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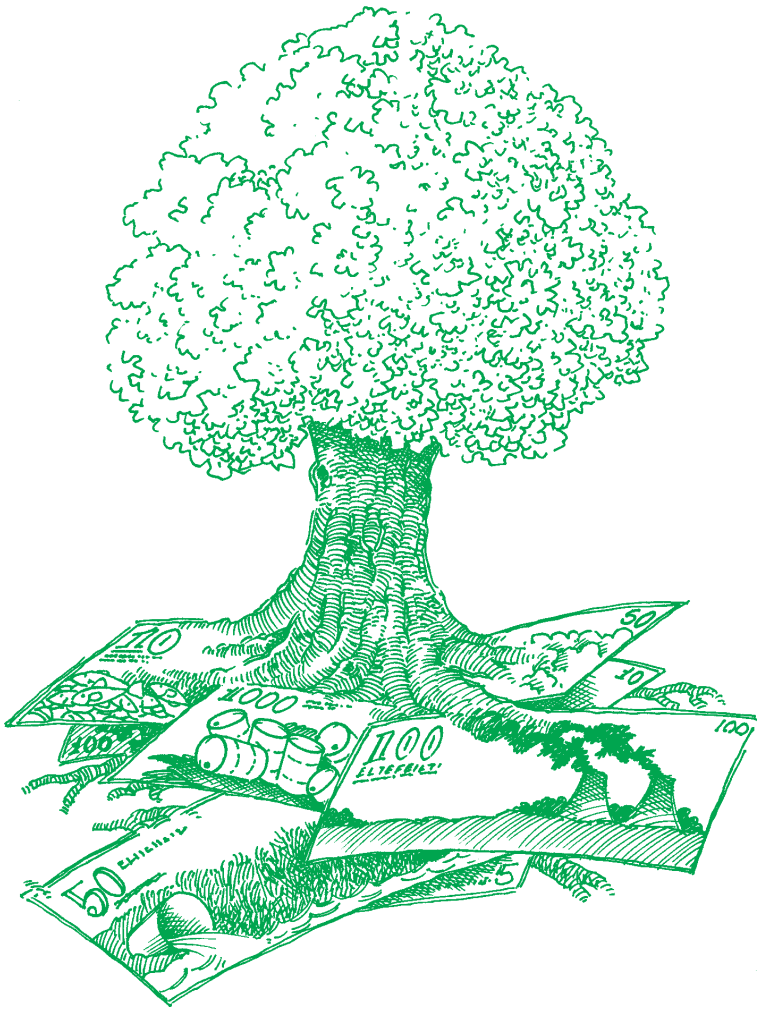

ENVIRONMENTAL TAXES

Implementation and Environmental Effectiveness

Copenhagen 1996

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PREFACE

The work of the EEA relating to the review and evaluation of environmental policy instruments was accelerated in early 1996 when the Committee on Environment, Public Health and Consumer Protection of the European Parliament asked the EEA to quickly produce two overview reports on 'green taxes' and on 'voluntary environmental agreements'.

The 'Mission' of the EEA includes the 'provision of timely and targeted information'. This report on Environmental Taxes is targeted on policy-making agents and the public and is timed to coincide with the on-going work of the Commission on the 'Communication on Environmental Levies used in Member States'. The report on 'voluntary agreements' will be published towards the end of 1996.

Both reports are examples of the Agency's state of the art and prospects reports which are intended to feed the policy debates with the best available information. They are also intended to be accessible so as to encourage the wider involvement of European citizens in policy development and implementation, thus enriching the 'prior consultation process' requested by Parliamentarians.

A great deal has already been written about green taxes, particularly by the OECD, the Nordic Council and the European Commission, and the EEA needs always to add value to existing work. This brief report therefore focuses on the environmental effectiveness of green taxes and on political barriers and solutions to their implementation. It also tries to emphasise the value of non-energy taxes and to be accessible to non-experts.

One of the key advantages of environmental taxes is that they correct false price signals in the market place by incorporating the costs of pollution and other environmental costs into prices - a process of both 'getting the prices right' and implementing the 'Polluter Pays Principle'. This advantage of green taxes was recognised by the Council in the conclusions of the Environment Council of 12 December 1991 which addressed a Community common platform for the UNCED 1992 :

> *"In order to reach the necessary reallocation of economic resources to achieve sustainable development, full social and environmental costs should be integrated into economic activities so that environmental externalities are internalised. This means that environmental costs and others related to the exploitation of natural resources in a sustainable way and borne by the supplier country should be reflected in economic activities. Economic and fiscal instruments could be among the measures used to achieve this."*

Since then there has been an increase in the use of environmental taxes but there is still considerable scope for their much wider use. We hope that this report will encourage more policy development and policy evaluation in this area. If the structural changes required by sustainable development are to be achieved then more comprehensive fiscal reforms are needed to encourage 'goods' like employment and to discourage 'bads' such as pollution and environmental degradation.

However, progress with environmental taxes requires changes at the EU level to allow greater harmonisation and compatibility between fiscal measures, the internal market and key sectors like energy, transport, and agriculture. There also needs to be easier means of getting majority political support for fiscal measures, and perhaps the current IGC process can provide the opportunity for this.

The Agency produced this report based on initial drafts provided by Paul Ekins (Forum for the Future, United Kingdom), Mikael Skou Andersen (University of Aarhus, Denmark) and Hans Vos (DHV Environment and Infrastructures, The Netherlands). The project was co-ordinated by Teresa Ribeiro (Project Manager). Substantial additions and editing were provided by David Gee and Kai Schlegelmilch with support from Keimpe Wieringa.

The report was reviewed by an Advisory Group consisting of two Members of the EEA Scientific Committee - Frank Convery (University College Dublin), and Knut Alfsen (Statistics Norway) - and Jos Delbeke (EC-DG XI), Jean-Philippe Barde (OECD) and representatives of the Secretariat of the Committee on Environment, Public Health and Consumer Protection of the European Parliament. Additional technical consultation was undertaken with the EEA National Focal Point EIONET Group and Klaus Thostrup (DG XXI).

I would like to thank the EEA project team and the other contributors for their efforts in producing this report in such a short time.

Domingo Jiménez-Beltrán
Executive Director

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EXECUTIVE SUMMARY

Main Conclusions

1 *Although the 5th Environmental Action Programme of the EU in 1992 recommended the greater use of economic instruments such as environmental taxes, there has been little progress in their use since then at the EU level. At Member State level, however, there has been a continuing increase in the use of environmental taxes over the last decade, which has accelerated in the last 5-6 years. This is primarily apparent in Scandinavia, but it is also noticeable in Austria, Belgium, France, Germany, The Netherlands and the United Kingdom.*

2 *Evaluation studies of 16 environmental taxes have been identified and reviewed in this report. Within the limitations of the studies, it appears that these taxes have been environmentally effective (achieving their environmental objectives) and they seem to have achieved such objectives at reasonable cost. Examples of particularly successful taxes include those on sulphur dioxide and nitrogen oxides in Sweden, on toxic waste in Germany, on water pollution in The Netherlands, and the tax differentials on leaded fuel and 'cleaner' diesel fuel in Sweden.*

3 *Most barriers to implementation, especially of energy taxes, such as the potential negative impacts on competitiveness; on employment, (particularly on specific sectors or regions); and on low income groups can be overcome by:*

- *careful design,*
- *the use of environmental taxes and respective revenues as part of policy packages and green tax reforms;*
- *gradual implementation;*
- *extensive consultation; and information.*

The mitigation of potential negative impacts can be ensured through the above measures, as recent experience in Scandinavia has demonstrated. The overall competitiveness of countries may be improved by well designed taxes which can spur innovation and stimulate structural change, though the latter remains speculative.

4 *As environmental concerns move from point-source emissions and problems, such as industrial emissions from pipelines and chimneys, to include more diffuse and mobile sources of pollution, such as solid waste, or from the agricultural and transport sectors, there is increased scope for the greater use of taxes, as well as other market based instruments, at both Member States and EU level.*

5 *If environmental taxes are well designed and implemented to exploit the advantages described above, they could deliver improvements in four key areas of public policy:*

- *the environment;*
- *innovation & competitiveness;*
- *employment, and*
- *the tax system.*

These are the main conclusions of a report on environmental taxes by the European Environment Agency (EEA), requested by the European Parliament. The report provides an overview of the main issues involved in environmental taxes, with a particular focus on their environmental effectiveness and on the political barriers to their implementation. It provides illustrative examples of environmental taxes only; comprehensive reviews are available from OECD (1995).

Key Points

Why environmental taxes?

The main reasons for using environmental taxes are:

- they are particularly effective instruments for the *internalisation of externalities*, i.e., the incorporation of the costs of environmental services and damages (and their repairs) directly into the prices of the goods, services or activities which cause them; contributing to the implementation of the Polluter Pays Principle and to the integration of economic and environmental policies;
- they can *provide incentives* for both consumers and producers to change their behaviour towards a more 'eco-efficient' use of resources; to stimulate innovation and structural changes; and to reinforce compliance with regulations;
- they can *raise revenue* which may be used to improve environmental expenditures; and/or to reduce taxes on labour, capital and savings.
- they can be particularly effective policy tools to tackle current environmental priorities from such '*diffuse' pollution sources* as transport emissions (including air and maritime transport), waste (e.g. packaging, batteries), and chemicals used in agriculture (e.g. pesticides and fertilisers).

Types of environmental taxes

In order to facilitate measuring the effectiveness of environmental taxes they have been classified into three main types, according to their main policy objectives:

1. *cost-covering charges* - e.g. designed to cover the costs of environmental services and abatement measures, such as water treatment (user charges) and which may be used for related environmental expenditures (earmarked charges);
2. *incentive taxes* - designed to change the behaviour of producers and/or consumers; and
3. *fiscal environmental taxes* - designed primarily to raise revenues.

In many cases a mixture of these three functions can be observed in practice.

The development of environmental taxes has generally been from cost-covering charges in the '60s and '70s, to combinations of incentive and fiscal environmental taxes in the '80s and '90s, and then their more recent integration into 'green tax reforms', where taxes on 'bads' such as pollution replace some taxes on 'goods' such as labour.

Who is using environmental taxes?

The current trends concerning environmental taxes (here divided into taxes on energy and other environmental taxes) can be summarised as follows:

- *environmental taxes*, (non-energy taxes according to the European Commission classification of DGXXI), represented *only 1,5% of total EU taxes* in 1993; in only a few countries do environmental taxes represent a larger proportion (Netherlands 5.1%; Denmark 4%); taxes classified as *energy taxes*, however, represented a larger proportion (*5,2% for the EU on average*) and up to around 10% in Portugal and Greece and 6-7% for Italy and the UK);
- general trends of taxation since 1980 show an increase in labour taxes and a decrease of capital taxes, while the share of energy and *environmental taxes remained relatively stable*, with a slight increase in energy taxes;
- although there has been little progress in implementing environmental taxes at EU level, *considerable progress has been made at Member State level*, particularly in northern European countries;

- several countries are currently implementing environmental taxes in *'green tax reforms*', using the new tax revenues to lower other taxes, such as labour taxes.

Do environmental taxes work?

Table 1 summarises the results of the review and qualitative assessment of the small number of evaluation studies available on environmental taxes. The main conclusions are:

- the taxes evaluated revealed *environmental benefits* and, in most cases appear to be *cost effective* within the constraints of the evaluation performed;

- *Examples* of particularly effective taxes are those on Swedish air pollution; on Dutch water pollution; and the NOx charge and tax differentiation schemes for vehicle fuels in Sweden.

- incentive taxes are, in general, environmentally effective when the tax is *sufficiently high to stimulate abatement measures;*

- a significant contribution to the environmental effectiveness of the cost-covering charges is provided by the *use of revenues for related environmental expenditures.*

- Taxes can work over relatively short periods of time (2-4 years), and so compare favourably with other environmental policy tools, though with energy taxes (as with some regulations), they can take 10-15 years to exert substantial incentive effects.

- Evaluating a tax and its environmental impact is not easy. Taxes are often part of a *policy package that is hard to disentangle:* therefore the effectiveness of the tax 'per se' cannot always be clearly identified.

In addition, taxes can have multiple environmental effects and secondary benefits that could improve policy in four key areas - the environment, innovation and competitiveness, employment and the tax system.

Political Barriers

There are several important political barriers to the introduction of environmental, particularly energy, taxes:

- the perceived impacts on *competitiveness*, and often on employment, particularly in some sectors/regions;
- the perceived impacts on *low-income groups* (i.e. the poor may pay proportionally more than the rich);
- perceived conflicts between *national taxes and EU*, or world trade, rules;
- the *EU unanimity rule* when voting on fiscal measures;
- perceptions that the taxes have to be *high* if they are to work;
- the perceived *conflict* between changing behaviour (i.e. less tax) and maintaining revenues;
- *existing subsidies and regulations* etc. that provide environmentally perverse effects; and
- *other policies and cultures* which negate or inhibit environmental taxes.

This report finds that *most barriers to implementation can be overcome* by:

- the removal of environmentally perverse subsidies and regulations;
- careful design of the taxes and of mitigation measures;
- the use of environmental taxes and their revenues as part of policy packages and green tax reforms;
- gradual implementation;
- extensive consultation; and
- information.

Table 1: Summary of an assessment [1] of selected environmental taxes[2]

Instrument	Environmental effect	Incentive effect	Remarks on overall effectiveness
Fiscal environmental taxes			
Sulphur tax (S)	+++	+++	Average S-content of fuels dropped considerably (40 %) over 2 years and consequently significant S emission reductions were achieved. Although being a fiscal environmental tax, it had strong incentive effect, probably due to high tax rate.
CO_2-tax (S)	?/+	?	Shift in district heating from fossil fuel to bio-fuels over 2 years; increased competitiveness of combined heat and power production.
CO_2-tax (N)	+ +	?	Partial analyses indicate some effects such as reduction of total CO_2 emissions of 3-4% in 2-3 years from a rising trend.
Tax on domestic flights (S)	+	?	Some impact on acceleration of replacement of combustion chambers by one airline and on emissions generally over 1-3 years.
Waste charge (DK)	++	?	Evaluation ongoing; dramatic increase of reused demolition waste from 12-82% over 6-8 years ; and decrease in waste production; tax rate nearly doubles cost of waste disposal.
Incentive charges			
Tax differential on unleaded petrol (S)	+++	+++	Tax differential substantially *contributed* to phasing out of lead over 5-7 years; differential apparently covered additional costs of unleaded petrol production - strong incentive effect.
Tax differential on 'cleaner' diesel (S)	+++	+++	Tax differential induced dramatic increase of market share of 'cleaner' fuel complying with stricter environmental standards in 3-4 years. Tax rebates for such fuels provide strong incentives as they reduced production costs to a level lower than those of standard fuels.
Toxic waste charge (D)	++	++	Reduction in waste production of at least 15% in 2-3 years. Planned capacities for incineration were consequently reduced.
NO_x-charge (S)	+++	+++	Design and tax rate provided incentive for monitoring and abatement measures in liable plants contributing to reduction of NOx emissions by 35% in 2 years; successful strengthening of permit policy.
Fertiliser charge (S)	+	?	One of the factors, within context of the agricultural reform policy, contributing to decreased use of artificial fertilisers over 5-10 years
Water pollution charge (F)	+	+	Tax-bounty system and sector contracts may have had some positive environmental impacts over 10-12 years; revenues of charge are modest.
Water pollution charge (D)	+	+	Positive impact on applying for and issuing of lower-pollution permits. Early announcement contributed to stepping up construction of wastewater treatment capacity.
Cost-covering charges: user charges			
Water pollution charge (NL)	+++	+	Charge created funds for rapid increase of treatment capacity; although the tax incentive was low, use of the revenue for extending treatment capacity contributed to a substantial improvement of water quality over 10-15 years.
Household waste charge (NL)	+	?/+	Fairer distribution of costs of household waste management; variable rates may have provided incentive for reduction of waste (10-20% less waste/head).
Cost-covering charges: earmarked charges			
Battery charges (S)	++	0	Charge renders recycling of Pb-batteries feasible; collection rate in 1993 was 95% (60% in 1989),; for other batteries effect is still unclear.
Aircraft noise charge (NL)	+	0	Satisfactory in terms of fund-raising; allowed for covering cost of sound insulation measures around airport

Legend:
+/++/+++ = small/medium/high effect
0 = absent or negligible effect
? = unknown effect

1) The incentive effect evaluation is based on the evidence found on tax payers being encouraged to reduce pollution, mostly due to significant differentials between the tax rate and the cost of abatement measures (or a proxy). The environmental effectiveness is based on the evidence on environmental benefits derived from the tax. The question marks indicate lack of evidence.
2) Brief details of each tax reviewed are included in Annex II.

EU compatibility and unanimity voting need to be addressed.

The overall competitiveness of countries may be improved by well designed taxes which can spur innovation and possibly encourage structural change.

Recommendations

1 Greater use of environmental taxes

While the need to change production and consumption patterns has gained wide acceptance since the Rio Summit in 1992, the report for the review of the Fifth Environmental Action Programme (5th EAP) 'Environment in the Europe Union 1995' published by the EEA at the end of 1995, concluded that, three years after the publication of the 5th EAP "… most production and consumption trends remain unchanged…". Environmental taxes, among other policy instruments, can help achieve such structural changes, by correcting price signals and market distortions. They should therefore be used more extensively.

The use of environmental taxes can be expanded in 3 main ways:

- their *extension* to more European countries;
- increasing their *harmonisation and compatibility* at the EU level;
- *developing new tax bases*, increasingly based on input materials as well as on emissions, and extended to new or expanded tax bases such as water resources, minerals, hazardous chemicals, transport (air and maritime), land use and tourism. The physical resource flows through the economy like energy, minerals and the profits from land use could yield substantial tax revenues for green tax reforms.

2 Careful design and implementation

The benefits of environmental taxes and the potential for their increased use is considerable, but careful design and implementation is necessary to realise these gains in practice. The box below, without pretending to be exhaustive, summarises some points for the successful implementation of environmental taxes.

3 More and better evaluation

While the theoretical evaluation of environmental taxation is a well developed field, adequate evaluations of practical experiences with such taxes is still comparatively rare. Consequently, decision making processes may be impaired by lack of feedback information on the performance of different policy options. Improving this situation implies increased evaluation efforts, greater availability of reliable data, and evaluation mechanisms designed into the policy package. The need to integrate evaluation with tax design has been recognised by OECD, which has agreed on methodological guidelines for economic instrument evaluation. (OECD 1996 forthcoming).

4 More research - especially of policy packages and externalities

Environmental taxes often work best when part of a policy package aiming at addressing one (or more) environmental problems, but the interaction of several policy tools is then complex. Further analysis and understanding of these issues could be extremely helpful for future policy making. Particularly worthwhile would be the development of a framework addressing the potential applicability of different policy tools according to a typology of environmental problems.

Finally, in order to improve the design of environmental taxes, research is needed in areas such as economic modelling and the evaluation of externalities, in particular in relation to their distributional aspects.

More research is clearly needed, but sufficient is already known to justify much further policy development on environmental taxes.

Table 1a

Checklist for the successful implementation of environmental taxes:

- Studies in advance investigating the potential effects of the tax/policy package, in particular the calculation of the abatement costs in each sector, equity implications; and the benefits and costs of improving eco-efficiency.
- Early and greater involvement of tax/fiscal authorities;
- Extensive consultations with stakeholders and the public;
- Early announcement of environmental taxes;
- Their introduction within a policy package of complementary measures;
- Gradual imposition of the tax;
- Recycling of revenues to:
  - tax payers, e.g. for environmental measures, via rebates or investment incentives, provision of information and training;

  - related sectors (e.g. some revenues of a waste tax going to the waste sector);

  - reduce other taxes such as taxes on labour.
- Increasing incentive effect, via:
  - gradually increasing the real price signal over long periods;

  - gradually reducing exemptions;
- Evaluation measures designed into the tax system.

1. INTRODUCTION

Environmental policy in the 1970s and early 1980s was mainly driven by regulations - of emissions, environmental quality, processes and technologies. Such regulations are often described as instruments of 'command and control'. However, during the later 1980s and the 1990s the interest of policy makers in more market-based instruments of environmental policy (for example, environmental taxes, tradable permits and deposit refund systems) was stimulated by a number of factors:

- a new orientation towards markets and deregulation in public policy;
- increasing recognition of the limitations of government in general, and of traditional 'command and control' systems of environmental regulation in particular;
- increasing concern that regulations might not adequately cope with emerging environmental problems despite imposing substantial economic costs;
- a desire to further implement the polluter pays principle and to 'internalise' such environmental costs as pollution into the prices of goods and services; and the need to integrate environmental policy into other policy areas such as agriculture, transport industry, tourism and employment;
- a need to find more cost-effective and flexible tools for achieving environmental progress.

These factors led to increasing official support for environmental taxes.

The purpose of this report is to provide an overview of the use and implementation of environmental taxes, in particular in Europe. It briefly sets out the rationale for environmental taxes and identifies the environmental themes towards which they are directed (*Section 2*). They are then classified by purpose and motivation (*Section 3*). The report only looks at environmental taxes, and not at subsidies or other taxes that may have unintended impacts on the environment.

The report then provides an overview of the national applications of economic instruments in industrialised countries mainly within the EU (*Section 4*) based largely on the OECD reports and surveys on economic instruments in 1987, 1992 and 1994 (OECD 1989, 1994c, 1995).

Increasing support for environmental taxes

Some EU views on environmental taxes:

• The 5th Environmental Action Programme (EAP) 'Towards Sustainability' in 1992: "In order to get the prices right and to create market based incentives for environmentally friendly economic behaviour, the use of economic and fiscal instruments will have to constitute an increasingly important part of the overall approach. The fundamental aim of these instruments will be to internalise all external environmental costs incurred during the whole life-cycle of products from source through production, distribution, use and final disposal, so that environmentally friendly products will not be at a competitive disadvantage in the market place vis-à-vis products which cause pollution and waste." (EC 1992).

• The Commission's Communication *Economic Growth and the Environment: Some Implications for Economic Policy Making* (COM(94) 465 final): "In our economy, economic decisions are to a large extent taken on the basis of price signals. As consumers adjust their purchase decisions to price changes and companies determine product design, technological development and the organisation of their production processes to a large degree as a function of market prices, it is essential that these prices correctly reflect the full costs and benefits to individuals and to society. ... Environmental taxes will prove to be one of the more effective policy responses in a significant number of cases."

• The Delors' White Paper on Growth, Competitiveness and Employment in 1993: "Finally, if the double challenge of unemployment/environmental pollution is to be addressed, a swap can be envisaged between reducing labour costs through increased pollution charges." (EC 1993,p.150)

Many economic instruments are still of recent origin, so there are few systematic evaluations of their effectiveness. However, the relevant studies are reviewed in *Section 5*. There may be considerable difficulties involved with the introduction of environmental taxes and *Section 6* addresses these major issues such as the effects on competitiveness and equity, the possibility of achieving a 'double dividend' through green tax reform, and related issues of design and administration. *Section 7* makes recommendations for future work on policy and research.

This report does not provide a comprehensive summary of all green taxes, as they are well described in reports from the OECD and the Nordic Council (Nordic Council 1994 and 1996 forthcoming). However, it does provide an accessible overview of both the potential, and the implementation difficulties, of environmental taxes, based on some illustrative examples. Comments on the Report would be welcomed.

2. WHY ENVIRONMENTAL TAXES?

The five main reasons for using environmental taxes are summarised below.

1. Bringing 'Externalities' into Prices

The main economic reason for using taxes in environmental policy is to bring the costs of pollution and other costs of using the environment- called *externalities*- into the prices of the goods and services produced by economic activity. Such pollution costs are called 'externalities' because they are side effects of the economic activity and their costs are not part of the prices paid by the producers or consumers directly involved. For example, pollution from coal fired power stations helps cause acid rain which damages soils, vegetation, water and buildings belonging to people and countries who do not directly benefit from the power station. And because the prices paid by the power producers and consumers do not include these 'external' costs, they give incorrect market signals, encouraging power production beyond the level of economic efficiency for the economy as a whole. Similarly, the full costs of using a car, which include the use of land, air pollution, noise, accidents, congestion etc. are 'external' to the car driver and not fully included in the price of cars or fuel.

When such externalities are not included in prices they create large distortions in the market by encouraging activities that are costly to society even if the private benefits, for example, of car driving, are substantial. Estimating the economic value of externalities is not easy but recent estimates of the external costs of road transport show them to be large and rising, costing the EU an average of 4.2% of GNP (see *Table 2*).

An environmental tax tries to bring these external costs into prices (the 'internalisation of externalities') so that both social and private costs are brought closer together. The better prices allow the markets for say, transport or power production, to work more efficiently. This internalisation of external costs will lead to a re-allocation of resources of an economy according to 'fair and efficient' prices by re-distributing the costs. (EC 1992; EC 1995).

Environmental taxes also help to implement the *polluter pays principle,* as they confront polluters with the full costs of their polluting activity.

The externalities discussed so far are all *negative externalities*, being costs, but there are also *positive externalities* where there are beneficial side effects of an economic activity enjoyed by those not directly involved in that activity. For example, forestry produces direct benefits for those involved in planting trees, but forests also provide benefits to society in general by retaining rainfall, by absorbing the greenhouse gas, CO_2, by binding and maintaining the soil, by providing habitats for other species, and by providing beauty for some people. And just as taxes can be used to internalise negative externalities, so a subsidy to say forestry can be used to internalise positive externalities. (This kind of environmentally positive subsidy, such as the Forestry Credits in The Netherlands, is very different from the negative subsidies on environmentally damaging activities such as intensive agriculture or commuter car use).

It is important to analyse the *distribution of externalities* i.e. who pays them, as well as who causes them, in order to maximise economic welfare when designing environmental taxes. As with car transport, it often appears that the poor, or least advantaged, pay most of the external costs of economic activity.

In practice, there is usually little or no agreed data on the economic cost of externalities, or their distribution, so policy makers fix the environmental tax rate at levels they think will achieve their policy objectives. (Baumol & Oates 1975/1988). In addition to bringing full costs into prices, these policy objectives can include encouraging 'greener' behaviour and innovation, and raising revenue.

Table 2: Estimates of the total external costs of road transport (in billion ECU)

Country	(year)	Cars	Buses	M/cycles	Freight	Total	Total (% of GDP)	Author
Europe 17 inc. Norway and Switzerland	(1991)	164.2	9.1	20.9	56.4.	250.6	**4.2**	INFRAS/IWW 1994
Austria	(1991)	4.9	0.2	0.5	1.0	6.6	**5.0**	INFRAS/IWW 1994
Belgium	(1991)	6.5	0.2	0.6	1.3	8.7	**5.4**	INFRAS/IWW 1994
Denmark	(1991)	2.1	0.2	0.4	1.0	3.4	**3.2**	INFRAS/IWW 1994
Finland	(1991)	2.2	0.2	0.2	0.7	3.3	**3.3**	INFRAS/IWW 1994
France	(1991)	22.8	1.2	1.8	15.0	40.8	**4.2**	INFRAS/IWW 1994
Germany	(1991)	45.8	1.7	5.0	9.4	61.9	**4.5**	INFRAS/IWW 1994
	(1994)	<8.8	to	24.6	1.9- 9.9	10.7- 34.5	**0.8- 2.5**	Friedrich 1995
Greece	(1991)	1.7	0.3	0.2	1.0	3.2	**5.6**	INFRAS/IWW 1994
Ireland	(1991)	1.0	neg[3)]	neg[3)]	0.5	1.5	**4.2**	INFRAS/IWW 1994
Italy	(1991)	19.7	1.6	6.8	6.7	34.8	**3.8**	INFRAS/IWW 1994
Luxembourg	(1991)	0.2	0.01	0.02	0.07	0.3	**4.0**	INFRAS/IWW 1994
Netherlands	(1987)							van der Kolk 1987
	(1990)	2.9	<	0.7>	1.3	4.9	**2.2**	Bleijenberg 1994
	(1991)	5.3	0.2	0.5	1.9	7.9	**3.3**	INFRAS/IWW 1994
Norway	(1991)	1.6	0.1	0.2	0.4	2.3	**2.7**	INFRAS/IWW 1994
Portugal	(1991)	4.2	0.3	0.5	0.4	5.4	**9.8**	INFRAS/IWW 1994
Spain	(1991)	11.8	1.2	1.4	6.3	20.7	**4.9**	INFRAS/IWW 1994
Sweden	(1991)	3.8	0.2	0.6	1.0	5.6	**3.0**	INFRAS/IWW 1994
Switzerland	(1991)	3.8	0.1	1.0	0.8	5.7	**3.1**	INFRAS/IWW 1994
	(1992)					2.0	**1.1**	Jeanreanaud 1992 [1)]
UK	(1991)	26.6	1.5	1.4	9.0	38.5	**4.7**	INFRAS/IWW 1994
	(1991)					30.0	**3.7**	Pearce 1993
USA	(1992?)					110	**2.1**	Mackenzie 1992
	(1994)					(USD) 778	**12.3[2)]**	Litman 1994

1. Accidents, noise and air pollution damage to buildings only. Estimate of 7.7. Swiss centimes per vehicle kilometre multiplied by 50.3 billion vehicle km = 3.87 billion CHF.

2. This figure is much higher than the others because more externalities are taken into account.

3. Negligible

Source: Maddison et al. 1996, p.220.

'Cars are not fair'

"Yet the present system is also unfair: to those who cannot afford cars and who are driven on to inadequate public transport; to millions who live near busy main roads and motorways; to children who breathe in car fumes; to people who prefer walking or cycling; to our grandchildren who may have to cope with the effects of global warming. Changing our attitudes to the car will require enormous political courage. But we cannot go on as we are" (The Independent, Extract from an Editorial, 19 May 1996 p. 20).

2. Incentive Effect

An environmental tax provides an incentive to avoid the tax by using, or generating less of, the substance being taxed. For example, if sulphur emissions are taxed then *producers* have an incentive to reduce the emissions by filtering etc. or by using materials and processes that create less sulphur pollution. The tax that is paid will raise prices to the *consumer* who also gets an incentive to use less of the taxed product. Environmental taxes may be targeted directly on consumers, such as the tax differentials for leaded/unleaded petrol, or on producers, such as carbon taxes, but in all cases they affect both consumers and producers by changing relative prices and therefore behaviour. This is called the *incentive* effect of environmental taxes.

However, because the price is only one factor that determines economic behaviour, the success of an environmental tax in achieving behaviour change depends on the particular market for the substance being taxed. For example, if the use of domestic energy cannot easily be reduced because of a lack of information and money for energy efficiency measures, then raising the price of domestic energy with a tax may not induce much, if any, of the desired behaviour change. Similarly, if the use of cars cannot easily be reduced because of the absence of competitive, safe and reliable alternatives, like public transport or cycling, then raising the price of petrol with an environmental tax may not lead to reduced car use. This failure of behaviour to respond to a price change (called an 'inelastic demand' by economists) means that either the tax has to be huge in order to have an incentive effect (and this can then reduce economic welfare by over-taxing some groups), or that other measures are needed to tackle the market resistance to behaviour change, such as support for energy efficiency, for public transport or for cycling.

This is why environmental taxes work best when they are part of a *policy package* that addresses all of the main aspects of a market, and which allows a modest price 'signal' from the tax to work well. For example, the unleaded petrol taxes in Europe have been successful because they were accompanied by consumer awareness campaigns about the brain damage to children from leaded petrol, and by regulations, and sometimes tax incentives, on catalytic converters, which only work with unleaded petrol. However, disentangling the tax effects from the other elements in a policy package is very difficult (see *Section 5*).

A key change in behaviour is to reduce pollution, and taxes can be a more cost effective tool for reducing pollution than regulations. This is because many polluters, even those with low pollutant reduction costs, will often pay tax on the pollution remaining after all their cost effective reduction measures have been taken. However, the tax payments will provide a *continuous incentive* to look for new ways of reducing pollution, unlike regulations which provide no such incentive once the regulatory standard has been met. This dynamic incentive of taxes is one of the ways in which environmental taxes help to minimise pollution control costs and to encourage innovation.

3. Minimising pollution control costs

A regulation on pollution control usually expects all polluters to reduce their pollution by the same extent, irrespective of their costs of doing so. An environmental tax allows each polluter to decide whether its cheaper to pay the tax or to reduce pollution. Those polluters who face the highest costs of pollution reduction will tend to pay more of the tax whilst those facing low reduction costs will reduce pollution instead. The costs of achieving any given level of overall pollution reduction with a tax will therefore be cheaper than with a regulation. (In theory, a regulation could be ap-

plied differently to each polluter but the information and administrative costs of doing so would usually be too high.)

A review of studies comparing the expected costs of pollution reduction via regulations or via economic instruments concluded that "these studies generally show that there are substantial economic gains from using a policy instrument which would efficiently allocate emissions reductions between polluters, rather than the type of 'equal abatement' rule which frequently results from conventional command and control regulation" (Tietenberg, 1990, quoted in OECD 1996 forthcoming, p.27). The studies reviewed were theoretical (or ex ante) studies and there is very little research on pollution control in practice (ex post studies) to see if regulations are indeed more costly than taxes. However, a forthcoming review of the efficiency and effectiveness of economic instruments concludes that "Whilst the ex post evidence available cannot conclusively prove the efficiency of economic instruments, it is clear that it would be substantially more difficult to demonstrate the alternative thesis, that regulatory approaches are more efficient than economic instruments" (OECD 1996 forthcoming, p.134.). Our review of the environmental effectiveness of environmental taxes reinforces this conclusion (see *Section 5*).

Taxes may not always be as effective as regulations. If the environmental effects of pollution are local to particular eco-systems, then even high pollutant reduction cost producers in that area may need to be controlled, and a tax is a less certain way of doing this than a regulation. And if a given quantity of pollutant reduction is needed then a regulation can usually deliver this more certainly than a tax can.

However, in some cases *tradable permits* can also deliver given quantities of pollution control more efficiently than regulations. This report does not cover tradable permits but the OECD review concludes that the use of such permits to control air and water pollution in the US, or to manage fish stocks in New Zealand, Canada and Iceland, can be effective (OECD 1996 forthcoming, p.134).

4. Encouraging Innovation

If the prices of fossil fuel energy, or water, or waste are increased through environmental taxes then this can encourage new ways of meeting our needs. Such innovation can lead to new technologies, processes and products. For example, the US tax on CFCs helped to encourage the development of substitute chemicals that were then exported. Similarly, the Swedish tax on sulphurous diesel helped to encourage the development of new, less polluting fuels. Environmental taxes can therefore help to move our economies towards the more *'eco-efficient'* use of energy and resources by raising the price of nature (Weizsäcker 1994 & 1996). Sustainable development seems to require large increases in 'eco-efficiency' (e.g. by a factor 10 - see the Carnoules Declaration, 1994). Such large scale structural changes in production and consumption can be encouraged by environmental taxes, especially if their price signals are gradual and predictable over the long planning periods required by industry.

Given the uncertainty about the human and environmental effects of many of our chemicals and other products, any increase in eco-efficiency that environmental taxes encourages also helps to implement the *'precautionary principle'*. i.e. the reduction of exposures to substances before there is conclusive evidence of serious harm.

Any innovations that are encouraged by taxes can also help improve *competitiveness*. The OECD considers these *dynamic efficiency* gains to be one of the main advantages of environmental taxes (OECD 1996a, p.12).

5. Raising Revenue

Given that producers and consumers will probably not cease entirely the activities that are be-

ing taxed, the taxes and charges will raise revenues. These may be used to address environmental problems directly; or they may be used to subsidise producers or consumers to shift to more environmentally-benign activities, providing a second incentive for environmental improvement; or they may be applied to other government purposes, allowing, for the same level of government expenditure, other taxes, for instance on labour, to be reduced. In general, taxes on labour, capital and savings are often more costly in terms of economic welfare than environmental taxes, so that a shift of tax burden from these activities to environmental taxes increases economic efficiency and welfare.

This is because the taxes reduce incentives to work, save or invest. US data for example, shows that each dollar raised in taxes costs about 20-30 cents in lost economic output (Ballard, Shoven and Whalley, 1985). Environmental taxes are the only taxes that do not have this *'tax burden or distortionary'* effect, and they actually increase rather than decrease economic welfare (Repetto 1992). This means that environmental taxes could be used to replace revenue from other more costly taxes on labour or capital. Shifting taxes from what can be called economic 'goods' such as labour and capital, onto 'bads' such as pollution, is called *ecological, or green tax reform (*See *Section 3)*.

Multiple Environmental Gains, Secondary Benefits

Environmental problems are inter-related. Often a single pollutant will contribute to several different environmental problems. Reducing this pollutant is therefore likely to ameliorate several problems, although exact effects will be hard to predict with certainty. The 5th Environmental Action Programme (EAP) grouped key environmental concerns into *environmental themes* such as climate change, ozone depletion, acidification, etc. In reviewing the 5th EAP, the EEA Report assessed environmental progress, and the key EU environmental measures, against these themes (EEA 1995, Chapter 4, pp.45-116, and Appendix 1, pp.145-147). It will therefore be useful to see how the main environmental taxes which have been introduced relate to these environmental themes.

Table 3 illustrates in a very general way some of the multiple effects which can be expected from a range of environmental taxes. Specific taxes are described in more detail in the *annexes II and III.*

The level of an environmental tax should reflect the severity of the environmental problem to which it is directed. The fact that an environmental tax can have beneficial effects on a number of environmental problems should be taken into account when the rate of the tax is being set, and when cost effectiveness is being evaluated. The 'multiple pollutant effect' approach to environmental policy making, currently being developed by the EU and UNECE, is particularly amenable to such an integrated analysis of the impacts of policy tools like environmental taxes. Of course, regulations too can have multiple impacts on several environmental themes, but as mentioned above, their incentive effects are usually more limited.

The Main Advantages of Environmental Taxes

If environmental taxes are well designed and implemented to exploit the advantages and secondary benefits described above, they could deliver a 'Double, Double Dividend' for policy-makers by achieving improvements in:

- the environment;
- innovation & competitiveness;
- employment; and
- the tax system.

However, realising these gains in practice is often difficult, as *Section 6* illustrates.

Why environmental taxes?

1 *Internalising external environmental costs* is the main reason for using environmental taxes instead of regulations. They incorporate the *costs of environmental services and damages* directly into the prices of the goods, services or activities which give rise to them. This also helps to implement the *Polluter Pays Principle* and to integrate economic, fiscal and environmental policies.

2 They create *incentives* for producers and consumers to shift away from environmentally-damaging behaviour, especially if they are reinforcing controls/permits and other elements of a policy package.

3 They can often achieve *more cost-effective* pollution control than regulations.

4 For producers they may act as a spur to *innovation*. When energy, water and raw materials, as well as solid, fluid or volatile emissions become taxed, taxpayers will develop new modes of production, transportation, housing, energy use and general consumption to reduce their tax liability. This helps to achieve more 'eco-efficiency'; to implement the *precautionary principle*; and to improve both sustainability and international competitiveness, where tomorrow's products depend on today's innovations.

5 They *raise revenues* which can be used directly to improve the environment; to give others incentives to do so; or to reduce other, more costly taxes, such as labour taxes, with the objective of increasing employment and overall economic welfare.

Table 3: An indication of multiple environmental impacts of some environmental taxes on 5th EAP environmental themes

5th EAP Themes	Carbon/ energy/ fuel tax	CFC tax	NO_x tax	SO_2 tax	Waste tax	Tax on Fertilisers	Tax differential on leaded petrol	Waste water charge
Climate change	●●	●	●		●	●		
Ozone depletion		●●						
Acidification	●		●●	●●		●		
Air pollution /quality	●		●	●	●		●●	
Waste management					●●			●
Urban issues (noise)	●							
Inland waters	●		●	●	●	●●		●●
Coastal/ marine waters	●		●		●	●	●	●●

Legend: ●● The main target of the environmental tax
● Other environmental themes where the tax will have secondary benefits

3. TYPES OF ENVIRONMENTAL TAXES

Policy instruments that rely for their effect on financial incentives rather than regulation are often called *economic instruments*. The OECD (1989) survey, *Economic Instruments for Environmental Protection*, distinguished five categories of economic instruments: 1) taxes and charges, 2) subsidies, 3) deposit-refund systems, 4) market-creation, and 5) financial enforcement incentives. The 1989, 1994 and 1995 OECD surveys identified taxes and charges as a major category of economic instrument in terms of impact and frequency of application.

The definition of the terms charges, taxes, fees, duties and levies may differ between countries and may even be seen as arbitrary. OECD (1995, p.7) says: "Defining the scope of the work is inevitably imprecise. Similar measures in different countries may be variously defined as taxes, charges, levies, fees or duties, and it is not the intention to enter into semantic discussions of the borderline between these concepts." Hence, this report adopts a simple classification of environmental taxes that is based on their policy objectives and which distinguishes between the main uses to which the revenues can be put. This classification is similar to that of OECD, 1989.

Types of Environmental Taxes

1. Cost-Covering Charges

The earliest experience of environmental taxes arose from the implementation of traditional regulatory environmental policy. Regulating emissions to land or water costs money. In accordance with the polluter pays principle, it seemed appropriate that the cost of regulation should be paid by those being regulated. Hence, the first category of environmental taxes, still important today, is that of cost-covering charges, whereby those making use of the environment contribute to or cover the cost of monitoring or controlling that use.

Cost-covering charges can be of two types:

- *User charges*, where the charge is paid for a specific environmental service. Example: treating waste-water or disposing of waste. E.g.: the Dutch pollution charge.

- *Earmarked charges*, where the revenue from the charge is spent on related environmental purposes but not in the form of a specific service to the charge-payer. Example: revenues to finance recycling services. E.g. the Swedish battery charge.

2. Incentive Taxes

An environmental tax may be levied purely with the intention of changing environmentally damaging behaviour, and without any intention to raise revenues. Such a tax may be termed an incentive tax. The level of an incentive tax can be set according to estimates of:

- the cost of the environmental damage (Pigou 1920);

- what price signal will be needed to achieve the environmental objectives (Baumol & Oates 1988).

Revenues are often used to further encourage behaviour change via grants or tax incentives. Examples are the Swedish tax on NOx and the German toxic waste charge.

3. Fiscal environmental Taxes

It may be that a tax will change, and be intended to change, behaviour but will still yield substantial revenues over and above those required for related environmental regulation. Such revenues may be used to finance budget deficits; or shift taxes away from high income taxes, or high non-wage labour taxes, towards taxes on the consumption of resources and environmental pollution: here called 'Green Tax Reform'. These Green Tax Reforms often consist of energy taxes

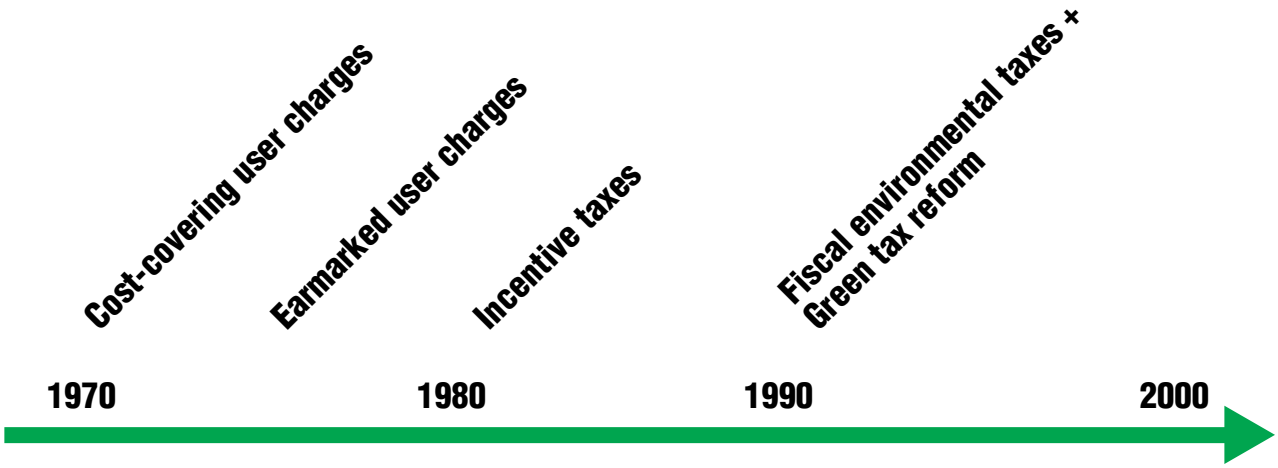
and several other non-energy taxes like taxes on waste, waste water, pesticides, fertilisers, and sulphur etc. Environmental taxes designed mainly to raise significant revenues are here called fiscal environmental taxes. Examples are the CO_2-taxes in Sweden and Norway.

Clearly these three types of environmental taxes are not mutually exclusive: a cost-covering charge may have incentive effects, as may a fiscal environmental tax, or the revenues from a fiscal environmental tax may be partially used for related environmental purposes. The motivation for the taxes may even alter over time.

However, classifying by main intention helps with the evaluation of effectiveness. *Figure 1* illustrates the general chronological evolution of taxes used for environmental purposes.

This report is concerned with taxes that are intended to benefit the environment. However, many taxes which were not introduced with the environment in mind nevertheless have an effect on it. Often this effect is unintended but it is no less real. For example, the taxation of energy that was very common in European countries before the environment was of concern, and which was motivated purely by considerations of revenue, will have reduced air pollution all the same. Similarly the subsidies of the EU Common Agricultural Policy may be intended to support farming in member countries, but insofar as these subsidies bring about the increased use of agricultural chemicals, and extend agriculture onto previously uncultivated lands, they are a cause of environmental destruction or degradation. Such taxes or subsidies that cause unintended effects are not the focus of this report. However, before considering new, environmentally motivated taxes it makes sense to see whether the environment can be improved by rationalising the current tax and subsidy system. The OECD has recently reviewed the environmental impacts of subsidies (OECD, 1996b).

Figure 1:
A general illustration of the chronological development of environmental taxes



4. WHO IS USING ENVIRONMENTAL TAXES?

This section briefly reviews trends in the use of environmental taxes and in the share of labour, capital, energy and environment taxes in total taxes and GDP; and reviews recent experiences with 'Green tax reforms'.

The rather limited progress in the use of economic instruments at the EU level since the Fifth Environmental Action Programme, 1992, and the Delors' White Paper on Growth, Competitiveness and Employment, 1993, can sometimes give the impression that these instruments have been more characterised by discussion and rhetoric than practice. However, such an impression underestimates the significance of the developments that have taken place at the national level during the last 5-6 years.

In a number of countries the use of economic instruments has spread widely, in particular in the Scandinavian and the Benelux countries, but also to some extent in larger European countries such as the UK, France, Italy, Austria and Germany. They have also started to be used in the transitional economies in Eastern Europe, as well as in the more advanced industrialised economies in Asia. The command-and-control approach established in the early phase of environmental regulation, following the Stockholm conference of 1972, is gradually giving way to a mixed policy approach including the use of incentive- and market-based policy instruments. In transitional economies, such as Poland, Hungary and Estonia, environmental charges and taxes, despite many implementation problems, are seen as a promising mechanism to integrate economic and environmental policies (OECD 1994a). However their current, quite extensive use in Eastern Europe is hampered by inflation, economic disruption and weak enforcement (REC 1994). In Asian economies with rapid industrialisation, such as Taiwan, Korea, Malaysia, Thailand and Singapore, market-based instruments have become frequently applied, over the last five years, alongside traditional command-and-control regulations (OECD 1994b).

At the EU level the Packaging Waste Directive has provided scope for individual member states to apply economic instruments in this field, until a more harmonised EU approach is defined. Harmonising tax policy in the EU is difficult. The EU is a supra-national institution in which the harmonisation of taxes requires unanimity among Member states, and while common environmental taxes, such as a Europe-wide CO_2/energy tax, would represent a step forward in the integration process, they have not received unanimous support. The present efforts at the EU-level are thus targeted towards improving the conditions for member states that wish to use economic instruments (EC, 1996 forthcoming). However, the EU has agreed upon minimum excise rates, and these are to be reviewed in 1996/1997 and this will provide an opportunity for further harmonisation.

Trends in the Introduction of Environmental Taxes

The OECDs' first review of the use of environmental economic instruments in member countries (OECD 1989) identified about 150 instruments in use in 1987, or 100 if subsidies, purely administrative charges and liability are excluded (OECD 1994c, p.22). However, the significance of these instruments was not very great. Only about a third may have had some incentive impact and the OECD 1994 review concluded: "Basically, then, in 1987 environmental policies in the OECD Member countries were command-and-control policies with some financial and economic add-ons" (p.177).

By 1994 the number of instruments had increased by over 50%, with the most growth in product charges and deposit-refund systems (the latter being outside the scope of this report). Moreover, five countries had introduced carbon or carbon-energy taxes (Denmark, The Netherlands, Norway, Finland and Sweden); four countries had conducted a limited green tax reform (all previously mentioned except Finland); eight had set up official Task-forces or Commissions to explore

further opportunities for such reform (e.g. Belgium, Denmark, Finland, Netherlands, Norway, Sweden, Canada); or for implementing environmental taxes in general; and a further six had announced an intention to make an increased use of economic instruments in environmental policy (OECD 1994c, p.188). And the United Kingdom had introduced a road fuel 'escalator' in 1993, rising duties by an average of at least 5% per year in real terms until further notice.

The purpose of the economic instruments was changing too, with an increase in the incentive function. In 45% of cases, the instruments appeared to have been designed for an incentive effect, although in most cases there was little or no evidence about whether the incentives were working.

It is clear that, at the national level in OECD countries, economic instruments in general, and environmental taxes in particular, are commanding much greater attention than they were 5 or 6 years ago. Given that the factors described in *Section 2* which stimulated consideration of environmental taxes are as relevant now as they were then, further action on environmental taxes may be expected.

For example, the introduction of environmental taxes on a *regional and local level appears to be increasing*. This has happened for example in many German towns, where a levy on packing material was introduced (the first was Kassel in 1994). Other examples are the reported water charge in the Netherlands (and also elsewhere, see *Section 5*), a tourism tax in Tyrol/Austria, and sewerage charges in Catalonia/Spain.

Environmental taxes might also play a more important role in future because of the *erosion of other tax bases*, such as capital, that has taken place during recent decades and which is likely to continue. Meanwhile expenditures have increased due to an increasingly costly and ageing population and the tasks of a welfare state. Governments are seeking ways of compensating for these tendencies, having recognised the limitations of further taxes on labour.

The other major developments since 1989 are the failure of the US Government to introduce its proposed BTU tax in 1994, and the failure so far to introduce the EU-wide carbon-energy tax, proposed in 1992.

Environmental Tax Revenues and General Trends of Taxation

The following figures show the development of taxes on the four production factors of labour, capital, energy and environment in the 15 Member States of the EU. Data are available for 1980 and 1993 only.[1)] The figures give an impression of the potential for the introduction of green tax reforms.

In the period 1980-1993 total taxes in the EU 15 (as percentage of GDP) have increased from 38% to 42% (see *Figure 2*). What were the main underlying trends? As shown in *Figure 3* taxes on labour is the main source of taxation (about 50%): this share has have been stable during the period 1980-1993. Capital was the second important source for taxation (almost 20%), but this has been declining. The share of taxes on energy and environment was relatively small in 1993 (5.2% and 1.5% respectively, *Figure 3*) but it is rising slowly.

[1)] The taxes were assigned to the production factors labour, capital, energy and environment. The assignment was discussed and agreed upon in several meetings of experts and academics from all Member States in 1994 and 1995, co-ordinated by the Task Force on statutory contributions and charges within DG XXI (Customs and Indirect Taxes). This task force publishes its results in Eurostat 1996. These tables are based on statistics provided by Eurostat 1995. But significant shifts in taxation took place after 1992/3, which will not be reflected in the figures.
The work is based on a study by Jarass/Obermair 1993/4 (see *Annex I*).

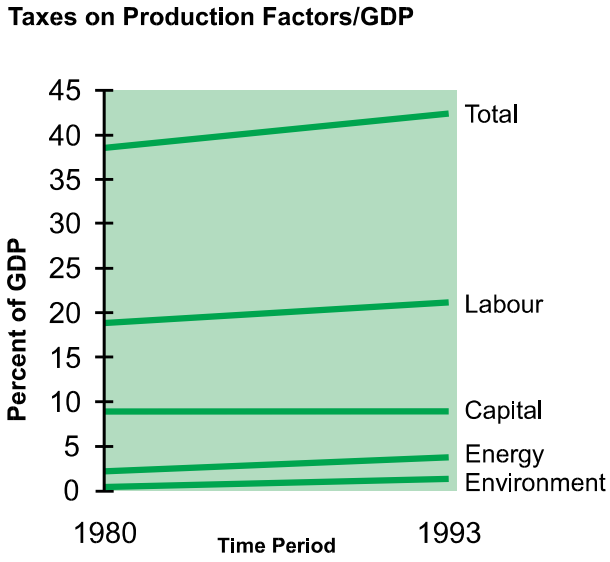


Figure 2

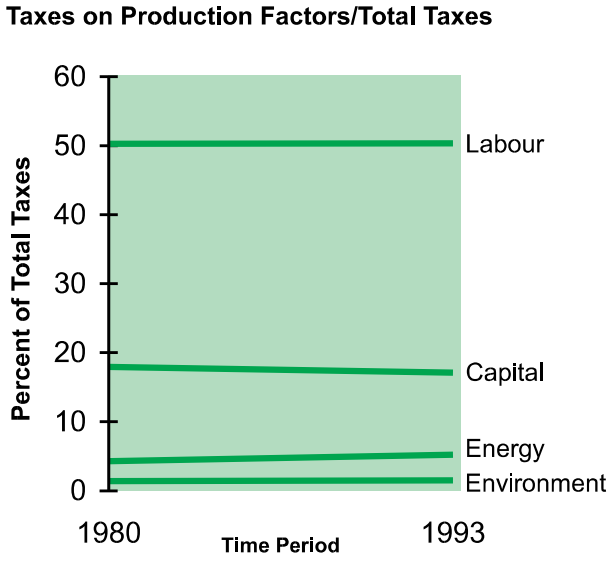


Figure 3

Two general observations can be made.

1 It is too early to appraise the Delors' White paper (1993) recommendation on shifting taxes off labour and on to energy and pollution.

2 The increase of energy and environment taxes is significant compared to labour and capital taxes. The latter two are directly linked with general GDP growth, which means that GDP growth will normally lead to higher taxes on capital and labour. This is not the case for taxes on energy and environment due to their decoupling from GDP. For example energy consumption and waste production - two important sources for taxation - show a smaller increase than GDP growth. A more active fiscal policy is needed just to keep their shares of total taxes. In addition, environmental taxes are often based on quantity instead of on prices and can erode in real terms, due to inflation. Linking these taxes to an index, e.g. the consumer price index, would give more predictable and less arbitrary price signals.

The following *Figures 4 and 5* show the share of environmental and energy taxes as against total taxes for each Member State of the EU 15. As far as any conclusions may be drawn from these figures southern countries had sharp increases of energy taxes, while those of other countries increased only moderately or even declined. With environmental taxes the picture is more varied.

As indicated earlier the work of DG XXI is based on a study by Jarass/Obermair 1993/1994. Since some inconsistencies and contradictions appear between the figures of DG XXI and Obermair/Jarass (*Annex I*) a manual has been developed by Jarass/Obermair (1996) on behalf of DG XI (Environment) and Eurostat, in which a consistent way of assigning the taxes to the various production factors is proposed. This manual was developed in co-operation with experts from DG II, DG XI, DG XXI, Eurostat and several Member States. It may serve as a common basis for future assessments of tax developments.

Green Tax Reforms

The general trends in taxation show no or only a small increase of taxes on energy and the environment. However, several countries aim to shift part of the tax burden away from distorting taxes on labour or capital, and onto on energy and the environment. The recent experiences of Sweden, Denmark, Netherlands and Norway are briefly described on page 27.

Figure 4

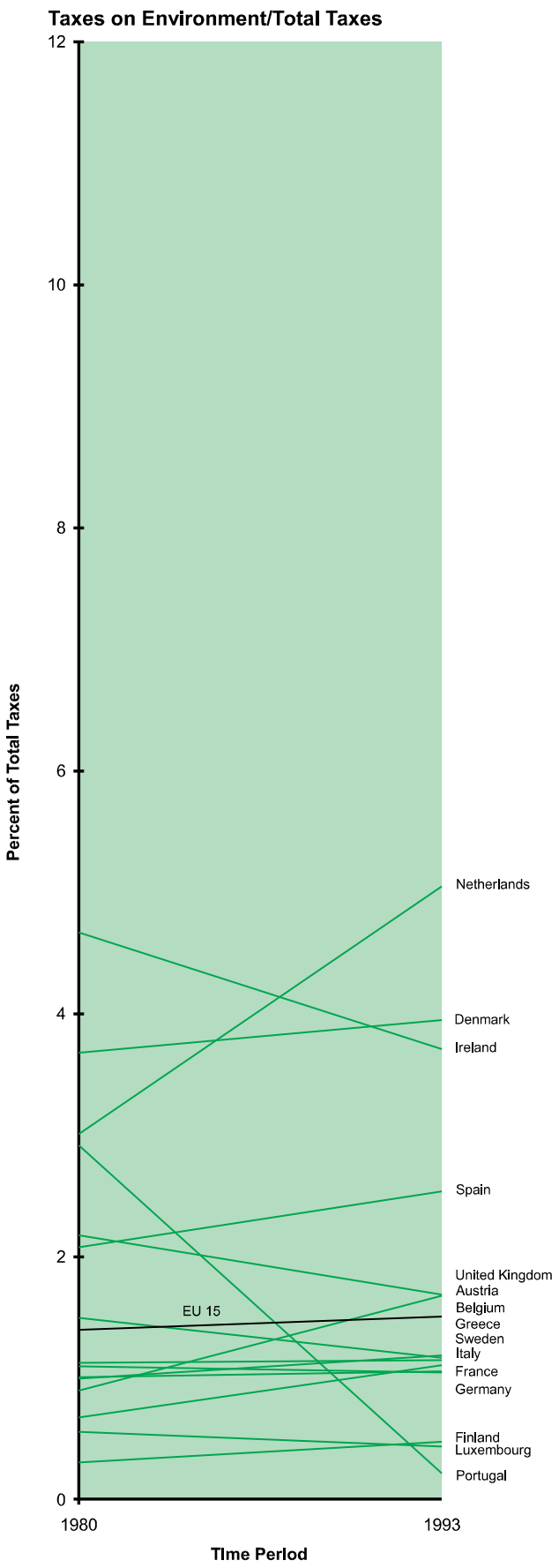
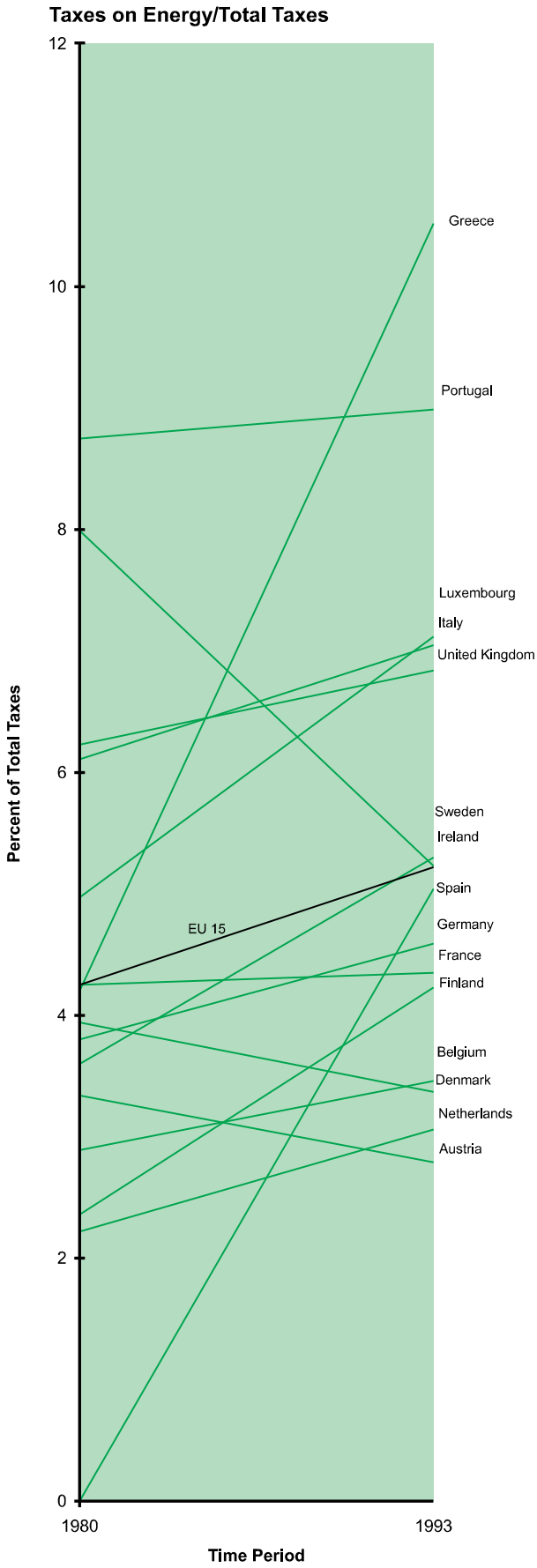


Figure 5



Denmark
An essential part of a major tax reform passed in 1993 was the redistribution of taxes from labour to natural resources and pollution. The reform provided for marginal income taxes to be lowered by about 8-10 per cent from 1994-1998, and for the phasing in of new green taxes worth DKK12 billion. Increased gasoline and energy taxes account for the greater part of the increased revenue, but about 1/3 arise from an increase of the waste charge and a new water supply tax (Andersen 1994b).

Denmark had already introduced a CO_2 tax in 1992, also on industries, and with effect from 1996 this tax is increased considerably. The new tax shift is based on the principle of revenue neutrality, and the revenue from the increased CO_2 tax is returned to industries, e.g. by means of a lowering of social security contributions and for energy savings purposes. The government has signalled its intention to analyse the possibilities for a further tax shift (MOF 1995).

Sweden
Sweden was the first country to implement a tax shift from income taxes to taxes on energy and pollution. Although an energy tax had been imposed since 1974, a new CO_2 tax was introduced in 1991 together with the imposition of VAT on energy. In addition environmental taxes on NO_x and SO_2 were introduced (Sterner 1994, OECD 1994d).

The tax shift was an important component of a larger tax reform. The total redistribution of the tax burden was equivalent to 6 per cent of GDP, while the tax shift between labour and energy accounted for 4 per cent. The background for the tax reform was first of all the need to lower high marginal tax rates on labour income, but climate change also played an important role. With the CO_2 tax Sweden intended to set a good example for other countries to follow.

At the time when the reform was undertaken it was expected that more countries would soon introduce carbon-energy taxes or similar measures on industrial energy use. The Swedish government gradually realised that this could take a long time, and in 1992 the energy tax burden was partly shifted from industry to households. The CO_2 tax was reduced to 25 per cent of the normal rate and the energy tax component was abolished, but the tax burden was not shifted back to labour. Instead carbon-energy taxes on households were increased. Reflecting the recent more widespread practice of carbon-energy taxation, the Swedish parliament has recently proposed to increase the CO_2 tax to 50 per cent of the original level.

But also several non-energy taxes have been applied like taxes on fertiliser and pesticides, beverage containers and batteries. A tax on HC and NO_x has been levied on domestic air transport since 1989.

In spring 1995 a parliamentary commission was established to evaluate the existing system of energy taxes and environmental charges, and to see whether there is potential for another revenue-neutral shift of the tax burden.

The Netherlands
The Netherlands' Green Commission was established by the State Secretary of Finance in 1995, to prepare proposals for a greening of the tax system which could come into effect within the next two years. The Green Commission consists of senior politicians, high-ranking civil servants, university professors and representatives from trade, industry and non-governmental organisations (NGOs).

The Commission has prepared three reports, of which two already have been released. The first report, released in late 1995, reviewed existing tax arrangements in particular in the transport sector, and recommended to change these, e.g. by reducing the purchase tax on fuel efficient private vehicles. The second report, released in spring 1996, investigates the possibilities for raising existing environmental taxes, and concluded that the role of energy taxes is pivotal in this respect. It also recommends deductions for environmentally friendly investments. In this recent report, it was evaluated that the CO_2-tax, in existence since 1980 in several forms, reduced the national level of CO_2-emissions by 1% in 1994 (Dutch Commission 1996). A third and final report, to provide a more long-term proposal for a greening of the tax system, is expected in autumn 1996.

Norway
A Green Tax Commission, established by the government, has been working since 1994 to review the relationship between different systems of taxation, and will submit its final report in mid-1996. The intention is to propose changes in the present tax system, giving it a more 'green' profile. The Commission consists of high-ranking civil servants, the social partners, NGOs and members of the academic community. Statistics Norway is also represented and plays a key role in modelling the effects of a tax-shift.

The Commission has applied a broad approach, and analysed distortions of present taxes as well as 'green' taxes proper. Subsidies, also termed 'negative green taxes', have been under particular scrutiny. Norway's CO_2 tax which was introduced in 1992 is presently one of the highest that is applied to industries, and the 'first mover'- role of Norway is also under discussion in the Commission. Preliminary calculations produced for the Commission indicate that there may well be further room for unilateral action (a NOK220 increase of the CO_2 tax per ton) in terms of a revenue-neutral tax shift, without harming the employment or competitiveness situation. Measures assume a binding climate agreement and that other countries sooner or later follow suit. The Commission is also analysing the possibilities for a 'double dividend' from unilateral action (Moe 1996 forthcoming).

5. DO ENVIRONMENTAL TAXES WORK?

This section defines effectiveness; summarises the findings of the 16 available studies of environmental effectiveness, and recommends improvements to the evaluation of taxes.

Definitions of Effectiveness

Taxes might be called effective if they do what they are supposed to do. In theory, environmental taxation should attempt to improve the market efficiency of the environmental goods and services by imposing a price on such goods equal to the marginal costs of their use (marginal environmental damage costs). If authorities manage to calculate these costs, environmental taxation is inherently effective, provided that no other major imperfections distort the relevant markets. Good knowledge of marginal environmental damage costs is an exception, however. Only one example is known where authorities are explicitly basing the tax rate on an estimate of these costs[2].

As shown in the definitions in *Section 2* environmental taxes can have different functions:

- cost-covering
- incentive effects; and
- revenue raising.

For these functions, the concept of 'environmental effectiveness' needs to be defined. For assessing the effect of taxes, two criteria may be substituted for the theoretical criterion of equality of tax rate and marginal environmental damage costs:

1. The effect of the tax on environmental pollution or the use of scarce resources (*environmental effect*);
2. A comparison of the tax rate with the marginal pollution abatement costs, or, as a proxy, average abatement costs of measures, taken by tax payers (*incentive effect*).

[2] The UK landfill tax, to be introduced in October 1996

These criteria can be used to assess a similar impact in different ways. The first criterion directly attempts to trace the contribution of the tax to the monitored pollution reduction, whilst the second criterion endeavours to establish incentives for the taxpayer to change their behaviour in a way more favourable to the environment often by adopting abatement measures or by saving on scarce resources.

Pollution reduction goals are often not set explicitly, or price incentives are not explicitly intended. This may be the case for all types of taxes, but especially for fiscal environmental taxes and for cost-covering charges. This makes evaluation more difficult, and qualitative rather than quantitative.

Assessing the cost-effectiveness of policy instruments is even more difficult. As data is usually deficient, no such evaluation is attempted in this report. However, some overall observations on policy effectiveness are made in *Table 1* (see *Executive Summary*). In evaluating the environmental effectiveness of taxes their functions need to be taken into account.

The main function of fiscal environmental taxes is raising income for government expenditures. Environmental effects are a side effect. However, positive environmental impact may be expected because of the price effect on behaviour. Consequently, evaluating the environmental effectiveness of this type of tax involves examining the environmental effects, e.g. in terms of pollution reduction.

Incentive taxes are designed to achieve a specific environmental impact. So the evaluation of environmental effectiveness includes comparing pollution reduction targets. It also involves measuring the incentive effect by comparing the differential between the tax rate and the cost of pollution reduction.

Cost-covering charges are primarily designed to raise funds for financing specific environmental systems, measures or programmes. Two types have been defined:

- the user charge and
- the earmarked charge.

In both cases, funds raised are a major objective, so effectiveness evaluation involves assessing the money available for carrying out the environmental measures or programmes. However, cost-covering charges may also have an incentive impact if charge rates for cost recovery reach substantial levels[3]. Incentive effects are sometimes aimed for in cases where formerly fixed rates for certain environmental services were differentiated according to the level of the service rendered[4].

Review of Studies on Effectiveness

Drawing firm conclusions about actual environmental effectiveness of green taxes depends on the availability of *ex post* policy evaluation studies. The study for the OECD concludes that there is little tradition in policy evaluation (OECD 1996 forthcoming). A practical reason is its complexity. These studies normally have to cope with difficult methodological problems as well with problems of data availability. Ideally they should also be independent of the institutions responsible for the design and use of the taxes.

Methodological issues include disentangling the tax effects from other elements in the baseline and the policy package and answering and the counter-factual question 'What would have happened without the tax?'. For these purposes a reconstruction is needed of all the relevant economic, environmental and societal factors and their mutual relationships in a quantitative or qualitative dynamic model. The reinforcing or possibly counteracting effects of other regulations on the tax scheme must be taken into account. New tax schemes almost always enter a policy field already crowded with other players: permits, standards, bans, agreements, etc., so isolating the exact contribution of the tax scheme requires an in-depth study which is rarely done: An exception is water pollution charges (Andersen 1994a). More such studies are needed.

Data availability plays a crucial role in policy evaluation. Data is often difficult to retrieve retrospectively; it may not have been kept long enough, or is not detailed enough, or is simply not suitable because it has been collected for other purposes, such as tax registers. Reconstruction can be a laborious job.

The time factor is also crucial in evaluation. Both taxes and regulations can take up to a decade or more to be effective so the time periods estimated, and needed in practice, to achieve a given level of impact need to be included in tax design and implementation.

Despite these difficulties a number of evaluation studies of environmental taxation have been conducted, of varying quality and independence, but covering sixteen environmental taxes, applied in at least six countries. However, judgements about the performance of green taxes remain at the level of best guesses.

Findings

Table 4 summarises the main findings in terms of effectiveness of the taxes/charges (environmental effectiveness and incentive effectiveness). Within the limitations discussed earlier, *Table 1* (see *Executive Summary*) tries to give an additional qualitative assessment of the effectiveness of the taxes, and adds some remarks on the functioning of the taxes.

[3] This has been reported by several authors who examined the Dutch water pollution charge.

[4] Variable charge rates for household collection (e.g. "pay-per-bag" schemes) are an example.

The diffusion of taxes over various environmental policy fields is wide-spread. Such instruments are found in water and air quality policy and in waste management. Their role in noise abatement policy is marginal. *Annex II* provides more details on the reviewed taxes.

Half of the taxes/charges considered in this report were reviewed in a Swedish policy evaluation study. Water pollution charge systems (France, Germany, the Netherlands) have been reviewed quite thoroughly. A number of studies - on the Danish waste charge, the Dutch waste and groundwater taxes and the Swedish environmental taxes - are pending.

As far as *environmental effects are* concerned, incentive charges and fiscal environmental taxes on air quality in Sweden, and on water pollution charge in the Netherlands have worked well. The tax differentiation schemes for fuels have been particularly successful, as has the Swedish NO_x charge. For the CO_2 taxes reviewed to date (Sweden and Norway) positive impacts have been found.

- The *incentive effect* of taxes has been studied in a few cases only. It appeared from the Swedish evaluation study that the tariffs on sulphur dioxide and nitrogen oxides were at levels which encouraged less polluting courses of action. In the water pollution charge schemes provisions for financial assistance were reported to be of great importance for adopting wastewater treatment measures (France, Germany, the Netherlands). In the Dutch case the charges themselves were found to exert an incentive effect due to high charge levels.

- *Incentive charges* are of a variable nature. As shown in *table 4* several taxes like the Swedish NO_x charge and the German toxic waste charge, are functioning quite well. Most of the schemes also have a fund raising capacity. Environmental effectiveness then is the resultant of incentive and revenue raising effects. This is reported to be positive to variable degrees for the water pollution charge systems. The impact of the fertiliser charge (Sweden) is less clear.

- The *overall effectiveness* of environmental taxes seems to be positive and even high in some cases. Policies on air quality in Sweden and water quality in the Netherlands have been well supported by taxes.

- As regards their functions the performance of the various types of taxes is variable. The main function of *fiscal environmental taxes* has not been studied. However, most of these taxes were reported to have a positive environmental effect.

- Most *cost covering charges* served their objectives, collecting money for pre-set purposes quite well.

Table 4 Evaluated taxes, their functions and effectiveness

[5] Incentives for producers and consumers.

[6] Not all sulphur emissions are taxed in this way The percentage reduction of the lower, taxed emissions of sulphur is much higher, but a figure is not available.

Instrument	Environmental function	Environmental effects	Incentive effects[5)]
Fiscal environmental taxes			
Sulphur tax (S)	To increase penetration of low-S fuels and adoption of S-abatement measures	Reduction of 6,000 tons of S corresponding to 6% reduction of total S emis- sions[6)]; reduction of S content of oil by 40% on average; ¼ of tax payers reduced S emissions by 70% on average	Average abatement costs were about SEK 10, lower than the tax rate of SEK 40 therefore strong incentive effect.
CO_2-tax (S)	To reduce CO_2 emissions	Hard to evaluate due to short period of operation; possible shift in fuels and in- creased competitiveness of combined heat and power plant	Unknown
CO_2-tax (N)	To reduce CO_2 emissions	CO_2 emissions dropped by 3-4% in 1991-1993 from a rising trend	Price of heating oil increased 15% and price of petrol increased 10%; otherwise unknown
Tax on domestic flights (S)	To reduce emissions by nationally operated air transport	Unknown, but most likely very small	Unknown
Waste charge (DK)	To reduce waste generation and increase recycling and reuse	Reused fraction of demolition waste increased from 12% to 82%; contributed to an increase in reuse and recycling rate of 20-30% between 1985-93	Tax rate doubles average cost of waste dumping and increases cost of incineration by 70% on average; otherwise unknown
Incentive charges			
Tax differentiation on leaded petrol (S)	To increase penetration of unleaded petrol	Emissions of lead dropped by about 80% between 1988-1993	Tax differential exceeds additional production costs of unleaded petrol
Tax differentiation for diesel (S)	To increase penetration of low-pollution diesel fuels	75% reduction of S emissions by diesel cars; 95% in cities; reduced emissions of particles, smoke, NOx, Hydrocarbons and PAC expected but not quantified.	Tax differential higher than additional production costs of classes I and II
Toxic waste charge (D)	To reduce the amount of toxic waste	Reduction of toxic waste production of 20-45% between 1991-93.	Tax rate increased average dumping and incineration costs by at least 5-15%.; rate doubled in 1993 increasing this cost to 10-30%; otherwise unknown.
NO_x-charge (S)	To speed up reduction of NO_x emissions form large combustion plants	Main cause of the reduction by 9,000 tons in 1992 (35% of liable emissions)	Charge rate of SEK 40 exceeds average abatement costs of SEK 10
Fertiliser charge (S)	To reduce the demand for fertiliser	N down by 25%; P down by 65% between 1980 and 1992; charge was one of the factors	Unknown
Water pollution charge (F)	To stimulate adoption of in-plant wastewater treatment measures and building of treatment plants	Modest	Charge rate considerably lower than average pollution abatement costs
Water pollution charge (D)	To support adoption of water pollution abatement in permit application process	Early announcement contributed to stepping up construction of wastewater treatment capacity	Original relation between charge rate and marginal abatement damage costs were not implemented
Cost-covering charges: user charges			
Water pollution charge (NL; non-State)	To finance wastewater treatment plants	Water pollution (BOD) down to 5% of households and to 4 million i.e. from industry	Average charge slightly lower than average pollution abatement costs
Household waste charge (NL)	To promote a fair distribution of waste management costs over users	10-20% less household waste supply in 'pay-per-bag' villages	Unknown
Cost-covering charges: earmarked charges			
Battery charges (S)	To cover costs of collection and disposal and of information	Collection rate of lead-batteries 95%; decreasing share of small Hg and NiCd batteries	Charge renders recycling of PB-batteries feasible
Aircraft noise charge (NL)	To finance insulation and redevelop- ment programmes around airports	Insulation of buildings around airport areas	Very low

Future Evaluation

It is clear from this brief review of the evidence on the evaluation of environmental taxes that evaluation needs to be build into the process of designing and implementing the taxes so that both methodological and data availability problems can be minimised. The OECD has recently considered this question in some depth (OECD 1996, forthcoming) and *Table 5* summarises some of the information and design features that will help improve future evaluation studies. A checklist for successful implementation can be found in the Executive Summary. Effectiveness depends of course on successful implementation and this issue is discussed in the next section.

Table 5: Linked policy process and evaluation procedure

Stage	Policy process	Link	Stage	Evaluation procedure
1	Identifying and defining the environmental problem			
2	Discussing the need for policy intervention and setting objectives			
3	Designing and assessing effective and efficient options (instruments or instrumentmixes)	→ ←	1	Description of the instruments and of the institutional context, definition of relevant internal and external factors; (baseline inventory)
4	Selecting, discussing and adapting instrument chosen	→	2	Definition of evaluation criteria
			3	Construction of evaluation model and definition of all data to be gathered
5	Introduction of instrument (mix), implementation of control and enforcement	→	4	Continuous collection of data and reassessment of influential factor, and ex post evaluation
			5	Possible adaptation of the evaluation model, evaluation criteria and data
6	Possible modification of instrument (mix) after evaluation	←	6	Conclusions, recommendations and feedback into the policy process

Source: OECD 1996, forthcoming, table 9.1., p.115.

6. IMPLEMENTATION: BARRIERS AND SOLUTIONS

This section deals with the main barriers to implementation such as competitiveness, impacts on low-income groups, and legal aspects. Potential means to mitigate negative impacts, e.g. via policy packages are discussed.

Competitiveness

The impact of previous environmental taxes and regulations on competitiveness has been reviewed by OECD, who concluded that: "The trade and investment impacts which have been measured empirically are almost negligible" (OECD 1996a, p.45). However, most taxes implemented so far have been relatively small and insignificant in relation to regulations, and future taxes, particularly energy taxes, may damage competitiveness if the increase in costs from the tax has to be absorbed by price increases, or by profit reductions. In highly competitive markets even small increases in costs can be damaging, particularly for specific sectors, firms or regions.

Taxes on emissions will mainly affect the competitiveness of domestic companies compared to foreign companies whilst taxes on products can also affect foreign producers, and therefore may conflict with the internal market of the EU or with the World Trade Organisation rules.

The impact of taxes on competitiveness may also affect the environment. For example, if the tax leads to the relocation of production, with its associated environmental impacts, it could just shift the environmental damage elsewhere. Of course, if the taxed environmental effect is purely local, then the country levying the tax and possibly losing the business through relocation will experience local environmental improvement, and the country to which the activity is relocated may experience environmental deterioration. If the environmental effect is global (e.g. climate change from CO_2 emissions) then the reallocation of emissions from one country to another may mean that there is no environmental gain from the tax at all. Indeed, there could be environmental losses if the non-taxed ('free rider') country's CO_2 efficiency is worse than the taxed country's.

The impact of new and significant energy taxes on competitiveness has been extensively reviewed, with the results of ex ante studies varying from small and positive to large and negative, depending mainly on the modelling, how the revenues are recycled, and the extent of exemptions and delayed implementation for energy intensive sectors. The OECD has concluded that: "Probably all that can be said with confidence is that the effect of a carbon tax policy on competitiveness could be substantial" (OECD 1996a, p.42).

Many studies have shown that whilst well designed energy taxes can improve the *overall* competitive position of a country, the impact on particular *sectors and regions* can be negative. Countries introducing carbon or energy taxes have taken this possibility seriously.

Competitiveness for Whom?

The existing price and tax systems in OECD countries are generally very favourable to the fossil fuel industries because of the failure to incorporate environmental externalities into prices (World Energy Council, p. 7). This puts renewable sources of energy at a competitive disadvantage, although some countries have introduced 'infant industry' help to stimulate their development, such as in the UK where a levy on fossil fuels helps to support renewable energy industries. However, 92% of this levy finances the decommissioning and some other costs of the nuclear industry. In many countries energy supplies are obliged to buy electricity produced by independent producers mainly based on renewables, (Eursolar 1996, p. 7).

Many firms involved in the energy efficiency and renewable energy sectors, and those firms who are not energy intensive, such as telecommunications, retail and personal services, would be net gainers from energy tax schemes with revenue

recycling[7]. So any analysis of competitiveness has to address the question of winners and losers.

Innovation and Competitiveness

Environmental taxes, like regulations, may enhance competitiveness, via the spur to innovation mentioned in *Section 2*. Several authorities consider that environmental regulations and other stimulants to technical change, enhance innovation. (Porter, 1995). If the direction of change is to be followed elsewhere in the world then the countries and companies that tax or regulate first may achieve 'first mover' advantages. The Delors' White Paper in 1993 argued that a tax shift from labour to the environment would secure improved competitiveness: "The Community would improve the overall strength of the economy through optimal use of its resources and the prevention of costly clean-up operations, while a first-mover advantage can be exploited; the latter element is not to be underestimated as the new technology is not only a necessity in the industrial world but also in the NICs and LDCs" (EC 1993, p. 147).

It may be significant that Denmark, Norway and The Netherlands which has significant environment taxation are the top three most competitive European countries, according to a recent report. (Institute for Management Development, 1996).

Mitigating adverse competitiveness effects

There are usually trade-offs between minimising the potential negative impacts on competitiveness, maximising the environmental gains, and improving overall welfare. For example, the worst polluters may be exempt from say energy taxes whilst less polluting sectors are taxed. Although this may be necessary from a political or welfare point of view, it is likely to be less environmentally satisfactory.

1. Exemptions

The European Commission's 1992 proposal for a CO_2-energy tax exempted the six most energy intensive sectors and was made conditional on a similar energy tax being imposed in other major OECD states. In the amended proposal in 1995 the exemptions remained, but the condition-clause was dropped. Four of the five European countries which have introduced carbon-energy taxes since 1990 (Denmark, Finland, the Netherlands, Norway, Sweden) have exempted or partially-exempted their energy-intensive industries from these taxes. The Finnish CO_2-/energy tax does not include any exemptions from the general tax rate of energy intensive industries. *Table 6* shows the year of introduction of the carbon taxes and the level of revenues that either have been or are expected to be raised by them. It also shows the substantial difference, except in the case of Finland, between countries' *nominal* carbon tax rates, and the *effective* rates once the various exemptions, mainly for industry, have been taken into account. The nominal rates give the rate that has to be paid by the tax payers , whilst the effective rates are taking into account exemptions and different tax burdens on sectors.

Great care must be taken in interpreting *Table 6*, because the overall taxation of energy in those countries is far more complex than it suggests. This makes it very difficult to compare countries' overall taxation of energy and impacts on competitiveness.

Some exemptions from energy taxes are conditional upon investments in energy efficiency, as in Denmark and The Netherlands.

[7] E.g. crafts sector would profit twice: 1) by the use of revenues for lowering labour taxes and 2) by the increasing need to insulate houses and install new energy technologies . But many studies as well as public discussion seem to overemphasise the potential loses of only a few sectors instead, the potential benefits arising for winning sectors may appear to be underestimated. A lack of awareness therefore and a general fear of new taxes (even if others are decreased) may be an explanation for this unbalance.

Table 6: Carbon (or carbon/energy) taxes in five European countries and effective tax rates after exemptions/reimbursements

CO_2 taxes	First year of introduction	Revenue raised million ECU (year)	1993 carbon tax rate, USD/tonne CO_2	
			nominal	effective
Denmark	1992	441 (93)	57	25
Finland	1990	415 (95)[1]	13	13
Netherlands	1990[2] 1996[3]	672 (95)[1] 1008 (98, est.)[1]	na 6-16	na na
Norway	1991	744 (94)	205	74
Sweden[4]	1991	1397 (95)	192	120

1 This revenue comes from a combined energy/CO_2 tax.
2 This is the fuel (50% carbon/energy) tax.
3 This is the small users' energy tax.
4 Apart from domestic air travel. Sweden is the only country to levy a tax on fuel use in domestic flights, although it is reconsidering this.
na not available

Sources: EF 1996 forthcoming, except nominal and effective carbon tax rates from Haugland 1993, Figure 13, p.30

2. Border Tax Adjustment

Environmental tariffs can ensure that imports pay a similar level of tax to domestic products, thereby neutralising any competitiveness effects in the domestic market, while export rebates can ensure that the taxed domestic industries' ability to compete abroad does not suffer. However, calculating appropriate tariffs on imports, especially when the environmental tax base is an industrial input, such as energy, rather than a final product, is difficult, and easily interpreted, rightly or wrongly, as protectionism.

Border tax adjustments may run counter to international trade rules (designed to prevent protectionism), especially where, because of a focus on industrial inputs or processes, they end up treating domestic and foreign products differently. However, the US tax on chloroflourocarbons (CFCs) is levied on imports on the basis of calculations of CFCs used as content as well as in the imports' manufacture, (Hoerner 1995 p.185-199). CFCs may be a special case both because they are the subject of a widely supported multilateral environmental agreement, and because they are due to be phased out rapidly anyway. It is likely that import tariffs based on carbon or energy contained in imported products would not be so readily accepted.

3. Tax-free thresholds

Initial consumption of energy or water can be free of tax, but with rising taxation of higher levels of consumption. This can lessen the impact of the tax on small firms whilst increasing the incentive to be more efficient with the taxed commodity. The Netherlands energy tax has been designed this way for both small firms and households.

4. Recycling of Revenues
The tax revenues may be used to support environmental expenditure by tax payers through grants, other payments or tax incentives, as with Swedish NOx tax, or they may be used to finance reductions in other taxes on labour or capital, as in The Netherlands and Austrian energy tax proposals, or the UK landfill tax. This then provides the 'carrot' of revenues as well as the 'stick' of the tax. This targeted recycling of revenues 'earmarking' is crucial to the success of 'green tax reforms', and explains much of the difference between the results of studies into such reforms.

The detailed study of the experience of water charges in four countries by Andersen (1994a) supports the view that earmarking is important . Andersen (1994a, p.210) concludes: "A closer examination of the differences between these two instruments (fiscal and earmarked taxes) ought to be high on the agenda of the environmental research community. On the basis of the Dutch and French experiences we can conclude that even modest earmarked taxes are in practice significantly more effective than the conventional view would lead us to assume."

5. Reforming energy cost provisions in Business taxation
In theory, the business tax system could be reformed to provide incentives to use less energy by not allowing energy costs to be exempt from tax as a business expense, except for high energy users, and by providing a tax free portion of total costs to all other firms. If, for example, the tax free amount was 5% of total costs and the average energy cost was 2.5% of total costs, then most firms would gain and have a continuous incentive to further reduce energy costs since profits from energy savings would be tax free (Bund-Laender-Arbeitskreis-BLAK,1993). This may be a more elegant way of exempting high energy users, whilst providing incentives to other firms, than by using an energy tax. However, government revenues may be needed to finance this reform.

6. International Harmonisation
Many of the measures needed to mitigate competitiveness impacts would be unnecessary if there were harmonisation of environmental taxes at EU and even OECD or global levels. However, this seems difficult to achieve, though action to improve EU co-operation is recommended below.

Equity and the existing price and tax system

Low income consumers and households are potentially vulnerable to environmental taxes because they spend proportionately more of their income on some environmentally sensitive goods, such as energy or water, than do richer groups. For example, studies by Pearson & Smith (1991) have shown that the EC carbon-energy tax would be regressive unless compensatory measures were taken. However, this study only showed regressive effects in Ireland and the UK; in France, Germany, Italy, the Netherlands and Spain the proportion of carbon tax payments to household total expenditures is hardly related to income, if at all (Pearson & Smith 1991, Figure 5.2, p.43).

These possible distributional effects on low income groups warrant serious political attention when taxes on energy, water or similar essential taxes are being designed, if public support for these taxes is to be secured. The inability of the British Government in 1994 to raise VAT on domestic fuel from 8% to 17½% was at least partly due to concerns about the impact of this tax increase on the poor. In retrospect, a policy package that included more measures to offset the regressive effects of the tax and which accompanied the announcement of the tax might have made the tax easier to introduce. An impressive compensatory package was only offered when opposition to the tax was already strong.

The means of mitigating any regressive effects of energy or water taxes, or transport taxes in rural areas, are varied and are very specific to the tax and benefit systems of particular countries,

but two examples will illustrate the potential for overcoming these problems.

a The *Dutch small energy users' tax* **,** introduced in 1996, was designed specifically to address the distribution of the tax burden. Revenues are recycled separately to businesses and households, corresponding to their respective tax payments. For businesses, the recycling is mainly achieved through a reduction in employers' non-wage labour costs and corporation tax. For households (but also for businesses), a tax-free threshold of energy use has been introduced, which avoids a regressive burden on low-income households. In addition, households get income tax relief such that an average energy user in each of four income groups will be made no worse off from the tax (higher and lower than average energy users in each group will be worse and better off respectively). This transparent and specific revenue-neutrality, with regard to particular groups as well as overall, seems to have contributed substantially to the tax's acceptability in The Netherlands.

b Similar tax free thresholds could be introduced for the initial consumption of other 'essentials' such as water, with taxes on higher consumption serving to stimulate more efficient use, e.g. *the water tax at Setúbal in Portugal.* This has a progressive scale for charging households for both water consumption and waste-water treatment. For a monthly water consumption of 25 cubic metres (m^3), the first 5 m^3 are charged at PTE67.5 per m^3, the next 10 m^3 at PTE102.5 per m^3, and the next 10 at PTE 162.5 per m^3 (EF 1996 forthcoming). Such a progressive scale clearly prevents charges bearing too heavily on the essential use of water. These measures are also applied in most parts of Portugal.

The design of environmental taxes needs to take into account the existing price and tax systems. As we have seen in *Section 2*, the distribution of environmental externalities is often uneven, with low income groups, or children, bearing proportionately more of the costs of environmental pollution than other groups. A well designed environmental tax could help remove some of these inequities and improve overall economic welfare. Similarly the existing tax systems could be regressive, once evasions, exemptions, tax avoidance and the actual take-up of allowances are taken into account, thus enabling environmental taxes to improve overall equity. For example, a recent analysis of the commuting tax allowance in Denmark indicated that the lion's share of the tax allowance fell in metropolitan areas (Krawack 1995). Despite the existence of reasonably good facilities for public transport, many wage earners, especially in the more affluent districts, prefer to go to work by car. In the suburbs of Copenhagen more than 30 per cent of the wage earners benefit from the tax allowance, while only 14-17 per cent of the wage earners in the rural western part of Denmark do so. One third of the total tax allowance, which amounts to DKK3,5 billion annually, benefits company managers and higher ranking salaried workers, while low-income workers receive only 16 per cent of the total allowance.

Legal, institutional and administrative aspects

Market failures, market structures and subsidies and cultures and EU-rules can provide countervailing pressures, or perverse environmental incentives, that can undermine or even neutralise the intended effects of environmental taxes.

1. Market Failures

Markets for environmentally sensitive goods are often complex, involving much more than the price. For example, the market for energy efficiency can fail to work well because of information gaps; a demand for short pay-back periods; tariff structures that encourage energy supply rather than energy saving; poor access to capital; and the landlord/tenant problem, where neither party

gains sufficiently from energy efficiency to make it worth-while to invest in it. If most of these factors are working to discourage energy efficiency then a tax to encourage it would need to be unnecessarily high. A comprehensive approach to market failure, which addresses these 'transaction' and other costs, is therefore needed.

2. Environmentally perverse subsidies and tax allowances

Any subsidies on intensive agriculture, fossil fuels, or road and air transport will act to counteract the effect of a tax designed to improve the environmental impact of those activities. The aviation industry, despite its significant environmental effects, is exempt from both VAT and energy taxes. The maritime industry is similarly exempt, but its environmental impact is less than that of aviation. Current studies are pointing to the need to bring the aviation industries within the field of environmental taxation (Stichting Natuur en Milieu & Delft University, 1996 forthcoming; Swiss Environmental Transport Association 1996; Barret 1991). The size of these perverse subsidies could mean that their reform would often be the most cost effective place to start improving the environment. Similarly tax allowances that encourage, say, car commuting, will undermine a fuel tax designed to discourage commuter car use.

A recent study by the OECD gives a comprehensive overview of problems, in particular for the environment, that occur from subsidies. It may be useful looking closer at subsidies before implementing environmental taxes. The OECD concludes: "there *is* reason to believe that there exist *some* subsidies/tax concessions whose reform or elimination could lead to both environmental and economic benefits." (OECD 1996b, p.19-20).

While in some member states the full costs of public sewage treatment plants are passed on to the polluters by means of user charges, other member states offer a considerable discount on the user charges through state subsidies (RIZA 1995). While the use of state subsidies might be justified in cohesion countries, which, as newcomers in the EU, have an implementation gap, the need seems less obvious in member states with a more mature record of membership. Nevertheless funding from the Cohesion, the Structural or the Regional Fund should not be taken as an excuse for not charging polluters with full costs.

In particular the study found that there are state subsidies in Belgium and Germany. Prices for discharging waste water vary considerably across Europe. For two similar industries the waste water charge bill (advanced treatment) with a location in the Netherlands is 15500 ECU, while in Germany it is 4458 ECU. In Portugal subsidies are significant. Irish local authorities have been more keen on covering the actual costs by means of the charges (Convery & Rooney 1996 forthcoming).

The study concludes that countries with full cost-coverage tend to have better extended sewage treatment systems, whereas countries that depend on state subsidies are more behind.

3. EU Compatibility

Taxes at Member State level may be incompatible, or perceived to be so, with the Internal Market or other EU rules (see e.g. Borgsmidt 1996, forthcoming). This is a complex area which DGXI is planning to produce guidelines on shortly, in the proposed 'Communication on Environmental Levies used in Member States.' This should help Member States to take unilateral action that would be compatible with EU rules.

4. The EU Unanimity Barrier to Harmonisation

Article 130s of the Treaty of the European Union provides that "provisions primarily of a fiscal nature" are to be adopted by the Council "acting unanimously on a proposal from the Commission". Article 130s goes on to provide that the Council may "define those matters referred to in this paragraph on which decisions are to be taken by a qualified majority".

In theory, the Council of Ministers could decide to vote by Qualified Majority on, say, taxes that are primarily environmental but in practice this is unlikely to happen, even if definition problems could be overcome. More promising is the possibility of amending the Treaty to allow for Qualified Majority Voting in all fiscal and environmental matters. If improvement is to be made concerning implementation of Taxes at EU and Member States level this issue should be seriously addressed and discussed at the Intergovernmental Conference (IGC), revising the Treaty. Furthermore, the Treaty needs to facilitate harmonised economic policies in sectors such as energy and transport.

5. Administrative and Implementation Costs
The costs of introducing and administering environmental taxes depend on many factors and there is no simple way of comparing them to the costs of administering alternative instruments. Where an environmental tax can be easily included in already established systems of taxes, such as excise charges, this will reduce its administrative burden. Where, on the contrary, either new systems of taxation need to be set up, or special systems of monitoring (emissions, for example) need to be established, the burden is likely to be greater. For example, the Swedish NOX tax (see *Table 4*) is payable on measured emissions but the measurement of emissions is expensive. It has been estimated that the monitoring of the NOX emissions costs SEK350,000 per plant, or SEK4,000 per tonne of NOx abated (OECD 1996, forthcoming, p.41).

However, regulations may already require monitoring, as they do for some of the Swedish NOx taxed plants, so the monitoring costs are actually rather lower than the above figures suggest (OECD 1996, forthcoming, p.41).

It is important when considering the administrative cost of a policy instrument to include all costs, and not just those to the public administration. Thus, with deposit-refund systems, although the public administrative costs may be very low, the costs to consumers of returning the articles to retailers, and of retailers storing them, and of producers collecting and transporting them to their point of re-use, recycling or disposal should all be taken into account.

In general, the administrative costs of environmental taxes compare favourably with other policy tools.

6. Other Institutional Barriers to Taxes
Environment Ministries are used to regulations and to the range of stakeholders they need to consult. Regulations also can deliver more certain pollution reduction, though at uncertain cost, compared to taxes. Environmental Taxes involve new stakeholders, such as Finance Ministries and Tax Collecting authorities, and new issues, such as tax rates, tax bases, revenue recycling, market failures etc. (e.g. in Scandinavian countries Finance Ministries often took the initiative). The familiar is usually preferable to the unfamiliar. These cultural barriers to taxes can be significant, but can be overcome by extensive consultation, education, the sharing of experience, experimentation and political will.

Political barriers can also be minimised by widening the appeal of environmental taxes to those interested in improving competitiveness, employment and the tax system through a comprehensive package of tax and related reforms.

The 'Package' Approach to Competitiveness and Employment

Environmental taxes seem to work best when they are part of a package of measures designed to address market failures, equity, competitiveness and employment via a tax shift from labour to pollution, and other measures.

A considerable number of studies have been carried out in recent years to analyse and model the economic effects of a tax shift from labour to en-

vironmental resources. A major study carried out for the European Commission by DRI et. al. (1994) showed that assigning a more ambitious role to environmental taxes, and the integration of environmental aspects in other policy areas, would leave the EU GDP in 2010 some 1-1.5% higher compared to a continuation of current policy approaches, while employment would increase by 2,2 million. This, and other studies, have indicated the benefits of reducing employers' social security contributions rather than reducing direct income taxation (Bureau de Plan 1994).

Most studies on macro-economic effects have been carried out in a national context, under the assumption of a more or less unilateral tax shift. These circumstances are less favourable to the tax shift, because the increased taxation of energy and other resources may reduce competitiveness of energy intensive industries, and cause the dislocation of jobs to 'free rider' countries. Nevertheless, studies carried out at the national level generally point to the possibilities of achieving a moderate 'double dividend' even in the case of unilateral measures, provided that the tax shift is designed to avoid excessive effects on competitiveness.

There is no space in this report to review in detail the large number of studies of this issue that have been carried in recent years. (For overviews see De Wit 1994, Ostertag/Schlegelmilch 1996, Ekins 1996 forthcoming). However, some examples of recent 'package' approaches are summarised below.

Sweden

In 1991 Sweden unilaterally introduced a level of carbon-energy taxation almost equivalent to the Commission proposal (for the year 2000) of USD100/ton CO_2 but with some exemptions for energy-intensive industries. However, in 1992 it decided to lower the carbon-energy tax on industry, following a study by an official commission which studied energy prices and taxes in the industrialised countries, and found that Sweden had the highest level of taxation. (Finansdepartementet 1991). The commission calculated the expected employment benefits from a lowering of carbon-energy taxation. Since the model used did not take into account the possibilities for adapting to carbon-energy taxation through technological change and in-plant measures to improve energy-efficiency, it represented a worst-case scenario in terms of employment losses due to the carbon-energy taxation. The commission found that about 10,000 new jobs could be created, especially in energy-intensive industries, by giving up carbon-energy taxation.

The Swedish recession created a sense of urgency to do something to improve competitiveness, and the energy tax on industry was dropped, whilst the tax on households was increased. According to the Swedish Ministry of the Environment and Natural Resources, energy consumption in industry increased considerably in early 1993, following the abolition of the energy-carbon taxation, despite declining industrial output. (MENS 1994, p.31). The Swedish government has recently proposed to re-impose the carbon-energy tax on industry again.

The Netherlands

In the Netherlands the work and reports of the Wolfson Committee (1992) formed the basis for the recent introduction of a carbon-energy tax on small users. The conclusions about the costs of unilateral carbon-energy taxation were based on a study by the Central Planning Bureau (CPB 1992), which showed clear effects on competitiveness if energy intensive industries were included in the tax, and also substantial petrol purchases across the border if petrol was included. The report also showed that there were only few principal differences between the macro-economic effects of a unilateral Dutch tax and an OECD-wide tax, because production and jobs in energy-intensive industries could shift location, outside the

OECD area even in the latter case. The Wolfson Committee thus recommended the introduction of a unilateral Dutch tax and to allow exemptions for energy-intensive industries. Such a tax could be introduced without damaging the domestic economy, and with slightly positive effects on employment (+15,000 jobs in 2000), provided that revenue was used to lower social security contributions. Recent calculations of the CPB which have just been published assess positive employment effects of about 3,000 additional jobs in 2010 in the case of an additional tax within the small-scale energy tax scheme. This calculation was requested by the Dutch Commission for Greening the Fiscal System (Dutch Commission 1996).

The work of the Wolfson Committee is particularly valuable because it identified the institutional and other failures in the energy market described above, and recommended ways of improving the 'elasticity' of responses to price signals.

Denmark

In Denmark the inter-ministerial Dithmer Committee calculated the impact of the recent increase of the CO_2 tax on industries, and found that a unilateral introduction would have a neutral effect on employment (in fact +1,000 jobs), while it would at the same time secure an additional 5 per cent decrease in CO_2 emissions, so that Denmark's 20% reduction target could be attained (Finansministeriet 1994). The revenue from the CO_2 tax is recycled to industries, but a smaller share of it is earmarked for investment subsidies. The standard rate of the Danish tax is DKK90 per ton CO_2, but it operates with a special low rate for energy-intensive industries and is to be phased in gradually from 1996 to 2000 (MOF 1995).

In this case the recycling of revenues for investment purposes is less significant for employment effects, but the Danish study used a more conventional method to model the socio-economic effects of the increased CO_2 tax than models used in more recent work, such as in Austria.

Austria

In a recent study from the Austrian Institute of Economic Research, commissioned by the ministry of environment, youth and family affairs, the ministry of science and the ministry of agriculture, a similar problem of relatively small elasticities in different energy markets is acknowledged (BmU 1995). The report provides an overview of major international and national studies of the economic impacts of a tax shift, and discusses the weaknesses of the modelling techniques applied.

In the Austrian study 10 different scenarios have been modelled, which investigate different tax models and reimbursement methods for revenue neutrality. The main scenario, 'Labour cost reduction and technology support by subsidies' is one in which part of the tax is recycled through reductions in social security contributions, and part used for environmental investment purposes. In particular the targeted recycling of part of the revenue to investment support for specific, more energy-efficient technologies (that would otherwise not be introduced because of transaction costs and institutional rigidities) plays an important role for employment effects, especially in case of a unilateral Austrian tax. According to the study the main scenario will have a positive effect on employment (11-34,000 jobs), while a scenario without technology support yields a slightly negative impact on employment: *"The positive investment- and growth-impulse from the partial earmarking is explained by the fact that the market mechanism under institutional constraints functions insufficiently (...) A partial support of the desired adjustment measures by revenues from the tax bridges the market failure. Investments, which in the case of zero transaction costs would be profitable, are stimulated by use of these funds. Another important advantage, which should not be undervalued, is that such measures prevent energy price increases resulting in a decrease in energy services, in particular in the sector of households which is relevant for welfare considerations (lower temperatures; less mobility). Instead energy services - e.g.*

Table 7: Illustrative statements of some stakeholders on environmental taxes.

Stakeholder	Some illustrative positions
Advanced / Small and Medium sized Enterprises	• "Possibly the most important factor in an effective pursuit of sustainable development is getting the prices right. Unless prices for raw materials and products properly reflects the social costs, and unless prices can be assigned to air, water and land resources (…) resources will tend to be used inefficiently and environmental pollution will likely increase" (World Business Council for Sustainable Development, 1992) • "The Swiss Economy endorses the introduction of emission levies to conserve the environment" (Society for the Promotion of the Swiss Economy [Wf], 1993, p.21) • "A continuous price rise for non-renewable energies which must be predictable for the economy in the long run, and a concurrent and equivalent reduction in other taxes." (Federal Young Entrepreneurs' Association in Germany, 1995) • "Start the introduction of a tax on energy, e.g. on non-renewable fuels, by quickly announcing the date of the first price increase by 4 or 5 % above inflation. Also announce to continue this annual increase indefinitely" (European Business Council for a Sustainable Energy Future, 1996).
European employers association	• "With well-designed economic instruments, government can help industry turn good environmental practices into good business practices. (European Roundtable of Industrialists, 1994). • "The revised Commission proposal for an energy/CO_2 tax is inadequate to promote better control of CO_2 emissions in the industrial sector". (Union of Industrial and Employers' Confederation of Europe, UNICE, 1995, p. 13)
Trade Unions and NGOs	• "The internalisation of all costs is the sole means to guarantee the setting of realistic prices; (we) support the request presented by eight countries to the Commission, asking for it to take the initiative again to introduce environmental taxes, (The European Environmental Bureau EEB and The European Trade Union Confederation ETUC, 1996).
Global Institutions	• "It is necessary to phase out energy subsidies (…), the full-cost pricing of energy must reflect the long term marginal costs (…) and should ideally incorporate the costs of environmental detriments" (World Energy Council, 1995, p.7) • "All governments should adopt policies that make maximum use of environmental taxes and the 'polluter pays principle' of charging" (Commission on Global Governance, 1995, p.208)
The public	• 73% agree (17% disagree) with both green taxes and "Green tax reform" (Eurobarometer Poll, 1995)

heating - are produced with a changed factor combination: the supported insulation measures reduce the energy flow, while increasing the use of capital (..) Finally there are also positive innovative and technological effects of such support" (BmU 1995, p.161, EEA translation).

In May 1995 Austria increased some tax rates and introduced a set of taxes on energy from June 1996, and a share of the funds has been targeted on environmental technology support measures.

It is clear from this section that there are significant political barriers to achieving the considerable theoretical gains from environmental taxes. However, it is also clear from the experiences of several member states that these can be overcome (Gee, 1996 forthcoming).

There is no one model way of introducing environmental taxes, but the 'checklist for successful implementation' in the *Executive Summary* is based on a synthesis of experience to date and may be of use to countries wanting to use environmental taxes more widely.

Success with environmental taxes depends on political support. Although the whole issue of environmental taxation is still very controversial, it is clear from the *statements by some key stakeholders* summarised below that support for environmental taxes is already substantial and increasing. In addition political parties and EU-institutions are increasingly supporters of environmental taxes.

Illustrative statements of some stakeholders

The statements above have been selected to represent a summary of the general views of some stakeholder groups on environmental taxes (see *Table 7*).

7. RECOMMENDATIONS FOR FUTURE POLICY ACTION AND RESEARCH

Policy:

- more environmental taxes should be introduced in circumstances described in the 'Checklist on Implementation' and based on more and better evaluations.

- the potential of environmental taxes to strengthen regional taxation and harmonisation (both between and within countries) and to broaden tax bases should be explored further.

- as environmental policy-making moves *towards 'multiple pollutants/multiple effects'* strategies, where the inter-connections in nature are exploited to devise cost-effective strategies for dealing with several environmental problems caused by the same few pollutants (e.g. acid rain, eutrophication, low level ozone and global warming from SO_2, NO_x and VOCs), so environmental taxes *become even more appropriate as policy tools.* Regulations can also have multiple effects on several environmental problems, but eco-taxes are more flexible; are applicable to many economic actors; and are capable of affecting complex resource flows through the economy.

- more revenues from environmental taxes could be *'earmarked'* for environmental expenditures, such as environmental technology and public transport than has been the practice in the past. The positive incentive effects on producers and consumers can be greatly enhanced if both the tax and the revenues are providing both 'sticks' and 'carrots'. And the political acceptability of environmental taxes is usually higher when the revenue is visibly earmarked for environmental services. However, if such taxes are to become significant sources of revenue within a comprehensive budget neutral green tax reform, then much revenue will need to go into general treasury funds in order to help finance normal government expenditure on health care, education etc. *There are therefore strong political limitations to 'earmarking'.*

- The issues of the compatibility of environmental taxes in Member States with EU rules, and the EU unanimity vote on taxes, should be addressed.

- Measures should be taken to facilitate harmonised economic policies in sectors such as energy and transport.

Research:

- more independent *studies* which *evaluate* both the environmental impacts and overall cost-effectiveness of the 4 main environmental policy instruments (voluntary agreements, environmental taxes, tradable permits and regulations) are urgently needed. They should be designed and *built into the policy process* when the policy instruments are being developed. The OECD has recently agreed some methodological guidelines on this for economic instruments (OECD, 1996, forthcoming)

- more research into the *economic modelling* of environmental taxes is needed, especially to help reconcile model differences, and to integrate dynamic and multiple effects into the analysis of policy packages.

- studies should particularly address the issue of earmarking; and the potential for developing *new tax bases* in areas such as aviation, hazardous chemicals, tourism and land use.

- the developing field of *externalities evaluation* (both 'negative' and 'positive') needs to be expanded to cover priority areas such as aviation, chemicals, intensive agriculture, organic farming and forestry; and in particular to develop *distributional (or equity) analyses of externalities*, which are usually unevenly distributed throughout society

- *trends* in the main tax bases of labour, capital, energy and environment should be harmonised on the *new definitions* recently agreed by OECD, Eurostat, DG XXI and DG XI (Jarass/Obermair 1996), so that comparisons are available on the same basis for both EU and other main OECD countries from 1970, and updated every 3-5 years.

- more research into *the political economy* of tax administration; the role of *interest groups* in policy development; and *the public acceptability* of green tax reforms.

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ACRONYMS AND ABBREVIATIONS

A	Austria
B	Belgium
BOD	Biological Oxygen Demand
Cd	cadmium
CFC	chlorofluorocarbons
CPB	Central Planning Bureau (in the Netherlands)
D	Germany
DK	Denmark
E	Spain
EAP (5th)	5th Environmental Action Programme
F	France
FIN	Finland
GR	Greece
GWh	Giga-Watt-hour
I	Italy
IRL	Ireland
LDC	Less developed countries
M_gO_x	Mercury Oxygen
N	Norway / Nitrogen
NGO	non governmental organisation
NIC	Newly Industrialised Countries
NiCd	nickel-cadmium
NL	Netherlands
NO_x	nitrogen-oxides
P	Portugal / Phosphor
Pb	lead
PPP	Polluter Pays Principle
RIVM	National Institute of Public Health and the Environment
S	Sweden
SO_2	sulphurdioxide
UK	United Kingdom
VAT	Value Added Tax
VOC	volatile organic compounds

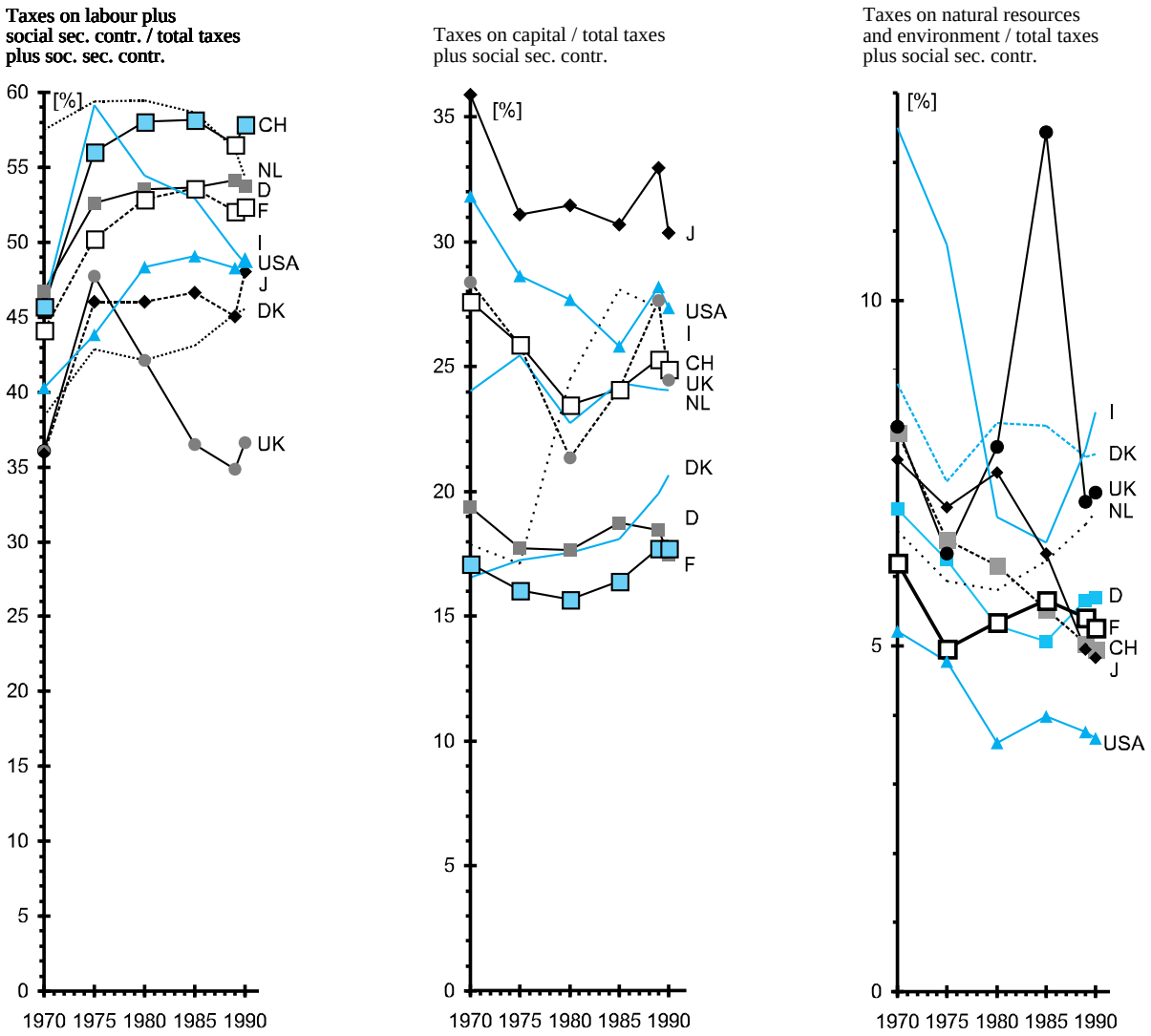
ANNEXES

Annex I - General Trends in Taxation 1970-1990

The figures are taken from Jarass/Obermair 1993/1994, p.48, who were the first to assign taxes according to these production factors covering the period from 1970 to 1990, during which the increase of taxes on labour was sharp and taxes on the environment decreased in comparison to total taxes. The study compared trends of taxation in six main EU-countries (D, DK, F, I, NL, UK) with those in some main competitors like the USA, Japan and Switzerland. The message of the figures below is clearer than that available from the 1980-1993 data (p. 25): Taxes on labour have risen sharply, mainly due to increases of social security contributions; taxes on capital decreased slightly; and taxes on natural resources and environment have decreased even more.

Note: The peak of levies on natural resources and environment in UK 1985 is due to royalties for domestic crude oil consumption (...). Different scales are used!

Figure 6: Factor levies per total levies



Annex II - Summary Details of reviewed taxes

Table II.1: The reviewed taxes

Instrument	Country	Number and types of studies
Fiscal environmental taxes		
Sulphur tax	Sweden	2
CO_2-tax	Sweden Norway	1 1
Tax on domestic flights	Sweden	1
Waste charge	Denmark Netherlands	(1) (1)
Incentive charges		
Tax differentiation petrol	Sweden International survey	2 (1)
Tax differentiation diesel	Sweden	2
Toxic waste charge	Germany	1
NO_x-charge	Sweden	2
Fertiliser charge	Sweden	1
Water pollution charge	France	2
Water pollution charge	Germany	2
Cost-covering charges: user charges		
Water pollution charge	Netherlands (non-State)	3
Household waste charge	Netherlands	1
Cost-covering charges: earmarked charges		
Battery charges	Sweden	1
Aircraft noise charge	Netherlands	1

(..) = study not yet finalised, and thus not included in the review of these studies (except for the Danish waste charge, where preliminary findings are available).

1. Sulphur tax (Sweden)

In 1991 a sulphur tax was introduced in Sweden in order to further the decrease of the emissions of sulphur. The tax applies to fuels (coal, oil, peat) that contain 0.1 % of weight of sulphur or higher. The tax amounts to SEK 40 per kg of S. If sulphur emissions are abated, the tax might be reimbursed. For light oils a tax differentiation scheme compensates the cost of producing oils of class I (maximum S-content of 0.001%) and class II (maximum S-content of 0.005%) through tax rebates. The maximum allowable S-content in light oil is 0.2% (class III) (see also under "tax differentiation diesel", below).

The sulphur tax should promote the use of cleaner fuels and the cleaning of flue gases from the use of fuels with a high S-content. An evaluation

study of economic instruments in Swedish environmental policy [8] indicates that the tax may have had a considerable impact. The average S-content of fuel oil decreased from about 0.65% in 1990 (the legal maximum allowable content was 0.8% at that time) to 0.4% recently [9]. The S-content of light oils is lower than 0.1% on average which corresponds with levels for which no tax is due. Policy effectiveness is high.

About a quarter of the tax subjects have taken measures to clean flue gases and are receiving tax refunds. The reduction of sulphur emissions is 70% on average.

It is concluded that the tax has had an impact on the emissions of SO_2. The Swedish evaluation study assumed an environmental impact of 6,000 tonnes. Total SO_2 emissions where approximately 110,000 tonnes in 1991, but the share of emissions that could be influenced by the tax is considerably lower, as a consequence of the tax base - fuels for combustion purposes - and the tax threshold. The average costs of the measures taken after the introduction of the S-tax was about SEK 10 per kg, which is considerably lower than the tax rate of SEK 40, and indicates a large incentive effect of the tax.

2. CO_2 tax (Sweden)

In Sweden a special CO_2 tax was introduced in 1991 as part of a fiscal reform. At the same time VAT on energy was introduced and general energy taxes were reduced. In 1993 the tax burdens were differentiated according to economic sectors: the total burden for industry was reduced through a decrease of the CO_2 tax and complete abolishment of the general energy tax, and the burden for other sectors was increased through an increase of the CO_2 tax. Bio-fuels are exempted from these taxes.

The impact of the CO_2 tax is difficult to determine since this tax is part of a broader tax reform package. Furthermore, the period of application of the tax is rather short. In 1994, an evaluation study of applied economic instruments in Sweden was published [10]. This study concludes that some indications about the steering effects of the tax can be given. In many cases energy production plants are said to have shifted fuels as a consequence of the tax. The tax relief for bio-fuels has lead to an increased interest to convert existing plants. The use of wood fuel in district heating continues to grow. Combined heat and power production has become more competitive, especially when coal and oil are used.

The report finds a tendency to a higher consumption of fuel oils in industry, while industrial production slightly decreased in the same period. This might be attributed to the tax relief for this sector after 1992. The consumption of fuels in the energy-intensive paper and pulp industry increased by more than 30% in one year, compared with about 20% for industry as a whole, illustrating the environmentally perverse effect of exemptions.

3. CO_2 tax (Norway)

The CO_2 tax in Norway, in place for 5 years, has been evaluated [11]. The analysis is carried out for selected sectors on a sub-macro level. The focus is on emissions from stationary sources in mainland manufacturing industry and services and from stationary and mobile sources of households. In total it covers about 40% of taxable CO_2 emissions.

The methodology implies a comparison of the actual economic developments (with the CO_2 tax)

[8] Ministry of the Environment and Natural Resources, The Swedish Experience - Taxes and Charges in Environmental Policy, Stockholm 1994

[9] See also S. Smith, Evaluating the efficiency and effectiveness of economic instruments: a conceptual and empirical analysis, in: OECD 1996 forthcoming.

[10] Ministry of the Environment and Natural Resources, 1994

[11] B.M. Larsen, R. Nesbakken, Norwegian Emissions of CO_2 1987-1994, Statistics Norway , Oslo, 1996 (mimeo)

and the fictitious developments (without the CO_2 tax). The price of heating oil and petrol increased about 15 and 10% as a result of the tax. The total effect of the tax was a reduction of CO_2 emissions of 3-4 per cent for the period 1991-1993.

The largest effect was calculated for the paper industry. Oil consumption would have been 21% higher without the tax. The impact in the intermediate products sector and the government services was 11 and 10% respectively. The impact was much lower in other sectors.

The effect of the tax on the household use of energy for heating was low because of a low share of oil for this purpose (less than 10 %). Private car transport by households would have been 2-3% higher per year without the tax.

4. Tax on domestic flights (Sweden)
Domestic flights are subject to a tax based on the emissions of hydrocarbons and nitrogen oxides. The tax rate is SEK 1 per kg for both pollutants. These taxes are additional to the CO_2-tax of SEK 0.32 per kg for aviation fuel used in domestic air traffic. The calculation of the taxes is based on standard emissions figures for types of aircraft and on average flight distances.

The report that evaluates the tax scheme [12] that the tax has resulted in "thorough analysis of aviation procedures and exhaust emissions from the aircraft". The tax is also said to have accelerated the change of combustion chambers of the aircrafts by one of the airlines subject to the tax. The direct impact of the tax on aircraft emissions is unknown.

5. Waste charge (Denmark)
Denmark applies a charge on the disposal (dumping and incineration) of non-hazardous waste since 1986. Current tariffs are DKK 195 per ton for dumping and DKK 160 per ton for incineration. The difference in tariffs reflects the aspiration to increase the share of waste incinerated and to decrease the share of waste for dumping. Tariffs will be further raised and differentiated in 1997. Waste incinerated in installations that recover heat or generate electricity will be charged DKK 160 per ton. Otherwise a charge of DKK 210 per ton is due. Landfilled waste will cost DKK 285 per ton.

Exemptions exist for certain types of waste. Charge paid for waste that is shipped off the waste site is reimbursed. The revenues from the Danish waste charge go into the general budget. Since 1993 they have been used as a part of the green tax reform.

This fiscal tax has an explicit regulatory function. The intended environmental impact includes reduction of waste generation, increase of reuse and recycling and a larger share of waste incinerated. Reuse and recycling of waste increased from 21% to 50% of the total amount of waste offered for collection in the period 1985 to 1993. Dumping decreased from 57% to 26%. The share of waste incinerated remained constant.

The financial effect of the waste charge is considerable. 80% of the landfill tariffs (waste charge excluded) are between DKK 150 and DKK 250 per ton. The waste charge of DKK 195 results on average in doubling the costs of waste dumping. The tariffs for incineration are between DKK 150 and DKK 300 per ton. The charge of DKK 160 increases the costs of incineration by 70% on average.

Currently, the charge scheme is under evaluation. The purpose of this study is to investigate the impact of the tax scheme on the changes in the disposal of waste mentioned above.

No results of this study are available to date. However, the Danish Environmental Protection Agency is of the opinion that the tax scheme has signi-

[12] Ministry of the Environment and Natural Resources, 1994

ficantly contributed to a substantial increase of de reuse of demolition and construction waste. Total waste supply only slightly increased in the period 1988-1993, by 2%. In 1985, 12% of the demolition waste was reused. The reused fraction increased to 82% in 1993. This results by far exceeds the target for the year 2000 which is 60% reuse. The Agency has based its opinion on statements made by representatives of the construction sector [13].

6. Tax differentiation on leaded petrol (Sweden)

In order to facilitate and accelerate the penetration of unleaded petrol, a tax differentiation of unleaded and leaded petrol was introduced in 1986 in Sweden, like in many countries. Phasing out leaded petrol was necessary for reduction of the lead emissions and to facilitate the use of cars equipped with catalytic converters. The tax differential increased from SEK 0.10 in 1986 to SEK 0.51 in 1992. The share of leaded petrol decreased from 100% in 1986 via 40% in 1992 to practically zero in 1993.

This instrument was rather aimed at producers of car fuel than at consumers. Producers should be persuaded to start producing unleaded fuel by (partial) compensation of the additional production costs. Drivers of cars suitable for this fuel would follow quite easily provided that the price of unleaded petrol would be lower.

Originally, the tax differential was too small to cover the additional costs. After the increase to SEK 0.51 the differential appeared to be sufficient [14]. Another reason for the dramatic fall of the share of leaded petrol after 1992 (40%) was the replacement of leaded fuel for cars that continue to require this type of fuel by a fuel containing an alternative lubricant, sodium. Total emissions of lead dropped by about 80% between 1988 and 1993.

[13] Danish Environmental Protection Agency, The Danish Waste Charge Act (note, 1995)

[14] Ministry of the Environment and Natural Resources, 1994

As to incentive impact of the tax differential, oil producers stated that the differential was an important reason for starting to produce unleaded petrol. Whether announced regulations, necessary in the framework of promoting cars with catalytic converters, also meant an important incentive is unknown, but not improbable.

7. Tax differentiation for diesel (Sweden)

Reduced tax levels apply for types of diesel fuel that comply with environmental characteristics which are stricter than those required according to environmental regulations. Three classes have been distinguished. Class III is the standard type of diesel for which a maximum allowable content for sulphur of 0.2% was set. Classes II and I comply with stricter requirements, not only for the contents of sulphur but also for the emissions of aromatics and other environmentally relevant characteristics.

Tax rebates were introduced for classes I and II in 1991. In 1994 the levels of the rebates amount to SEK 457 per m^3 and SEK 260 per m^3 for classes I and II respectively. The tax rebates should encourage the production and market penetration of the cleaner fuels by compensating higher costs of production.

The Swedish evaluation study [15] describes the impact of the tax rebates scheme on the diesel market as "dramatic". In 1990 less than 1% of the diesel sold in Sweden would have qualified for classes I or II. In 1994, 60% of all diesel fuels complied with class II and 15% with class I requirements. The emissions of sulphur from diesel cars decreased by 75%, and even by 95% in cities. The study attributes this apparent success to the combination of the tax rebates scheme and lower than expected production costs for the cleaner diesel fuels. It appeared that, rebates included, the costs of production of classes I and II were lower than

[15] Ministry of the Environment and Natural Resources, 1994

the production cost of standard fuel. This induced producers to concentrate production and marketing on the cleaner products. A conclusion that could be drawn from this: In some cases markets and the exploration of efficient solutions might need the help by government to be discovered.

8. Toxic Waste Charge (Germany, Baden-Württemberg)

A charge on toxic waste was introduced in April 1991 in the south-western Land Baden-Württemberg of Germany, in order to cope with the increasing amount of toxic waste. Hence, the tax may be classified as an incentive tax, though also raising substantial revenues. The tax rates were doubled in 1993 up to a level of 100, 200 or 300 DEM per ton depending on the potential danger and the expenditures for treatment.

In terms of environmental pollution it can be regarded as successful. The amount of toxic waste declined from 605,000 tons in 1991 via 430,000 tons in 1992 to 354,000 tons in 1993. At the same time the revenue rose from 19,8 million DEM in 1992 up to 36,7 million DEM in 1993. According to an evaluation study carried out by the Eco-Institute in Darmstadt (Öko-Institut 1994) only half of the 250,000 tons of reduced toxic waste may be classified as abated. The other half may be explained by using other terms, evasion or the recession. The tax has even led to a reduction of planned capacities of incineration. The consultants discovered a still large potential for abatement. Thus, they ask for residual substances also to be taxed in order to prevent attempts of evasion.

9. NO_x-charge (Sweden)

First of January 1992 a charge on emissions of NO_x was introduced in Sweden. About 185 large combustion installations for generation of energy are subject to the charge system. The charge is imposed on emissions which are being calculated on the basis of continuous monitoring. Tax subjects may apply for a fixed charge rate. It is assumed in those cases that emissions amount to 600 mg NO_x per MJ input of fuel for gas turbines and 250 mg NO_x per MJ of fuel input otherwise. Since these parameters by far exceed actual emission factors (amounting to 112 mg/MJ on average for all fuels), subjects are encouraged to install monitoring equipment and pay the charge on the basis of actual emissions.

Plants with an input energy capacity of at least 10 MW and a total annual energy production of at least 50 GWh are subject to the charge. The production threshold is decreased to 40 GWh in 1995 and is intended to be further decreased to 25 GWh in 1997.

The charge scheme is additional to the system of permits and its purpose to accelerate the reduction of NO_x-emissions. A reduction of 5000 to 7000 ton per year was originally aimed at. Total emissions of the liable plants amounted to 24.000 tons of NO_x in 1990, 21.000 tons in 1992 and 15.300 tons in 1993.

The tax rate is SEK 40 per kg NO_x emitted. The revenues (SEK 600 million in the first year of operation) are refunded to the payers on the basis of a proportional share of the total energy produced by the plants.

According to an evaluation [16] the charge has had an environmental impact that was noticeable from 1990 when the system was adopted by the Parliament. The main portion of the reduction of 9,000 tons of NO_x, realised in 1992, is reported to be attributable to the charge. The average emission of NO_x per unit of energy input dropped from 159 mg per MJ to 103 MJ. Based on adopted projects by the liable subjects, emission reductions are expected to continue.

[16] Ministry of the Environment and Natural Resources, 1994; S. Smith, Evaluating the Efficiency and Effectiveness of Economic Instruments - Lessons from International Experience, in: OECD 1996 forthcoming.

Table II.2: Net payments and emissions reductions, by sector

	Number of installations	Net payment (reception) per GWh of energy produced (SEK/GWh)	NO_x emission reduction, 1992-1993 (%)
Waste incineration	5	9763	42
Energy generation	53	(878)	23
Chemical industry	23	(94)	17
Pulp and paper industry	39	1304	13
Metal industry	2	(9168)	-2
Total	122	176	20

Source: OECD 1996 forthcoming.

Reactions of subjects to the charge could be traced by comparing net payments with emissions reductions, by sector. Table 7 shows the redistributive impact of the charge and NO_x reduction data for five sectors (figures for 122 plants).

The largest net payer is the waste incineration sector. This sector managed to bring about a emission reduction of 40%. The largest net receiver is the metal industry. Their emissions slightly increased. The results for the other three sectors are not conclusive in this respect.

The charge rate was set at SEK 40 per kg of NO_x for incentive reasons. The costs of reducing emissions in the installations under the charge scheme were estimated varying from SEK 20 to SEK 80 per kg. Many measures are reported to be cheaper than SEK 20 per kg, however. An average cost figure of SEK 10 per kg is considered to be likely by the Swedish Environmental Protection Agency. This implies that the charge provides a strong incentive for tracing and applying cost-effective solutions.

Since the primary objective of the charge system was to strengthen the permit policy, it can be concluded that the policy effectiveness was high.

10. Fertiliser charge (Sweden)

A charge on nitrogen and phosphorus content of fertiliser has been applied in Sweden since 1982. This charge was a "price regulating" charge aimed at providing financial support for the export of agricultural products (and skimming some of the farmers' rent due to low fertiliser prices). In 1984, an environmental charge on fertiliser containing P and N was introduced. The dual purpose of this charge is to raise the price and discourage the demand of fertiliser, and to create funds for financing measures to mitigate negative environmental effects of agriculture, such as manure treatment plants, counselling and information. The rates of both charges were raised to a level of about 30-35% of the sales value of fertilisers in 1991. The "price regulating charge" was dropped in 1992; the level of the environmental charge was about 10-13% in that year [17]. The rates are SEK 0.6 per kg for N and SEK 1.2 per kg for P.

The use of fertiliser has been reduced significantly since 1984. Even though, the impact of the charge systems on these reductions is hard to assess as a large agricultural reform programme

[17] Ministry of the Environment and Natural Resources, 1994

was undertaken during the same period. The Swedish evaluation report states that the impact on the use of nitrogen and phosphorus was noticeable. The reduction of N was largest when the charge rate reached a high level (1990). The use of P shows a continuous decrease during the period 1984-1992, of 50% in total. The report states that this result was caused by the charge system and by growing awareness about the negative effects of phosphorus on the environment. The latter factor was assumed to be influenced by information campaigns financed from the charge funds.

11. Water pollution charge (France)

The purpose of the French water pollution charge system is to stimulate and partly subsidise the construction of wastewater treatment plants operated by municipal and industrial dischargers. The responsibility for purification of wastewater remains with the polluters themselves; they pay the charge if they discharge to open water, and they are supported financially if they undertake treatment measures. The charge system is administered by the six *Agences de l'Eau*. These public bodies formulate objectives, decide about the necessary funds and calculate the charge rates on that basis.

According to an in-depth evaluation study of the system [18], the French charge is best described as earmarked. A major feature of the system is a tax-bounty scheme for firms and local authorities concluded in sector contracts and river contracts.

The amount of wastewater treated in public purification plants rose from 21 million i.e. in 1980 (30% of total wastewater emissions) to 32 million i.e. in 1992 (42% of total emissions). Industrial emissions of oxygen binding substances, suspended solids and heavy metals decreased by 28%, 38% and 39% respectively in the period 1980 - 1992.

[18] M. Skou Andersen, 1994a

Assessing the impact of the charge on pollution behaviour is difficult since the charge system is part of the French water quality policy that is dominated by permit issuing. This can be illustrated by some figures. Total expenses for water quality policy in France amounted to FRF 44,000 million in 1992 (42% of total environmental expenses of FRF 105,000 million) [19]. The funds created by the proceeds of the water pollution charges amounted to FRF 3,600 million, or 8% of the total water quality expenses. Investments for prevention and treatment of wastewater were FRF 19,000 million in 1992. These figure indicate that most of the measures taken for a better water quality are geared by the permit policy, and by the willingness of local authorities to undertake water treatment projects and pass (92% on average) of the costs on to the inhabitants [20]. Of course, the sector and river contracts may have been the decisive factor in starting treatment works in individual cases.

The charge rates are modest, compared with the charges in Germany and the Netherlands. Consequently, the incentive impact of the charge on adoption of pollution control measures - a refund takes place upon proof of adequate measures - is small (less than 10% of that in Germany and the Netherlands). The charge rate has also never been related to the marginal costs of abatement costs, and appears to be much smaller than the average costs of pollution control.

12. Water pollution charge (Germany)

The German water pollution charge system was introduced to reinforce the water quality policy which mainly is the competence of the German *Länder*. Although originally intended to be purely incentive, the actual system has been weakened,

[19] P. Chapuy, Evaluation de l'Efficacité et de l'Efficience des Systemes de Redevance de Pollution de l'Eau: Etude de Cas de la France, OECD Paris 1995

[20] M. Skou Andersen, 1994a; A. de Savornin Lohman, Synthesis report, 1995

as a compromise between Federal authorities and the States [21]. The system contains some incentive elements, such as reductions for best available technologies (BAT) and lowered rates in expectation of investments. As the charge bill is based on discharge values in the permits and not on actual emissions, the objective of the charge could be described as to encourage applicants for a low-discharge permit. Funds of the charge accrue to the Länder and are added to their budgets for water quality policy, financing monitoring and administrative structures.

As to the objective of the charge, the German system is probably best rated as an incentive charge, when it came into effect from 1981 on. Due to several changes, in particular after the German Union it may now also be characterised as an earmarked charge.

Although lack of data impedes a proper evaluation of the charge system in terms of environmental impact, some evidence exist that the early announcement of the system induced municipalities and industry to undertake action aimed at reduction of wastewater discharges by treatment of effluent. One evaluation studies observes that the decline in water pollution discharges began in 1981, the year of the actual introduction of the charge, though minimum requirements for discharges were also introduced around that time [22].

The charge rate was calculated against the background of marginal abatement costs of different industry sectors. But the rate was then set rather to limit the financial consequences for the charge subjects than to reflect marginal pollution abatement costs.

13. Water pollution charge (Netherlands)

The Dutch water pollution charge system is primarily geared towards financing collective wastewater treatment plants. It was introduced in 1970 in order to facilitate the building of wastewater treatment capacity for discharges into the large water bodies managed by the State (big rivers, estuaries, Ijssel Lake). The charge rates, as far as the non-State part of the system managed by the Water Boards is concerned (the other part is the state part of the charge, which is not evaluated here), is calculated on the basis of funds required for expenses for investment in and running of the plants in the coming period. The charge system accompanies a system of permit-giving.

Available evaluations observe that the Dutch water quality policy has been quite successful [23]. Treatment capacity increased from 52% in 1975 to 95% in 1992, in terms of households connected with a public sewage treatment plant. Of all discharges 74% was treated in 1991, against 51% in 1980. Emissions from the manufacturing industry went down from 19 million i.e. to 4 million i.e. in the period 1975 - 1991.

The discharges from large emitters in the manufacturing industry decreased by 80% in the period between 1975 and 1991. Two studies attempted to disentangle the impact of the charges from the impact of the Dutch water quality policy at large. One study [24] found a strong relationship between variations in charge rates of Water Boards and the rate of reductions of discharges within their jurisdiction. Another study [25] found that the majority

[21] R.A. Kraemer, The Effectiveness and Efficiency of Water Effluent Charge Systems: Case Study on Germany, OECD Paris, 1995; A. de Savornin Lohman, The Efficiency and Effectiveness of Water Pollution Charges in France, Germany and The Netherlands: a Synthesis of Available Evidence, OECD Paris 1995.

[22] M. Skou Andersen, Governance by Green Taxes: Making Pollution Prevention Pay, Manchester University Press, 1994a.

[23] A. de Savornin Lohman, The Effectiveness and Efficiency of Water Effluent Charge Systems: Case Study on the Netherlands, OECD Paris, 1995; M. Skou Andersen, 1994a.

[24] J. Bressers, Beleidseffectiviteit en waterkwaliteitsbeleid, diss., Enschede 1983, cited by A. de Savornin Lohman, Synthesis report, 1995

of interviewed industry representatives (54%) claimed that the charge has been the decisive factor in decisions in favour of water pollution abatement measures, whereas only 20% pointed at the permit policy to be of main importance. This study also stated that the average charge rate - which varies substantially across Water Boards - was only slightly lower than average pollution abatement costs. Consequently, in some individual cases, the charge rate would exceed the average abatement costs.

14. Household waste charge (Netherlands)
Collection and removal of household waste and waste from small municipal enterprises is the responsibility of the Dutch municipalities. Many cities and villages have boarded out waste management tasks to private firms, but they remain responsible for financial aspects. The majority of municipalities pass on (part of) the costs of waste collection to the inhabitants by annually issuing fixed rate waste bills. Increasingly, especially the smaller, rural cities are introducing variable charge rates. Three main systems are found. One or two municipalities actually weigh the contents of the dustbin at the moment of collection. A few villages apply a "pay-per-bag" system. Finally, a number of municipalities are basing the charge bill on the size of the household or the frequency of collection.

The motivation for variable charge rates primarily includes the wish for a fairer distribution of the costs across households, in the framework of rapidly increasing charge bills. Explicit reference to the "polluter pays principle" is made. Furthermore, variable rates may have an incentive impact on households.

An evaluation study analysed a number of "pay-per-bag" systems and observed that indications for a positive impact on the waste supply by households can be found [26]. Municipalities operating a "pay-per-bag" system produced 10-20% less waste per capita than comparable municipalities with traditional systems. Illegal dumping or dumping of waste in adjacent villages was reported to be of no major problem, provided that the price per waste bag did not exceed the level of DFL 2. This finding is similar to US studies of "pay-per-bag" systems, (OECD, 1996 forthcoming).

15. Battery charges (Sweden)
In 1991 charges on the sales of lead batteries over 3 kg and of small batteries containing over 0.025% of mercury and cadmium were introduced. The funds of the charges are allocated to finance collection and final deposition, which is not economically feasible without financial support, and information campaigns [27].

Lead batteries
The charge rate is SEK 40 per kg. A special company was established to administer the funds from the charge. As a consequence of producer responsibility, sellers of lead batteries have to take them back. The target for collection was 95%. In 1991 and 1992 the number of used batteries collected exceeded the number of sold batteries. In 1993 the collection rate was 95%.

Since the charge only amounts to 6 - 8% of the price of batteries and since consumers have no alternatives, the demand for lead batteries is hardly if at all influenced by the charge. The policy effectiveness of this user type of charge has to be measured in terms of the success of the collection system which is very good.

[25] J. Schuurman, De Prijs van Water, Gouda Quint BV, Arnhem, 1988, cited in A. de Savornin Lohman, Synthesis report, 1995

[26] DHV Milieu, Differentiatie van Tarieven voor Inzameling van Huishoudelijk Afval, Ministerie van VROM, Publicatiereeks Afvalstoffen nr. 1993/9, Den Haag

[27] Ministry of the Environment and Natural Resources, 1994

Mercury (Hg) and nickel-cadmium (NiCd) batteries

The charge rates for Hg-batteries and NiCd batteries are SEK 23 per kg and SEK 25 per kg respectively. The funds from the charges are used for financing final deposition of the collected batteries and for information, and to support recycling of NiCd batteries. The storage facility contains large unsorted amounts of old batteries with high Hg and Cd contents and many batteries are still in use. The funds from the charge are decreasing because Hg and Cd contents in today's batteries are falling below the level above which the charge is due. A deficit is expected.

The collection rate for batteries containing Hg was 89% in 1991, and only 49% for NiCd batteries which is below the target of 75% set by the government. NiCd batteries have a long durability and a significant number of these batteries built-in in consumer goods are sold outside the system of registration. A collection premium for this type of batteries is under discussion.

The charge rates are too low to have a noticeable impact on the demand for batteries. The decreasing contents of heavy metals is attributable to environmental awareness and international developments, rather than to price incentives. The policy effectiveness is good at the moment, but funds may fall short of the costs of disposal of batteries in the future due to less harmful substances in new batteries.

16. Aircraft noise charge (Netherlands)

Since 1983 a surplus is imposed on landing fees for aircraft landing on Dutch airports. This aircraft noise charge is differentiated according to noise characteristics of the aircraft. The proceeds are earmarked for financing measures to reduce the noise annoyance caused by airports (insulation and redevelopment).

The impact of the charge system in the Schiphol area was evaluated in 1991 [28]. Main conclusions were that the charge was rather effective in terms of raising money for the purposes intended. The impact on noise annoyance by aircraft was assessed to be "very limited". The relationship between the charge level and the actual noise production of the aircraft appeared to be very weak.

[28] Berenschot, Rapport Audit Sanering Woningen in verband met Geluidshinder Schiphol, 1991

Annex III - Some non-energy, environmental taxes

Table III

Country	Item	Description	Revenue
Australia (Commonwealth)	CFC	AUD 0.23 per kg levy introduced in 1989 on production and import to cover costs of administering CFC phase-out. (The States also have licensing and quantity based charges for CFCs).	AUD 0.15 million in 1989
	Recycled paper	Certain paper products made from 100 % recycled paper are exempt from Wholesale sales tax.	Estimated revenue loss less than AUD 0.15 million
	Some solar power equipment used for heating purposes and goods used to convert internal combustion engines on LPG or natural gas.	Exempt from Wholesale Tax.	
Austria	Tires	(under discussion)	
Belgium	Disposable razors	BEF 10 per razor (from 31 January 1994)	
	Beverage containers	Since 1 April 1994, a tax of BEF 15/litre (minimum BEF 7) is levied on containers of beer and some soft drinks if they are not submitted to a deposit-refund system and if they are not reusable or an annually increasing per cent of them is not being recycled, BEF 380 if not recycled (1 July 1994)	
	Paper, pesticides, batteries, packaging of ink, glue, oil and solvents	Dates of coming into force are under discussion	
	Disposable cameras	BEF 300 if not recycled (1 July 1994)	
Canada	Ontario, Manitoba	Alcohol beverage containers: CAD0.05 to CAD 0.10 on non-refillable containers	
	Certain provinces	Tyres: CAD 2 to CAD 4 per tire	
	Manitoba	Quarry minerals: CAD 0.10 per tonne	
	Prince Edward Island	Newsprint and promotional material (under discussion)	
	British Columbia	Lead-acid batteries: CAD 5 per battery	
Denmark	Raw materials	The excise duty is levied on extraction and export of sand, gravel etc. at the rate of DKK 5 per cubic metre.	DKK 120 million in 1993
	Certain retail packaging	The excise duty is levied on containers for beverage, soft drinks, fruit juice, spirits, vinegar and oils etc. The tax rate is between DKK 0.38 - 2.28 per container depending on the size and the type of the container.	DKK 305 million in 1993
	Carrier bags of plastic and paper	An excise duty on carrier bags of plastic and paper with a possible content of minimum 5 litre was introduced 1 January 1994. For bags of paper the tax rate is DKK 9 per kilo and for bags of plastic the tax rate is DKK 20 per kilo.	n.a.
	Disposable tableware	The excise duty is levied on plastic and paper cups, plates, cutlery etc. The tax rate is one-third of the wholesale value including the tax rate but excluding VAT. In connection with imports the tax rate is 50 per cent.	DKK 58 million in 1993
	Pesticides	The retail sale of pesticides sold in containers less than 1 kg or 1 litre is subject to a tax. The rate is 1/6 of the whole sale value including the tax but excluding the VAT. When the tax is paid in connection with imports the rates is 20 per cent of the producer price. Pesticides sold in larger quantities than mentioned above are subject to a tax of 3 per cent of the wholesale price excluding discounts and VAT. When the tax is paid in connection with imports the rate is 20 per cent of the producer price.	DKK 11 million in 1993
	CFC and halons	The excise duty is levied on the use of CFC's and halons or products containing these. The tax rate is DKK 30 per kilo of the products.	DKK 5.1 million in 1993
	Rechargeable batteries	A charge is levied on rechargeable nickel/cadmium batteries. The revenue of this excise duty is earmarked for covering the costs of a collection arrangement for used rechargeable batteries. The rate is DKK 2 per single battery and DKK 8 per battery attached to technical devices or apparatus	DKK 7.8 million in 1993

	Light bulbs	An excise duty on ordinary light bulbs exists while energy saving light bulbs are exempt from this duty. This difference in taxation between ordinary and energy saving light bulbs is a measure taken in order to encourage the use of energy saving light bulbs.	n.a.
Finland	Beverage containers	"Surtax" levied since 1976 on beer and soft drinks in non-reusable glass, metal and other containers. Rates are 3 FIM/litre on soft drinks in non-returnable metal or glass containers, 2 FIM/litre on soft drinks in other non-returnable containers. Approved return systems allow exemption from the surtax. Surtax of 1 FIM/litre applied to beer in non-returnable containers. Amendment in June 1994: beer and other alcohol beverage containers 4 FIM/litre. For approved system: - refillables: exempt - use as raw material: 1FIM/litre	Surtax revenues: - soft drinks; FIM 35 million in 1990 FIM 19 million in 1993 - beer; FIM 30 million in 1990 FIM 16 million in 1993
	Lubrification oil	Waste oil charge at the rate of 0.25 FIM per kg	FIM 21 million in 1993
	Fertilisers	Excise tax on fertilisers: 2.60 FIM/kg N + 1.70 FIM/kg P (repealed as of 16.6.1994)	FIM 516 million in 1993
France	Paper, pulp and board	Revenues partly used for promoting waste paper recovery	
	Tax in billboards, advertisements and signs or advertising sites	Fixed by municipal councils	
Iceland	Plastic bags	8 ISK per ba	n.a.
Italy	Polyethylene	Levied on polyethylene as primary product of carrier bags (since March 18, 1994)	n.a.
Mexico	-	-	-
Norway	Beverage containers	Also levied since 1988 on disposable beverage containers per litre: <u>Liquor and wine:</u> NOK 2.50 (1991) NOK 3.00 (1993) <u>Beer:</u> NOK 3.50 (1991) NOK 3.00 (1993) <u>Carbonated drinks:</u> NOK 9.50 (1991) NOK 9.30 (1993) <u>Non-carbonated drinks:</u> NOK 9.50 (1991) NOK 9.30 (1994) <u>Non-reusable beverage containers:</u> (since 1994) NOK 0.70	 NOK 41 million in 1991 NOK 48 million in 1993 NOK 13 million in 1991 NOK 11 million in 1993 NOK 60 million in 1991 NOK 24 million in 1993 NOK 59 million in 1991 NOK 65 million in 1993 NOK 95 million in 1994
Portugal	Batteries, packaging, glass, plastic, coal ashes, mining and tyres	These products are subject to different protocol for collection and recycling between the authorities and the related industry	
	Mineral oils obtained from recycling of used oils	Not subject to Excise Duty on motor fuels	
Sweden	Beverage containers [a)]	Levied since 1973 on beverage containers, per container depending on volume (paper and cardboard exempt): Returnable SEK 0.08 Disposable SEK 0.10 - 0.25	SEK 110 million for 1991-1992
	Batteries	Levied on batteries per kg: HgOx SEK 23 NiCd SEK 25 Pb SEK 32	SEK 17 million for 1991-1992
United States	Ozone-depleting chemicals	Ozone-depleting chemical excise tax imposed on CFCs, halons, carbon tetrachloride, and methyl chloroform. The rates are proportional to the ozone-depleting potential of each chemical and range from USD 0.137 to USD 13.70 per pound (in 1991) also imposed on imported products containing (or manufactured with) these ozone-depleting chemicals.	USD 886 million in FY 1991 USD580 million in FY 1992

Table taken from OECD 1995, p.86-89. Notes: a) Abolished in May 1993

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