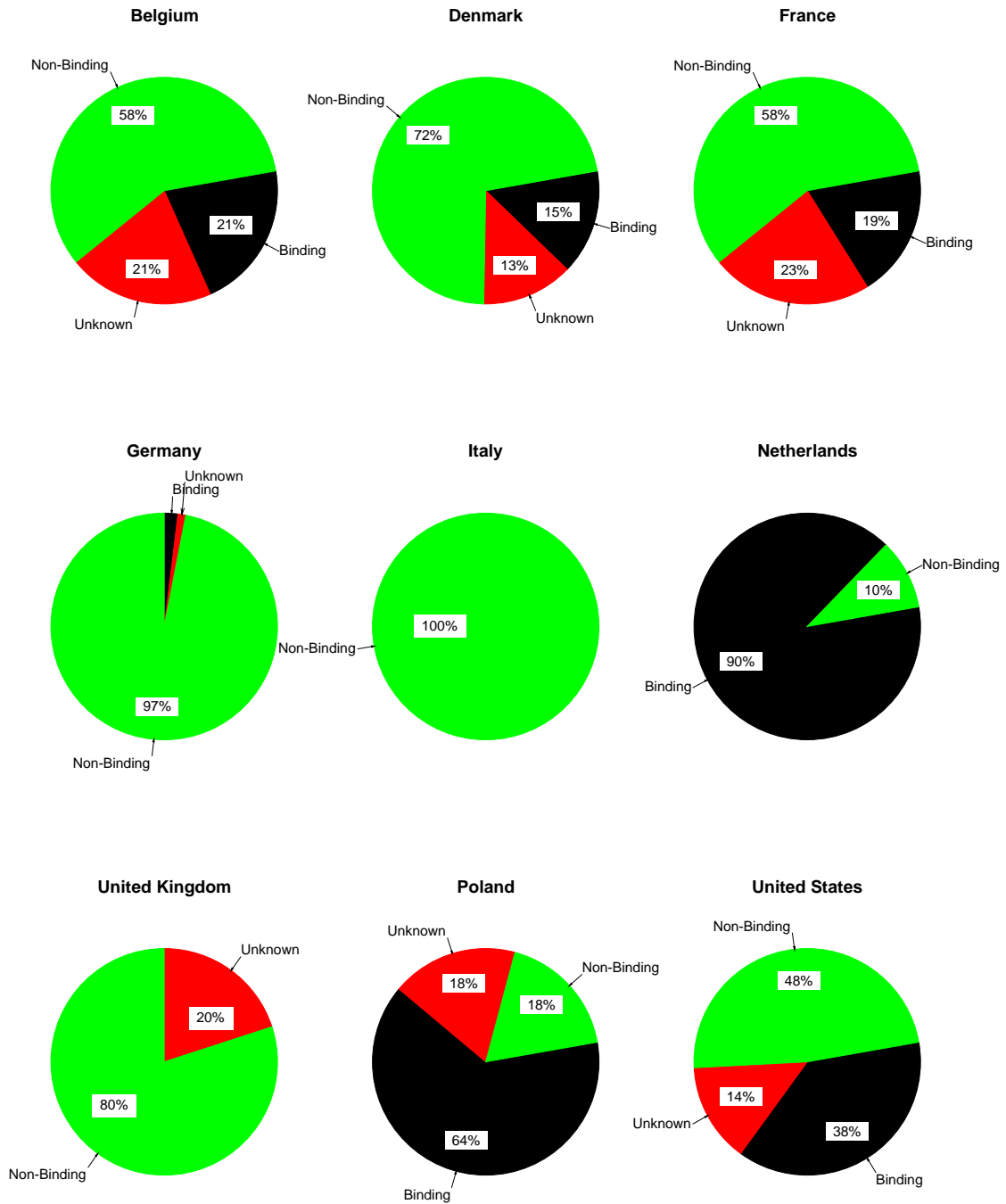
Australia and Canada also suffer from the same shortcoming.<sup>52</sup> The agreement to take back old cars free in Germany has also been criticised for achieving only what would have materialised without intervention, as the cars involved still have a market value. At the implementation stage too, negotiated agreements perform poorly due to non-enforceable commitments, poor monitoring and lack of transparency. In most countries, they are usually not legally binding (Figure 10), and even when they are, enforcement is difficult if the target is not clearly defined. It is still rare to build independent verification into programmes: for example, none was carried out in the first four years of the Australian Greenhouse Challenge Programme, intended to reduce CO<sub>2</sub> emissions from industrial fuel consumption; since 1999 independent verification has been carried out for a random sample of participants in the programme.

83. Voluntary agreements could in principle make use of, or at least take into account, economic incentives; in practice they do not. Negotiated burden-sharing between firms is typically driven more by equity considerations and concerns about competitiveness than by cost-efficiency concerns. In Germany, for example, where they are extensively used, voluntary agreements often attribute identical targets to individual firms rather than concentrating abatement where costs are lowest (Kirkpatrick *et al.*, 2001). In some cases, such as for the waste sector in Germany, voluntary agreements are used to achieve targets which are not supported by cost-benefit analysis. More generally, voluntary agreements often result in a piecemeal approach to individual environmental problems and are very unlikely to result in equalisation of marginal abatement costs.

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52. See IEA (2000) for Canada. Torvanger and Skodvin (1999) provide a survey of agreements in CO<sub>2</sub> mitigation policies in the United States, Germany the Netherlands and Norway, reaching broadly similar conclusions to Krarup (1999).

**Figure 10. Share of legally binding and voluntary agreements in a sample of seven EU countries, Poland and the United States**



Source: Öko-Institut (1998), "New Instruments for Sustainability- The New Contribution of Voluntary Agreements to Environmental Policy", Darmstadt.

84. The usual claim that negotiated agreements tend to reduce administrative burdens is not confirmed either by empirical evidence or analytical arguments.<sup>53</sup> In fact, when the number of potential participants in an agreement is large, administrative, monitoring and enforcement costs can be quite high, or significant set-up costs can be followed by weak or ineffective monitoring and enforcement. Creating an emission baseline, for example, is a very difficult and time-consuming task.

85. Voluntary approaches could play some beneficial role when used as a complement to traditional command-and-control systems, as they allow for some flexibility in meeting targets, but, in practice, they seem to be rarely so used. First of all, the target itself should be set outside the negotiated agreement, as in some of the Dutch agreements, for example. As evidenced in OECD (1999b), the design of VAs can be improved by including a number of specific features as possible safeguards against the main drawbacks, but such features are currently rarely used. These are: clearly established targets, precise characterisation of a business-as-usual scenario, credible regulatory threats and penalties in case of non-compliance, reliable monitoring, and third-party participation in the process of setting objectives and performance monitoring.

86. Overall, the potential for self regulation and win-win solutions are limited. Voluntary approaches may be effective in some cases, in particular if the sector concerned comprises a small number of firms and the environmental problem cannot be efficiently tackled with an economic instrument. In that case, it may not be too costly to establish a proper baseline for the firms concerned and to set up enforcement mechanisms. When the environmental problem can be efficiently tackled with economic instruments and abatement costs are potentially large, as for example in the case of climate change and problems associated with sulphur dioxide and nitrogen oxide emissions,<sup>54</sup> and involves a large number of polluters, voluntary approaches are not cost-effective.

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53. See for example Lyon and Maxwell (1999) and Maxwell et al. (1998)

54. At least emissions from stationary sources in the case of NOx.

Recommendations<sup>1</sup> on Instruments

	Belgium	Canada	Denmark	Finland	Germany	Norway	Poland	Sweden	United States
Use more economic instruments	.	.	.	.	.	.	.	.	.
Allow trading of quantitative emission permits (for given environmental targets)							.		.
Tax or cap-and-trade for GHGs	.	.	.	.	.	.		.	.
Tax or cap-and-trade for SOx and/or NOx	.	.		.	.				
Extend or modify tax/cap-and-trade on SOx and/or Nox			.			.		.	
Consider switch from vehicle to fuel taxes			.	.					
Use taxes to replace fuel economy regulations									.
Consider road pricing, or increased use of	.				.	.			
Rebalance diesel versus petrol tax	.		.	.	.	.			
Increase overall motor fuel prices to meet Kyoto targets and/or internalise other externalities		.					.		.
Economic pricing (including taxation), in water supply and/or treatment	.	.	.		.		.		.
Tax or cap-and-trade for agricultural nutrient leaching	.		.	.				.	.
Promote trade in water or water rights		.							.
Extend use of transferable fishing quotas		.				.			
Tax effluent, toxic discharges, pesticides, or other specific hazardous products		.				.			
Improve clarity and enforcement of voluntary agreements		.			.				

1. Some of these recommendations are found or implied in the text but not necessarily highlighted in the Introduction and Summary or Annex 2.

*Note:* The absence of an entry indicates that there was no specific recommendation made for the particular country/issue, but this is more frequently because the issue was not discussed for that country than because it was considered and felt not to warrant any recommendation.

#### 4. Some obstacles to implementation - competitiveness and income distribution

87. As economic instruments modify prices, they affect the structure of production and the level and distribution of income. Some industries, income groups or regions will be more affected than others. Where the potential effect is likely to change the production structure, this is often considered a “competitiveness” problem for industries adversely affected,<sup>55</sup> while effects on household incomes might be thought of more as distributional issues.

88. The way in which the effects are perceived depends partly on the point where the economic instrument is introduced: the more “upstream” is the activity taxed (or capped), the more important the competitiveness effect may be relative to distributional effects; by contrast, taxes on final consumption will directly affect household real income if the market structure allows firms to pass cost increases into product prices, the effect on production coming through consequent demand changes.

89. Of course, regulatory instruments also have effects on competitiveness and income distribution. Meeting technological or performance standards has costs and therefore affects firms’ competitive positions. And regulations are often not distributionally neutral: for example, compulsory fitting of catalytic converters has a smaller proportionate effect on the price of luxury cars than on other models. These effects from regulations are perhaps less obvious than those from economic instruments, which may explain the policy bias in favour of regulation. With regulation perhaps more prone to capture - as narrow interest groups exert pressure to shape rules that favour their interests - this bias is reinforced.

90. Distributional issues in a regional perspective also often underlie competitiveness concerns. For example, in Denmark, Finland, Norway and Sweden, the possibility that implementing a uniform CO<sub>2</sub> tax (to all sectors) might cause an exporter supporting a large share of economic activity in a particular region to close down - with significant effects on regional production, employment and revenues - has been a regional distribution concern; but it would at the same time be presented as a problem for competitiveness. Typically, putting an environmental tax on household consumption rather than production inputs, as commonly done in the countries surveyed, aims at minimising competitiveness effects and avoiding regional problems - at the price of reduced environmental or economic effectiveness. This approach evidently does not avoid consequences on household income distribution.

91. Thus, the distinction between competitiveness and distribution issues is rather blurred, and there are close links between them. For the sake of clarity, the two sets of issues are nevertheless discussed separately below, starting with competitiveness and regional distribution concerns and continuing with social distribution.

#### 4.1 *Competitiveness*

##### 4.1.1 *Exemption for competitiveness concerns is generally inefficient*

92. Countries repeatedly make exceptions to environmental taxes for heavy polluters (see Box 5 and Table 6). Exempting some sectors from the tax or reducing tax rates means that marginal abatement costs are not equalised throughout the economy, and excessive costs will be incurred in meeting environmental

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55. The focus of concern by producers themselves is frequently on competitiveness vis-à-vis foreign producers of similar products rather than domestic producers of different products, affected differently by environmental policy measures.

targets. Too much abatement is carried out, and too much output therefore lost, in sectors with relatively high marginal abatement costs, whereas too little advantage is taken of opportunities for abatement in low marginal abatement cost sectors. In fact, sectors with high levels of pollution per unit of output are, *ceteris paribus*, those where output losses per reduction in pollution are low - and these are usually the sectors exempted from environmental taxes. Moreover, sectors competing strongly with overseas producers face high price elasticities of demand, so that small rises in their costs are likely to cause relatively large falls in their output - and hence in the pollution they produce. This means in effect that the level of a uniform tax or permit price necessary to meet quantitative domestic emission targets is lower than without such competition. Refusing to take advantage of this by protecting such sectors again increases costs by raising the dead-weight loss associated with the higher tax rate in other sectors. What matters in the long run is the overall competitiveness of the economy, not that of particular sectors, and, for a given abatement target, it is in fact reduced by exemptions.

#### 4.1.2 *Special cases where exemption is debated*

93. A number of different arguments are employed to justify special treatment for specific sectors:
- that emissions will “leak” to other countries with lower environmental standards;
  - that countries who “lead the way” in introducing ambitious environmental policies should not force their own industry to migrate only for it to return, or perhaps not return, when other countries catch up;
  - that strong measures should not be introduced too quickly - heavily affected sectors should have a breathing space.
94. This section discusses policies motivated by such concerns, arguing that they rarely justify special treatment that affects marginal incentives. This is especially so once it is taken into account that special treatment in some cases, even if warranted, is likely to stimulate rent-seeking on a generalised basis.

Table 6. Sectors or taxes where competitiveness or distributional concerns reported<sup>1</sup> to distort policy

	Belgium	Denmark	Finland	Germany	Norway	Poland	Sweden	United States
Energy tax	•	•	•	•			•	
CO <sub>2</sub> tax		•	•		•		•	
Electricity tax		•	•	•			•	
Agricultural nitrate/phosphate discharge	•							•
SO <sub>2</sub> tax					•			
Wastewater tax	•			•				
Subsidies and/or fuel taxes in public transport					•			

*Note:* The absence of an entry indicates that there was no specific mention made for the particular country/issue, but this is more frequently because the issue was not discussed for that country than because it was considered and felt not to warrant any comment.



### Box 5. Competitiveness concerns as a factor shaping policies

One illustration of the practical impact of competitiveness pressures is the close relation between motor fuel taxes and prices in neighbouring countries (Figure 11). Here the motivation is partly public finances: if a small country increased its motor fuel taxes significantly above those of its neighbours, it could expect to lose revenue, initially from normal cross-border traffic choosing to refuel in the cheaper regime and, at higher levels of tax differential, from individuals or companies making cross-border trips for the sole purpose of refuelling at lower prices. The phenomenon is well illustrated (in reverse) in Luxembourg, which has very low tax rates on motor fuel: over 75 per cent of sales in Luxembourg are to non-residents.

In Canada, opposition to higher fuel taxes is partly based on fear of competitive disadvantage for the transport and transport-using sectors *vis-à-vis* the United States. However, although the use of road transport in Canada could be expected to decline somewhat if fuel taxes were significantly increased, this would not favour US over Canadian hauliers in Canada since any truck refuelling in Canada would have to pay the higher taxes, nor discriminate against Canadian hauliers in the United States since they could refuel there. Transport-using sectors in Canada would lose or gain according to the relative importance of transport in their costs.

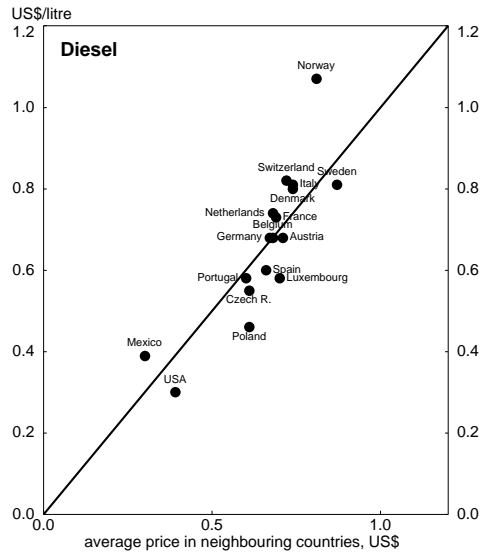
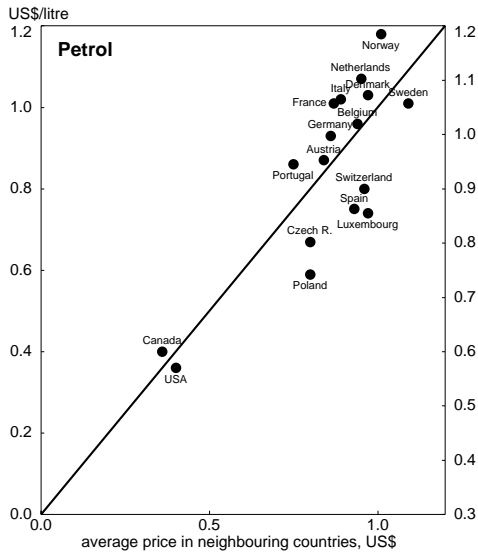
In Denmark, where sentiment might otherwise be in favour of somewhat higher fuel taxes, the Ministry of Taxation developed an econometric model of tax revenue as a function of the tax differential *vis-à-vis* Germany, which implied that the marginal cost of emission reductions through such tax increases would be very high compared with other taxes or measures. However, these losses could be reduced through a geographically graduated tax, with the rate increasing with the distance from the German border.<sup>1</sup> It may be worth noting, that, as far as the Kyoto target is concerned, CO<sub>2</sub> emissions from gasoline bought in Germany would count as German emissions under the EU burden-sharing Agreement.

More generally, energy or energy-related taxes provide many of the clearest examples where prospective losses of competitiveness for certain sectors have resulted in the implementation of a discriminatory tax structure. CO<sub>2</sub> taxes in Denmark, Norway and Sweden provide good examples of widespread zero-rating and rate differentials (Figure 12).<sup>2</sup> In fact, the desire to avoid “competitiveness” effects results in most such taxes being levied almost entirely on households and transport, with industry largely exempted (OECD, 2001*d*).

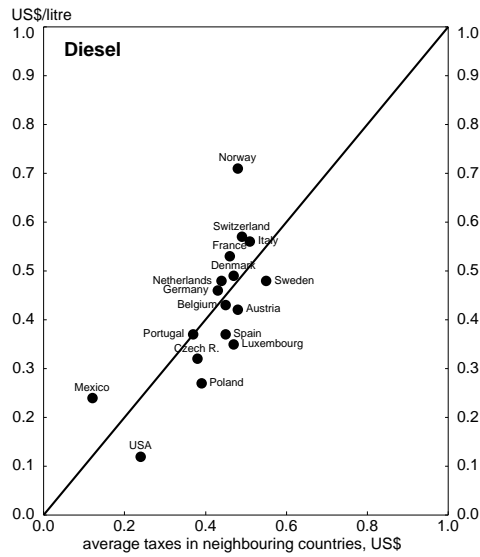
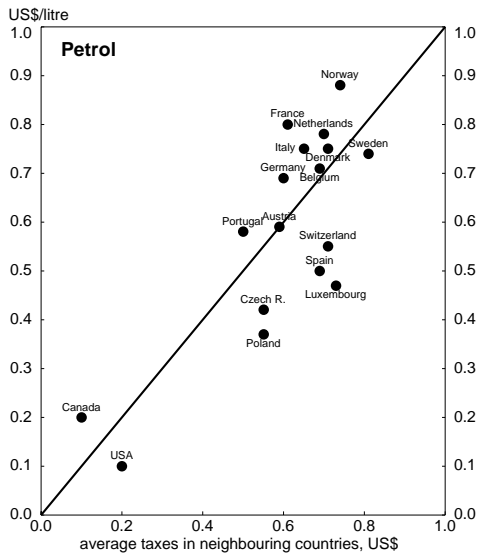
- 
1. This would not be wholly unprecedented; in Minnesota (United States), fuel taxes may “be lowered to a rate of \$0.03 above the contiguous state tax rate for sales from service stations competing with stations in other states located closer than 7.5 miles from the Minnesota station” (OECD database on environmentally related taxes).
  2. Data linking CO<sub>2</sub> tax rates with emission shares was available only for the countries shown in Figure 12, but the structures are similar in other countries with such taxes.

Figure 11. Fuel prices and taxes in neighbouring countries  
1999

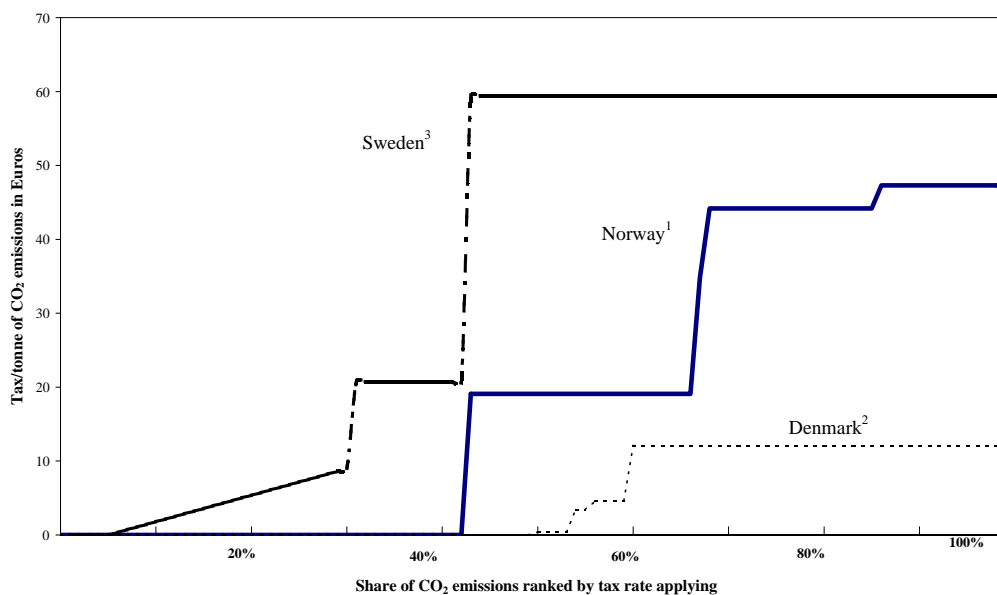
A. Total price including taxes



B. Taxes



Source: Based on IEA data.

Figure 12. CO<sub>2</sub> taxes in selected countries

1. 1998 tax rates, 1995 emissions data (Ministry of Finance).
2. 2000 tax rates, 1996 emissions data (Ministry of Taxation).
3. 2000 tax rates, 1996 emissions data (Swedish Ministry of Finance and Secretariat estimates).

#### 4.1.2.1 Leakage

95. The issue of leakage is most obvious where national pollution contributes to an environmental issue with a global character such as climate change. The essence of the argument, used for example by countries which have introduced a CO<sub>2</sub> tax, is that the reduction in domestic emissions in an internationally competing industry exceeds the reduction in global emissions by an amount equal to the leakage, *i.e.* the emissions associated with production that is shifted abroad due to increased production costs in the taxing country. That is, the marginal benefit - in terms of global emission reduction - is lower than the tax rate in the taxing country. Minimising the domestic cost of a given global emission abatement would indeed then imply a differentiated rate structure.

96. In the case of CO<sub>2</sub>, most OECD countries are parties to the Kyoto Protocol which, if implemented, will impose restrictions on all countries' emissions; "leakage" to another "capped" country should not then be a concern.<sup>56</sup> However, the problem may arise when some countries are not participating in an agreement to address a *global* environmental problem. In the Kyoto agreement, for example, the issue arises *vis-à-vis* non-Annex B countries, as only Annex B countries are subject to CO<sub>2</sub> emission caps. The costs of moving production to non-Annex B countries, however, may often be particularly high, and a shift may be impractical. Empirical analysis on carbon leakage effects provides estimates of "leakage rate" ranging from around 20 per cent to 2 to 5 per cent, and in fact, the loss of competitiveness of energy-

56. Indeed, the Danish authorities, for example, have stated that they would revise their system of reduced CO<sub>2</sub> tax rates if the Kyoto Protocol comes into force.

intensive industry is often found to be much less influential than what happens on international energy markets<sup>57</sup>.

97. Where policy is targeting a *local or regional* environmental problem, the case for exemptions is difficult to make, since leakage does not undermine the effectiveness of the tax or cap-and-trade scheme in addressing the problem. It is nevertheless sometimes argued that such possible leakage would amount to *imposing* pollution on receiving countries, generally in the developing world. These arguments, which are also used to justify barriers to trade based on environmental factors, assume that it is appropriate for OECD countries to attach a weight to pollution in other countries that those countries, implicitly, do not (since they could, if they wished, introduce appropriate policies themselves). Among the justifications for this approach are that political conditions in other countries may not allow populations' preferences to be adequately reflected in environmental policy. Affected domestic industry interest groups also have an obvious interest in emphasising this aspect in their lobbying.

#### 4.1.2.2 Leaders

98. In the case of one country (especially a small open economy) acting in advance of others, but expecting them to follow - which applies again in the case of CO<sub>2</sub> taxes imposed to meet Kyoto targets - significantly reduced profits in pollution-intensive production could induce production to move to countries where it would have a tax advantage. But this tax advantage would only be temporary until other countries too implement measures to meet the target. Either relocation costs would be incurred unnecessarily or the industry might not return.

99. However, if other countries are expected to follow suit, firms will calculate whether the costs to them of moving and returning are greater than the tax liability if they stay. If the industry would remain abroad, the implication is that the taxing country had little or no comparative advantage in that industry anyway. In any case, countries should be very cautious before they interfere with marginal incentives on these grounds. A more appropriate answer to such concerns would rather be to retain the marginal incentives and set up some compensation for the energy-intensive sectors subject to international competition, and to announce a phasing out of compensation once other countries have followed suit.<sup>58</sup>

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57. See OECD (1999c) and Burniaux and Oliveira Martins (2000), which provide empirical evidence using a general equilibrium model. The usual trade channel is less influential in determining leakages than often thought, as the leakage rate is found to be not very sensitive to changes in elasticities of substitution in non-energy markets. By contrast, unilateral carbon abatement in a group of countries corresponding to a large fraction of world carbon demand would cause a fall of the international price of carbon, thus increasing energy demand and carbon emissions in the rest of the world, depending on the structure of the international energy markets. This effect, however, departs from the "competitiveness" argument used by countries to justify exemptions.

58. The Danish authorities argue that their CO<sub>2</sub> tax structure is built in this way. Energy-intensive industry may be taxed at 3 krone per tonne instead of 25 krone per tonne, provided that they enter a "voluntary" agreement with the government under which they are required to make all investments which an energy audit implies would be profitable if they were taxed at 25 krone (which is already a reduced rate, the full rate, applied to domestic and space heating uses of energy, being 100 krone per tonne). This is equivalent to a tax credit of 22 (=25-3) krone per tonne calculated on initial emissions while preventing an enterprise taking the tax credit and moving production abroad, but with the addition of very large administrative expenses compared with the more straightforward way. See O'Brien and Høj (2001). According to Krarup (1999), most of the investment undertaken under the voluntary agreements would have been undertaken anyway by the company concerned, without the incentive of the tax credit. Unpublished government research reached the opposite conclusion, however. The UK climate change levy has a similar provision, as did the planned extension of the French *taxe générale sur les activités polluantes* to fossil fuels. See Section 3.1.3.1.

This can be done through the use of grandfathered tax credits, or emission permits, as already mentioned in a number of examples above.<sup>59</sup> Maintaining exemptions and rebates for taxes can be administratively expensive (OECD, 2001*d*) while tax credits or permit allocations - provided their calculation is simple - could reduce expenses.

100. Being a leader may also be seen as problematic when there is uncertainty as to the effective implementation of the agreement. This is the case for the Kyoto Protocol which has been ratified by only few parties yet. Again, however, if countries want to start unilateral action to reduce emissions (may be partly as part of a dynamic game to bring other countries in), they should also do it in a cost-effective way, which exemptions do not allow.

#### 4.1.2.3 Adjustment costs

101. Despite the presumption that special treatment exempting some sectors, or allowing them to pay lower tax rates on emissions, increases the overall cost of the resulting abatement, the strength of sectoral lobbies as well as genuine difficulties relating to the fairness of new taxes<sup>60</sup> means that in some cases only a differentiated approach is politically feasible initially. Again in this case, however, it is quite straightforward to provide compensation without relaxing marginal incentives to abate, as described above. A policy based on such transition cost arguments would logically be planning for exemptions, tax credits and free allocation of emissions permits to be phased out over time, which is not generally the case in the countries reviewed. A gradual phasing-in of taxes or caps, announced several years in advance, can also reduce adjustment costs, but with a lower short-run impact on emissions.

## 4.2 *Distributional effects*

### 4.2.1 *Environmental taxation may be regressive, though to an uncertain degree*

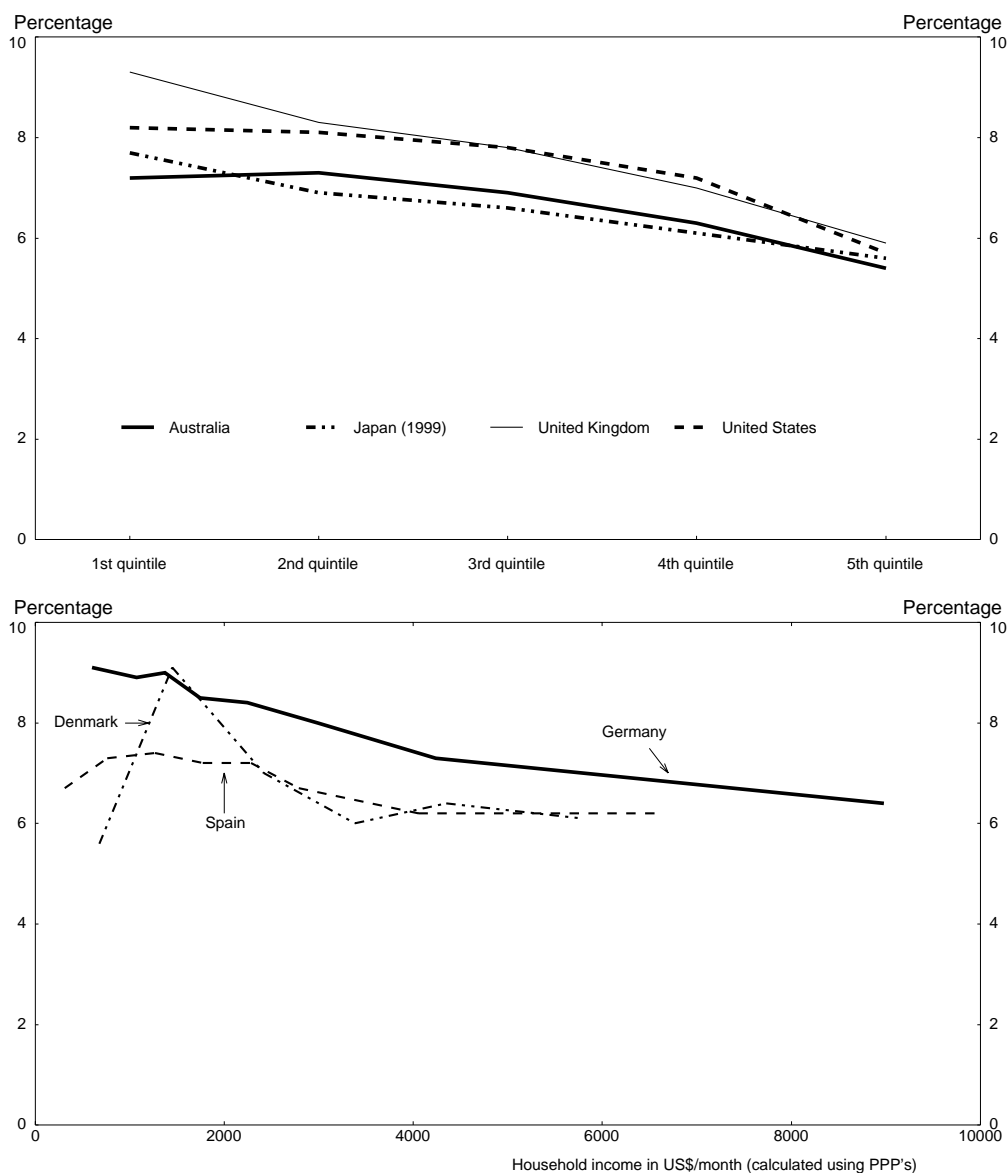
102. The distributional implications of measures pricing environmental externalities - that is, environmental taxes or "cap-and-trade" schemes - have been of concern in OECD countries trying to implement them, and their potential regressive effect is often seen as an obstacle to their effective implementation. In the United Kingdom, for example, the government has ruled out environmentally related taxation on domestic consumption of fuel and power because of expected undesirable distributional effects, and the VAT rate on domestic fuels is lower than the standard rate (OECD, 2001*d*). Empirical evidence supports the notion that low-income groups do spend a higher share of their income on energy products than others, so that they would be relatively more affected by energy taxes, although the difference is not dramatic (it may be more visible for groups within the lowest quintile, but such disaggregated data are not available) (Figure 13).

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59. Grandfathered emission permits or tax credits amount to raising a tax whose revenue is redistributed to producers. Under some circumstances these transfers may be more than is necessary to compensate producers for losses of competitiveness; it may be possible to achieve such compensation by grandfathering based on only a proportion of past emissions. See Bovenberg and Goulder (2000).

60. Environmental taxation can seem like retroactive justice. Companies may be penalised for using long-lasting but polluting equipment which they would not have installed had they known that they would be penalised for the emissions.

**Figure 13. Share of energy<sup>1</sup> in household consumption by level of income in selected OECD countries<sup>2</sup>**  
1998



1. Including fuel used for personal transport.  
2. For Denmark, Germany and Spain, consumption patterns by decile or quintile are not available.  
Source: National household expenditure surveys.

103. A more comprehensive analysis of distributional effects would need to take into account second-order effects such as those through the energy content of other goods, through changes in incomes as the structure of production adjusts to new energy prices, and through reductions in the tax-exclusive price of energy if overall demand is significantly reduced. Furthermore, the distribution of the

environmental benefits themselves should also be taken into account: for example, low-income residential areas usually suffer relatively more from air pollution, so reductions in such pollution - such as arise from fuel taxes and emission standards, road pricing to reduce congestion - may benefit those groups more than others. The results of empirical work in this area, that takes some of these considerations into account, are inconclusive.<sup>61</sup>

#### 4.2.2 ...but setting discriminatory marginal incentives is an inefficient response

104. OECD countries for whom income distribution is an important factor in public policy generally have well-developed safety nets. In fact, as noted in OECD (1996), the concern for income distribution is not specific to environmental measures and may apply to any other policy measure or reforms as well as to ongoing economic developments. Thus, compensating specifically for environmental policy measures may seem to run counter the general thrust of social policies.

105. If, nevertheless, governments want to take offsetting action, ways can be found to avoid undermining the cost-effectiveness of the environmental measure. For example, two illustrative but contrasting approaches to household water supply have been taken in different regions of Belgium to address distributional concerns: in Flanders, following a need to raise overall water prices to increase revenue, under a new pricing system the first 15 m<sup>3</sup> per head are supplied free, and the rest at a uniform relatively high volumetric price; in Brussels, although the Flemish approach was considered, it was decided to have a flat volumetric rate for all consumption and establish a social fund for helping those for whom financing water charges would be difficult. On the assumption that per capita water use is correlated with income, the Flemish approach also provides support for poorer water consumers.<sup>62</sup> Often, however, compensatory measures aimed at preserving marginal incentives do not target precisely the same groups as are affected by the measure. Compensation directed through the income tax system, for example, will miss non-taxpayers.

106. In practice, new environmental taxes are often introduced as part of a tax reform, and where there are net revenue gains some compensation may be possible. This is rarely direct: green tax reforms implemented in a number of European countries have combined new environmental taxes with reduced taxes on labour, as in Denmark, Finland, Germany and the Netherlands, for example; other taxes can be reduced (in Norway and the Netherlands, income taxes were reduced) or the revenues can be used to fund compensation schemes directed at energy-intensive firms. The availability of such revenue is sometimes thought to represent a bonus - "double dividend" - from environmental taxation, but the extent to which this is justified is debated (Box 6). What is clear, in any case, is that grandfathering emission permits (or

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61. Considerable empirical research has been conducted on this topic, dealing to a varying extent with these effects. Studies looking only at the "static" effects of environmental energy taxes, with input-output analysis, generally conclude that they are quite regressive. They may be less regressive, however, when general equilibrium or dynamic macro-economic models are used, depending among other factors on how the revenues are recycled and on wage behaviour. For example, Metcalf (1998) found that a tax reform in the United States (comprising a CO<sub>2</sub> tax, higher motor fuel excise taxes, waste taxes and taxes on a number of emissions to the air) in which revenues were recycled through lower marginal rates of income tax and social security contributions, would be highly regressive. Yet he also shows that, depending on how the revenues are returned to households, the environmental reform can be made distributionally neutral. Empirical evidence on the distributional effects of non-energy taxes, on the other hand, is quite scarce (perhaps because "non-energy" environmental taxes cover much less spending and have less of an impact) and the same is true for the distribution of environmental benefits.

62. There is some debate as to whether the Flemish scheme is not, nevertheless, regressive. See O'Brien (2001b).

compensating for an emission tax with a tax credit) on competitiveness grounds deprives governments of the revenue to compensate for possible distributional effects.<sup>63</sup>

#### Box 6. The double dividend

Most taxes exist to raise revenue; a good revenue tax is one that raises revenue without changing behaviour or the distribution of income very much. Environmental taxes, on the other hand, are designed to change behaviour<sup>1</sup> (but not income distribution), and raise revenue as a side effect. There is a certain controversy over whether the use of this revenue to make other changes in taxes or expenditure amounts to an additional dividend, unavailable without the environmental taxation - can environmental taxation produce a double dividend?

The short answer is: in principle “no”, in practice, “quite likely.”

##### In principle

If the tax system were optimal, the cost of raising additional tax revenue through any existing taxes would be the same for all tax bases; if tax and expenditure were optimally determined together, this cost would furthermore be equal to the marginal benefit of additional public expenditure. Hence the welfare available from the use of environmental tax revenue is equal to the marginal cost of raising tax revenue, if used to reduce taxes - and it does not matter much if it is used to increase expenditure or reduce taxation.

But the revenue itself already represents reduced welfare: it has been taken from those causing pollution, while the only gain (before the revenue is spent) is in the environmental benefits due to the change in behaviour, which will be a fraction of the actual tax revenue (unless substitution and demand elasticities are high). The with-compensation Pareto principle would require this revenue to be allocated to those suffering from pollution (if a no-pollution case is taken as the starting point) or back (through lump-sum transfers) to those paying the tax (if the pre-tax situation is the starting point). This would account for all the revenue and is the only way to be sure that the introduction of an environmental tax is actually Pareto-improving. Hence there is nothing left over for a double dividend.

##### In practice

However, tax systems are not optimal. Reforming them to improve efficiency is difficult and often politically costly. Under these circumstances, it is very likely that uses can be found for revenue from environmental taxes where the benefits exceed those from redistribution either to polluters or to pollutees. This is even more the case where popular opinion supports such moves. Environmental taxation can thus ease tax reforms that probably should be undertaken anyway, but which might not be politically feasible. This double dividend - a “muted” double dividend - is perhaps a political rather than an economic one.

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1. More precisely, they are designed to internalise the costs of environmental externalities in expenditure and production decisions. This may not always change behaviour very much.

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63. It is sometimes thought that a cap-and-trade system with “grandfathered” permits has no distributive implications since there is no tax revenue. This is obviously not the case. Even when permits have been grandfathered, if the overall constraint is binding, the value of permits will be passed on into final consumption prices, just as a tax would be. This is similar to a consumption tax whose revenue is wholly returned to producers in proportion to their historic emissions. Governments could choose to sell or auction all or part of the permit allocations, using the revenue to reduce other taxes or increase expenditure, and are thus making an implicit choice between alternatives just as they would if a revenue tax were imposed. The same would be true for an environmental tax compensated by a tax credit.



107. In some countries energy taxes are partly recycled to households in the form of subsidies for energy-saving investment. This may be presented as some form of compensation, but has little in common with an expressly-designed compensation measure. In practice, such measures also seem to be taken in response to a public conception that earmarking of environmental tax revenues is a good thing. While strict earmarking is not a good idea, the more general practice of making “green tax reforms” as part of a wider, generally revenue-neutral, set of tax and expenditure changes is certainly an effective way of gathering popular support, partly precisely because the wider the set of measures included, the less likely it is that easily identified groups will be “losers” from the changes. Of course, accompanying measures should be desirable in themselves.

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**APPENDIX**  
**Summary of recommendations by country<sup>1</sup>**

**Belgium**

Assess costs and benefits of policies and objectives.

Facilitate legal action by NGOs and individuals.

Extend economic pricing of water to Wallonie and Brussels.

Revise tax on excess nutrient discharge for livestock (or use cap-and-trade): apply the same rate to all discharges (not just excess); use tax credits to compensate effects on revenues; extend to all farming.

Bathing water: assess health risks, make standards enforceable by authorising legal action against bourgmestres.

Rebalance petrol/diesel tax.

Apply national tax or cap-and-trade to CO<sub>2</sub>, SO<sub>2</sub>, NO<sub>x</sub> and minimise exemptions.

Evaluate environmental benefits versus economic costs of eco-taxes.

**Canada**

Clarify policy objectives.

More dissemination of environmental information.

Set clear rules for actions and consequences for violating them (*e.g.* for voluntary agreements).

Continue removal of special tax treatment for resource sectors.

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1. Included here are explicit recommendations made in the Assessment and Recommendations or concluding sections of the Surveys along with a number of suggestions made explicitly or implicitly in the text of the chapters.

Economic pricing of water, in particular remove irrigation subsidy.

Make water rights transferable (in shortage areas).

Extend use of transferable quotas in fishery management; tax the rent thereon.

Rule-based fishery management following scientific recommendations.

Remove disincentives to regional mobility in unemployment insurance.

Use more economic instruments (e.g. charge on toxic emissions, effluent and waste; water discharge permit trading; pesticide tax...) and apply the polluter pays principle more systematically.

Introduce tax or cap-and-trade for GHG.

### **Denmark**

More systematic CBA.

Set water charges and taxes at the same level for all users (agriculture and some industry currently exempted from some taxes).

Establish cap-and-trade or tax for nutrients in agriculture; offset revenue losses through tax credits if wanted.

Remove exemptions from energy taxes and put in place transitional compensatory scheme; integrate tax and trading arrangement and bring renewables in.

Assess costs of avoiding "leakage" (through exemptions, low tax rates).

Remove exemption from fuel tax for public transport.

CBA on high fixed charges on cars (which are regressive) versus fuel tax.

Phase out national waste targets to let waste taxes play their role.

CBA on product taxes and associated recycling schemes.

### **Finland**

More systematic economic assessment of SD policies.

Economic assessment of biodiversity policy.

Use SO<sub>x</sub>, NO<sub>x</sub> and nutrient tax/charges.

Pursue policy action for SO<sub>x</sub>, NO<sub>x</sub> and nutrients in neighbouring countries.

Further decouple agricultural support from production.

Try to get nearer to “pure” CO<sub>2</sub> tax and compensate energy-intensive industries through tax credits if wanted; remove favourable treatment for peat.

Rebalance diesel/petrol taxation; shift from vehicle to fuel taxes.

Try domestic CO<sub>2</sub>/GHG trading.

Review costs of environmental effects of agricultural policy.

### **Germany**

Take economy-wide approach to environmental policy.

Define objectives more clearly.

Use more economic instruments.

Assess use of VAs to increase effectiveness (even better would be to replace with regulation/taxation).

Return to simpler waste-water tax structure, removing numerous exemptions.

Rationalise energy tax (refunds in double-dividend-seeking approach).

Better modelling and CBA in transport policy.

Consider road-pricing.

Rebalance petrol/diesel taxation, lower fixed transport taxes.

Tax or cap-and-trade on CO<sub>2</sub>.

Apply Polluter Pays Principle to agriculture.

Reduce coal subsidies.

### **Norway**

Auction oil production acreage (to get rent).

Make fish quotas transferable and auction to extract the rent (but problem for regional policy).

Do cost-benefit for local waste, emissions, traffic etc.

Increase tax on nitrogen to reduce phosphorus/nitrogen abatement cost gap.

Current CO<sub>2</sub> tax inefficient due to exemptions. Establish trading scheme - permits “should be auctioned” - otherwise existing companies get the rent. If not, set uniform CO<sub>2</sub> tax, at lower rate but with no exemptions.

Rebalance policy mix SO<sub>x</sub>/NO<sub>x</sub> - easy SO<sub>x</sub> abatement done, need to turn to NO<sub>x</sub> - tax mobile sources according to their NO<sub>x</sub> emission intensity.

Use toll rings more as road pricing systems (eliminate season tickets and introduce time-differentiated fees).

Rebalance diesel/petrol taxes.

Reduce support to buses in remote areas and high speed passenger ships.

Further decouple agricultural support from production.

## **Poland**

Clarify roles and responsibilities of different government levels and remove inconsistencies in the institutional set-up for management of water resources.

Use more CBA (including the environment) for major government project and policies.

Review tax system to phase-out environmentally harmful incentives; use taxes to internalise environmental externalities across the various types of energy, with an explicit link to the carbon content.

Increase use of user charges to finance environmental infrastructure investment and create conducive conditions for private sector participation in these investments.

Phase-out environmental funds progressively, by restricting their operations to the period required to implement EU environmental directives; in the short-run, improve appraisal criteria, transparency and accountability of the environmental funds.

Facilitate use of emission trading.

Revise air emission fees towards closer link to environmental externalities; phase-out fees with no incentive effect or no clear revenue-raising role.

Remove exemptions/rebates for water abstraction and waste-water discharge fees for specific sectors.

Prepare for EU accession paying attention to minimising the costs of meeting environmental targets.

## **Sweden**

More systematic CBA.

Favour inter-sectoral approach to environmental problems.

Introduce tax or cap-and-trade on nutrients using mineral accounting.

Raise Baltic fairway shipping dues as function of NO<sub>x</sub> abatement equipment.

Re-focus energy taxes more directly on emissions causing environmental problems.



Remove exemptions for the CO<sub>2</sub> tax.

Consider domestic cap-and-trade for GHG. Make effective use emissions trading and Clean Development Mechanism.

Better economic assessment of measures to promote energy efficiency and renewables.

Use more CBA in waste management strategy to better take economic and environmental costs of various types of treatment into account.

Move to a weight-based waste collection system.

### **United States**

Rationalise treatment of CBA, in particular by removing existing restrictions on its use for decision-making in environmental policy.

Improve legislative clarity to reduce role of case law in establishing legislative intent.

Remove subsidies for use of water by agriculture and extract rents on water extraction.

Evaluate environmental costs of agriculture and internalise them through taxes or cap-and-trade systems, such as on excess nutrients; compensate revenue losses, if wanted, through tax credits; increase the link between subsidies and environmental benefits.

Pursue the Total Maximum Daily Load programme using economic instruments.

Review the Resource Conservation and Recovery Act to improve its cost-effectiveness.

Expand the range and nature of risks covered by the Toxic Release Inventory.

Increase fuel taxes to replace CAFE standards.

Increase carbon-based energy prices to meet Kyoto targets.

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