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Enhancing Environmentally Sustainable Growth in Finland

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ENHANCING ENVIRONMENTALLY SUSTAINABLE GROWTH IN FINLAND

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by
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ABSTRACT/RÉSUMÉ

This document examines Finland's policy on natural and environmental resource management. In many fields, progress has been made and pollution curbed. However, there is still room for improvement with regard to cost-effectiveness. Economic evaluation of the measures planned in various fields should accordingly be more systematic. Until now, pollution abatement has been achieved largely through regulation; given the likelihood that very few least-cost options remain, it will be even more important to make wider use of economic instruments to minimise the cost of future measures. In order to ensure that Finnish enterprises remain competitive, energy and fuel taxes are heavier on households than on businesses (in particular the more energy-intensive ones, such as the wood and paper-pulp industries and the electricity sector). Restoring the balance in this area would bring about a marked improvement in the cost-effectiveness of Finland's policy to reduce CO_2 emissions, and foster adjustment towards more sustainable growth. Finally, environmental issues need to be more closely integrated into sectoral policies, particularly in the case of agricultural policy, much of which conflicts with the country's environmental policy objectives.

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Ce document examine la politique finlandaise en matière des gestion des ressources naturelles et environnementales. Dans de nombreux domaines, des progrès ont été réalisés et la pollution a été réduite. Toutefois, des progrès restent à faire pour augmenter l'efficacité par rapport aux coûts. A cette fin, l'évaluation économique des mesures envisagées dans les différents domaines devrait être plus systématique. La réduction de la pollution a été obtenue jusqu'à présent principalement par des mesures réglementaires; les options réductions les moins coûteuses étant désormais probablement épuisées, une plus large utilisation des instruments économiques s'avèrera d'autant plus importante pour minimiser les coûts des mesures à venir. Par ailleurs, dans le souci de préserver la compétitivité des entreprises finlandaises, la fiscalité sur l'énergie et les carburants pèse plus sur les ménages que sur les entreprises (en particulier celles fortement consommatrices d'énergie, telles que l'industrie du bois et de la pâte à papier et le secteur de l'électricité). Un rééquilibrage dans ce domaine permettrait d'améliorer sensiblement l'efficacité-coût de la politique de réduction des émissions de CO_2, et favoriserait l'ajustement vers une croissance plus durable. Enfin, une intégration plus poussée des questions d'environnement dans les politiques sectorielles est également requise, notamment concernant la politique agricole, qui entre dans une large mesure en conflit avec les objectifs de la politique environnementale.

JEL codes: Q23, Q25, Q28, Q48.
Keywords: Finland, sustainable development, environment policy, forestry policy.

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ENHANCING ENVIRONMENTALLY SUSTAINABLE GROWTH IN FINLAND

Ann Vourc'h and Miguel Jimenez[1]

1. Since the early 1990s, sustainable development issues have started to influence policy-making in Finland, as highlighted by the creation of the high-level National Commission for Sustainable Development in 1993. Recently, sustainable development has also been made a top priority area for the work of the OECD. The contribution of OECD Economic Surveys is focused on policies that have an impact on the environment and on natural resource use.[2] Environmental policies, and to a lesser extent resource management issues in forestry, and their interaction with sectoral policies are the major focus of this paper. It builds on the work undertaken elsewhere in the Organisation.[3]

2. Finland has realised considerable progress in improving the environment in many areas. It is in a very good position to meet its international commitments for reducing sulphur dioxide (SO_2) and nitrogen oxide (NO_x) emissions. Some further measures are needed to reduce nutrient discharges in the Baltic Sea. Meeting the Kyoto targets for greenhouse gas (GHG) emissions is the most challenging current issue. However, the decoupling of environmental pressures from output growth witnessed so far could become harder to achieve with continuing growth, putting a premium on ensuring cost-effectiveness of environmental and resource use policies. This will increase the importance of assessing the various abatement operations regularly and of making greater use of economic instruments. At the same time, a better design and integration of sectoral policies could often help to solve environmental and resource management problems at low, or negative, cost in terms of efficiency.

The major issues: an overview

3. A central focus of sustainable development is intergenerational equity: are future generations well equipped to attain the same or a higher level of well being as the current one? The opportunities for future generations largely depend on the total stock of capital (wealth) they inherit. Here, the capital stock is defined broadly, consisting of man-made physical, human and natural (resource and environmental) capital. "Social capital", the system of social values and institutions, is certainly also critical in this respect, and institutional aspects important for the setting of resource and environmental policy objectives and instruments are discussed in this paper. A key issue concerning sustainable development is the degree of substitutability of the various forms of capital. If they were substitutes, a decline in natural capital, for instance, could be compensated by a rise in physical capital. However, some forms of natural capital can probably not be substituted beyond (often unknown) limits. Their depletion could lead to irreversibilities, or regeneration processes could be very slow (forest ecosystems, biodiversity, ozone layer, etc.). This could severely impair the welfare of future generations.

4. Unfortunately, total wealth is very difficult to measure, largely because many environmental resources are very difficult to value. It is possible, however, to trace the development of an important indicator of total wealth, potential output, that is driven by physical and human capital formation, and technical progress. Potential output in Finland has continued to grow, even though it has suffered from the fall in investment during the recession in the early 1990s and the upward drift in structural unemployment. Continued growth reflects, among other factors, that educational qualifications of the Finnish population have risen strongly and are among the highest in the world. Consistent official estimates of total wealth *per se* (human, physical and natural resources, such as forests) for the past and projections for the future, which would provide a better indicator on whether the economy follows a sustainable path, are not available so far.[4] Attempting to measure an even wider definition of wealth, in particular including environmental resources, runs into serious valuation problems. Thus, judgements concerning the sustainable use of environmental assets have to rely on skimming a large number of diverse indicators. Indicators of environmental pressures for Finland suggest that assets of this sort may have decreased until the 1970s, but are likely to have risen again (even though some important issues such as the eutrophication of the Baltic Sea and acidification of some lakes remain serious concerns for environmental policy).

5. Policies aiming at cost-effectiveness are vital to achieve sustainability as they allow faster wealth accumulation. The natural environment is largely a public good, available to all, despite its exhaustible character. This implies that policy needs to ensure that production and consumption decisions take into account their effects on the environment. Ideally, cost-effective policies would aim to correct market failures by properly pricing the use of natural capital while prompting cost minimisation by the individual economic actors. This would imply that policy decisions are based on cost-benefit analysis. In practice, it is often difficult to evaluate the benefits of environmental policies. There is often considerable uncertainty concerning the cost. Concerning the policy instruments, it is generally agreed that economic instruments, such as taxes or permit trading schemes allow economic actors to search for the cheapest abatement method. However, they are little used in practice because of the transaction costs involved in establishing targeted tax or trading schemes. Of equal importance, economic policies in other domains can significantly affect the environment with agricultural, energy and transport policies being the most prominent examples. While policy goals often conflict, it is frequently possible to design better policies, which will reduce distortions, while keeping to the initial goals. For example, the aim of agricultural policy to raise the living standard of the farm community could be achieved in a way that reduces distortions in the use of natural resources by decoupling farm assistance from production.

Institutional framework

6. Finland has an extensive institutional framework for environmental management. The Ministry of the Environment is responsible for a large part of the environmental issues, while the Finnish Environment Institute, an agency of the ministry, monitors and assesses the implementation of environmental policies and provides information to the public. The Ministry of Agriculture and Forestry plays an important role in promoting sustainable forest management and deals with environmental problems linked to agriculture. Municipal environmental administrations were created in the late 1980s, and are taking increased responsibility in managing local problems, in particular regarding water.[5] They are also involved in land planning and environmental education, and since 1997, less commonly, in a campaign to reduce greenhouse gas emissions in urban areas. Important regional bodies are the regional environment centres (supervised by the Ministry of the Environment), with a prominent role in the enforcement of environmental legislation (*e.g.* permit procedures) and in the collection of information on environmental issues, and the regional forestry centres (supervised by the Ministry of Agriculture and Forestry), with responsibility for biodiversity management among other roles.

7. Finnish environmental policy is not yet based on a comprehensive environmental law, but the legislative and regulatory framework for environmental protection has been considerably extended and upgraded throughout the 1990s, partly to harmonise with European Union (EU) legislation.[6] The Waste Act, the Water Act, the Nature Conservation Act and several pieces of legislation on forestry address problems directly related to the environment. The Health Protection Act and the Building Act are also of relevance. A proposal has been made recently for a consolidated Environmental Protection Act which would replace the laws on air pollution control, noise abatement and environmental permit procedures. A system of integrated pollution prevention is in preparation that would rely on a case-by-case approach and on emission standards. Such an integrated system would allow more cost-effective emission abatement if accompanied by systematic economic assessment.

8. Since 1993, a specific forum, the Finnish National Commission for Sustainable Development, exists for debate on policies that aim at sustainable development. Chaired by the Prime Minister, its composition is very broad, with participation of the Parliament, central public administration, local authorities, business representatives, labour unions, scientists and non-governmental organisations (NGOs). It is divided into five subcommittees[7] and operates through working groups (*i.e.* climate change, biodiversity, forestry, trade and the environment, development co-operation). It is also in charge of monitoring the implementation of the government's Programme for Sustainable Development which was approved in 1998. The National Commission plays a role mainly in raising awareness of, and giving political impetus to, sustainable development issues.

9. Specific programmes, such as the Action Programme on Transport, the Agri-Environmental Programme and the Environmental Programme for Forestry, have been prepared by interministerial working groups. The practical implementation of sustainability objectives lies with various administration bodies. The Ministry of Trade and Industry (concerning energy) and the Ministry of Transport and Communications deal with environmental matters in different departments, but they do not have specific environmental units. There is no environmental unit in the Ministry of Finance. A specific unit on sustainable development issues exists in the Ministry of the Environment, and several other departments carry out activities related to the integration of environmental concerns into agriculture, energy and transport policies. The integration between ministries is based mainly on expert level co-operation. However, economic assessments are not systematically pursued in the Ministry of the Environment. Such assessments, accompanied by co-ordination with other ministries, especially the Ministry of Finance, would be beneficial for the implementation of a set of comprehensive sustainable policies, especially where traditional economic instruments like taxes could be used, or where subsidies have adverse environmental side effects.

10. Efforts have been made to develop environmental and resource accounting. Forest accounts have been the pilot project, but data have also been collected on the various environmental issues and policies. The main focus has been to establish environmental accounts compatible with input-output accounts and analysis. The possibility of constructing a green national gross domestic product (GDP) was considered in the early 1990s, but has not been pursued mainly because of the strong uncertainty attached to valuation. A set of 99 sustainability indicators is currently being developed on various issues (*e.g.* loss of biodiversity, economic and social indicators). Based on the environmental statistics, an interministerial working group prepares a yearly review on "Finland's Natural Resources and the Environment" which is published by Statistics Finland and the Ministry of Environment and is attached to the budget proposal. It provides a useful summary of sustainable development issues but does not yet play a strong role in the integration of sustainable development issues in the regular budget process. In 1998, the government decided to use this document as a tool to assess progress on sustainable development.[8]

Forestry policy aims at sustainable management of forests

11. Finland is endowed with very rich forest resources (Box 1). In recent years, the management of forests has evolved markedly from pursuing sustainable wood yield to a wider concept of sustainable development that includes long-term ecological concerns. Following the international conferences in Rio de Janeiro in 1992 and in Helsinki in 1993 (Second Ministerial Conference on the Protection of Forests in Europe), key new laws were approved: the Forest and Park Service Act (1994) which regulates the institution in charge of public forests; a new Forest Act (1997) that promotes "economically, ecologically and socially sustainable management" of forests; and the Act on the Financing of Sustainable Forestry (1997) which provides subsidies to forest projects that ensure the conservation of biodiversity. The commercial and conservation activities of the Finnish Forest and Park Service, which manages state-owned forests, were completely separated in 1998. At the same time, National Forest Programmes (in existence since the early 1960s) have broadened their focus to also include issues such as the recreational use of forests and environmental matters.[9]

Box 1. **The forest sector**

A large share (86 per cent) of the Finnish land area is covered by forests — by far the highest proportion in the OECD. Forest activities (sylviculture, hunting, recreational activities, etc.) have always played a major role in the economy. The share of GDP of direct forest exploitation and the forest-related pulp and paper industries, though declining gradually, is at present still around 8 per cent (Table 1). Four to 5 per cent of the labour force works in the forest sector, and some of the most important Finnish multinationals are forest companies. The wood processing industry, which includes wood products and pulp and paper products, is an export-oriented industry. It exports 70 per cent of its production, mainly to European countries, and accounts for about 30 per cent of Finnish exports. At least 330 000 Finns own some forest land. In addition, the state owns about a third of the forestry surface, mainly in the less productive, northern part of Finland, which is partly dedicated to commercial use (Table 2). Following the old Nordic tradition of Every Man's Right, everyone has free access to all forests in the country. These two factors are reflected in a long-standing involvement of the population in forest matters.

The state does not intervene in the roundwood market. Until now, forest owner associations have negotiated a benchmark price for wood with the industry, which has been used as a reference by small owners in individual negotiations. However, the Finnish Competition Authority is reviewing the current system, and the reference price may be suppressed in the future. Since the share of income from wood production represents on average only 20 per cent of total income for forest owners, they may chose not to sell their production immediately, but can wait until they are satisfied with the price. Even though the paper and wood product sectors are highly concentrated,[10] there is little evidence for market power on the demand side. In fact, even if Finland is naturally endowed with very rich forest resources, the processing sector of the forest industry does not benefit from lower roundwood prices as compared with its closest international competitors. While the state does not intervene in the roundwood market, it promotes the use of wood as an energy source.

Taxation of forestry activities has been reformed recently and is now in line with most other types of economic activity, although forest land is exempted from real estate tax. Earlier, the forest sector was subject to a tax based on land area (a property tax), corrected by a coefficient which depended on the average productivity calculated for large regional areas (and not for individual slots), thus mimicking a production tax. In 1993, this system was replaced by a profit tax based on net income, with a voluntary transition period of 13 years. Under the old system, the tax was largely based on acreage instead of direct production. Furthermore, tax deductions were sizeable, which lowered the tax as compared to alternative uses of funds. The new method applies the standard corporate tax rate of 28 per cent and allows the same deductions as for the business sector in general.

Table 1. **The forest sector in the economy**

As a per cent of total

	1990	1991	1992	1993	1994	1995	1996	1997
Value added[1]								
Forestry sector	7.5	5.8	6.5	7.4	8.2	9.2	7.4	7.8
Forestry and logging[2]	2.9	2.3	2.3	2.2	2.5	2.7	2.4	2.6
Manufactured products[3]	4.5	3.5	4.2	5.2	5.7	6.5	5.0	5.3
Exports								
Forestry sector[4]	37.7	38.0	36.3	34.5	34.2	33.7	29.0	29.0
Raw materials	8.5	7.7	7.4	7.2	8.2	7.3	5.7	6.3
Manufactured products	29.2	30.4	28.9	27.3	26.1	26.4	23.2	22.7
Employment								
Forestry sector	4.9	4.8	4.9	4.6	4.6	4.5	4.3	4.3
Forestry and logging[2]	1.5	1.5	1.4	1.4	1.2	1.2	1.2	1.1
Manufacturing	3.4	3.3	3.5	3.3	3.4	3.3	3.2	3.2

1. Gross at factor cost.
2. Includes related service activities.
3. Wood and wood products; pulp, paper and paper products.
4. SITC Revision 3 classification. Raw materials and manufactured products of cork, wood, pulp and waste paper.

Source: OECD (1998), *Foreign Trade by Commodities*; Statistics Finland (1999), *National Accounts 1990-1998* and *Bulletin of Statistics.*

Table 2. **Forest land ownership**

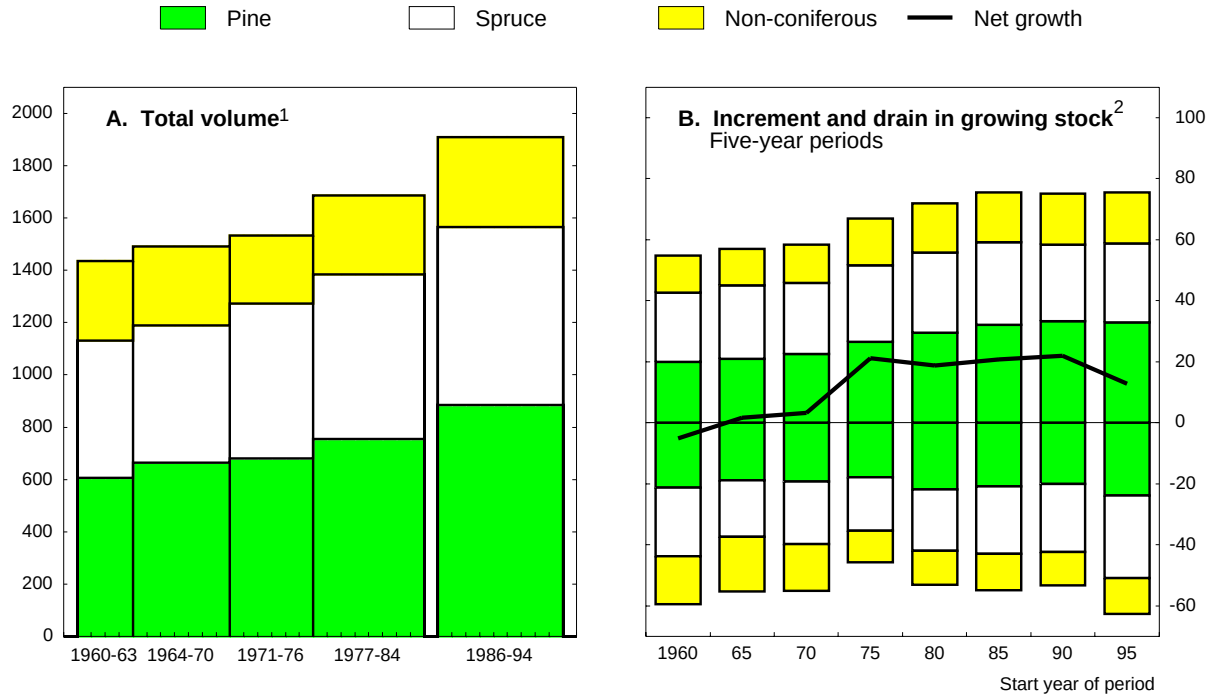
	Inventory period	Area 1 000 ha	Per cent of area			
			Farmers and other private owners	Companies	State	Other
Whole country	1986-97	20 085	61.8	8.8	24.5	4.9
Southern Finland	1986-97	11 119	75.8	11.8	7.1	5.2
Northern Finland	1992-94	8 966	44.4	5.1	46.0	4.5

Source: Finnish Forest Research Institute, *Finnish Statistical Yearbook of Forestry 1998*.

12. During the two decades that followed the Second World War, a considerable effort was made to increase the production and export of wood and wood products, as this is an area in which Finland has a clear competitive advantage. Annual harvesting increased substantially during this period and at the end of the 1950s overtook annual growth so that the forest resources dwindled. At the end of the 1960s, there was a conscious effort to implement forest management methods that ensured rising wood production in the long run. Since then, forest growth has exceeded annual drain[11] and overharvesting is no longer an issue (Figure 1).

13. The pace of forest exploitation is affected by different incentives (subsidies and taxes on production, profits or land). Subsidies to forest activities have been reduced to very low levels, whereas the tax regime has become neutral with respect to that of other economic activities (Box 1). It might be argued, though, that forestry should be subject to an extra tax that recovers a scarcity rent accruing from the use of land. Such a tax is worth studying if rents are considered to be sizeable. However, its practical implementation could be difficult since it may not be easy to distinguish the scarcity rent from the return on capital. Indeed, owners have already paid a price for their properties that includes an estimated future stream of scarcity rents. In addition, forestry activities would be taxed more, while farming is heavily subsidised, with both activities usually carried out by the same entity.

Figure 1. Use of forest resources
Million cubic metres



1. The width of the bar indicates the period of the forest inventory.
2. Million cubic metres per year. Drain refers to the losses in growing stock due to fellings, sylvicultural measures and natural mortality. The data for 1995 covers the period 1995-97.

Source: Finnish Forest Research Institute, Finnish Statistical Yearbook of Forestry 1998.

14. While overharvesting is no longer an issue, there are important environmental issues relating to the past reduction in the area dedicated to old forests[12] and inadequate practices in commercial forests (especially in the south). Both elements directly affect biological diversity. Finnish forests lie mainly in the boreal coniferous forest area. The genetic diversity of the species living there can be of particular importance. Four per cent of the species in Finland are classified either as endangered, threatened or in need of monitoring.[13] Lack of sufficient decaying wood, forest fires and fragmentation of large habitats are considered to be the three most important factors behind an increase in the number of endangered species and the deterioration of genetic diversity in wood areas. For instance, large investments in roundwood transport roads inside forests led to an excessive fragmentation of contiguous natural environments which are needed for many slow-adapting species that rely on large untouched habitats for their survival.

15. The rationale for some sort of public prevention to preserve biodiversity is quite compelling. From an economic point of view, there is a market failure since market prices for forest products do not reflect the risk of extinction and the "existence" and "option value"[14] of biological diversity. At the same time, the lack of a strong direct link between forestry practices and loss of biodiversity makes the use of taxes for the internalisation of such externalities rather difficult. For instance, the damage caused by building a road for wood transport may vary considerably from one area to another which makes a uniform tax on roads inefficient.

16. Several instruments are used to preserve biodiversity.[15] Purchases of forest land by the state are mainly directed at old forests, which are probably the most important biotopes from an international perspective.[16] The share of old forests in total forest land has decreased dramatically during the century and now accounts for less than 20 per cent. Since 1997, a considerable amount of private land has been purchased for nature conservation purposes. The funds for such purchases have almost doubled between 1996 and 1998, and most were dedicated to the acquisition of old forests (Table 3). It is expected that the area of protected old forests will increase from 9 000 ha in 1996 to 345 000 ha in 2007. Concerns about biodiversity have also surfaced in Finland with respect to roundwood imports from Russia, the source of around 13 per cent of the raw wood used by the industry. The sustainability of production of Russian providers, especially in the Carelia region, was cast into doubt during the 1980s. However, annual felling in Russia has decreased in the 1990s, and the total forest area is increasing again in the Carelia region. Concerns about the exploitation of old forests, and the lack of information on the origin of wood, have led the Finnish industry to establish a voluntary moratorium on imports from certain areas.

Table 3. **Spending on nature conservation**

Million FIM

	1994	1995	1996	1997	1998[1]
Purchase of land	161	183	184	321	362
Management of conservation areas	85	75	69	75	75
Compensation payments	20	19	19	43	47
Other	100	35	53	40	66

1. Budgeted.
Source: Statistics Finland.

17. Recent government initiatives pay special attention to the regulation of private forests, accompanied by subsidies to cover part of the costs and information on better forestry practices. The Forest Act defines particularly significant habitats in commercial forests where management has to be carried out in a way that retains their characteristics.[17] Regional forestry centres have a mandate to monitor the provisions of the Forest Act and courts can penalise the violation of the law. To compensate for income losses due to protection costs, the Act on Financing of Sustainable Forestry provides funding to private forest owners.[18] When land owners can demonstrate that environmental measures reduce the yield substantially, they may ask for compensation. Losses exceeding 4 per cent of the logging value or FIM 40 000 are fully compensated. No subsidy is granted for lower losses. Finally, information on environmental guidelines is disseminated by the 13 regional Forest Centres since it is considered that the spread of knowledge on ecological issues can be a cheap way to attain biodiversity goals.

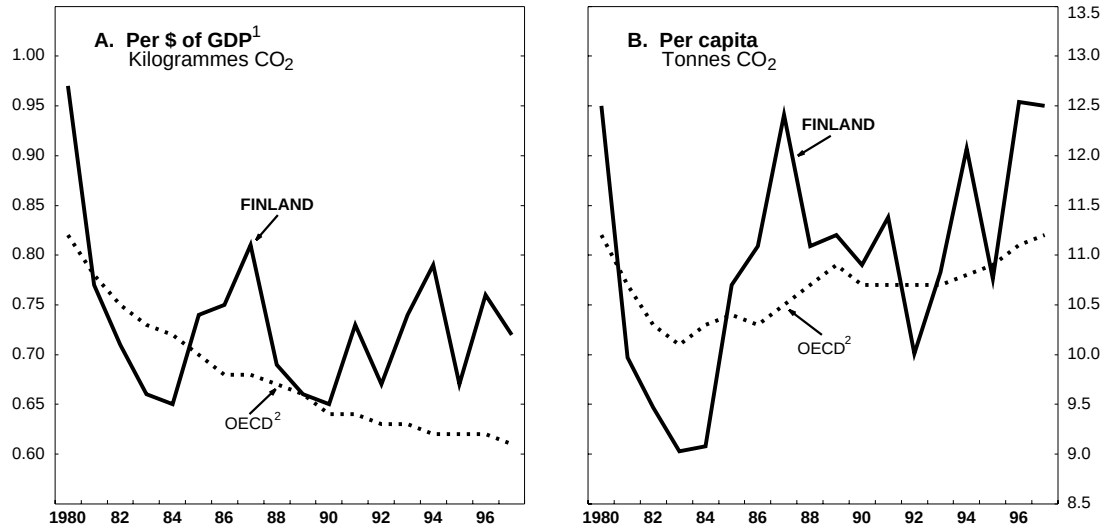
18. In addition to government measures, a forest certification system is being implemented by all participants in the forest sector. Certification and eco-labelling is an information mechanism that ensures that preferences for "sound" ecological products are internalised. In principle, there should be no need for government intervention in the design of such a system, but given the high cost of implementing a narrowly-targeted certification procedure,[19] a direct financial contribution by the state may be appropriate. The Ministry of Agriculture and Forestry is indeed facilitating the set up of the system by partly funding its implementation.[20] A careful analysis of the implementation costs of different certification systems and the benefits from increased income and improved environmental efficiency is necessary to assess the appropriate level of government funding. This evaluation should be carried out in a comprehensive framework that takes into account all policy instruments available for attaining well-defined biodiversity goals. The cost-effectiveness of tools already in place (regulations and subsidises, land purchases, information and training) should be assessed and compared with that of more market-oriented tools (like certification and labelling, or taxes where they are feasible) to find an optimal policy mix.

Climate change policy

19. Climate change is the top environmental policy priority in Finland. According to the burden-sharing of the Kyoto target within the EU, Finland is committed to return to its 1990 national emission level between 2008 and 2012. Although this is less stringent than for the EU as a whole, the goal is nonetheless ambitious.[21] Energy intensity is high in Finland, due to a number of structural features. First, the cold climate requires significant energy consumption for heating. Second, despite the remarkable development of the electronic equipment industry in recent years, forest-based and metal industries and to a lesser extent the chemical industry (which are highly energy-intensive) still form the backbone of the Finnish industry, together accounting for more than 60 per cent of total manufacturing output. Third, transportation distances are long, due to the country's low population density. Hence, carbon dioxide (CO_2) emission intensities are high in Finland compared with the OECD average, and they show no decreasing trend in per capita terms while, in relation to GDP, the decrease has halted since the second half of the 1990s (Figure 2). At the same time, energy efficiency is already high in Finland, in large part due to a wide utilisation of co-generation in electricity production (Box 2). Abatement will, therefore, be more costly.

20. Indeed, the official baseline projection puts total GHG emissions in 2010 about 27 per cent higher than in 1990, the bulk of the increase coming from CO_2 emissions after 2000 (Figure 3). In 1997, despite the recession of the first half of the 1990s and a substantial decrease in methane (CH_4) emissions due to changes in waste management policies, Finnish GHG emissions were already 4 per cent higher than in 1990 (and CO_2 emissions 10 per cent higher). Man-made CO_2 emissions originate almost exclusively from energy production and from transport, while agriculture and waste are the major sources for methane and nitrous oxide (N_2O) emissions (Figure 4).[22]

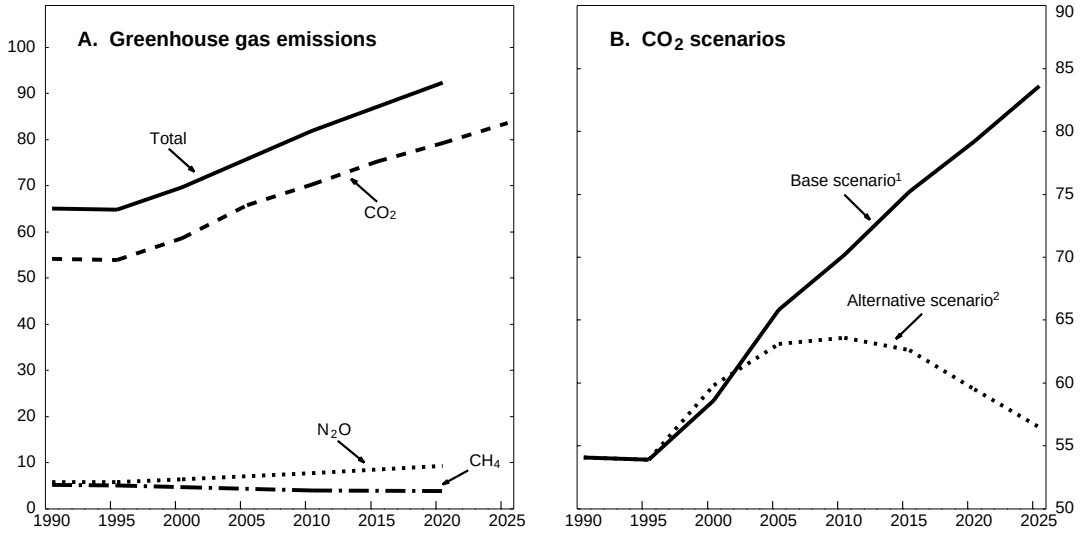
Figure 2. CO_2 emission intensities



1. Using 1991 prices and purchasing power parities.
2. Average excluding eastern Germany, Czech Republic, Hungary and Poland.

Source: IEA (1998), CO_2 Emissions from Fuel Combustion; OECD Environmental Indicators 1998 and OECD Secretariat.

Figure 3. Projections of greenhouse gas emissions
Million tons CO_2-equivalents



1. Scenario based on no change in current policy.
2. Policy scenario including increased use of gas and bioenergy for electricity generation combined with improvement in energy efficiency and higher taxation levels (see main text).

Source: Ministry of Trade and Industry.

Box 2. **Energy policy**

The general objective of energy policy has been to ensure reliable supply of energy at competitive prices, in a country where energy intensity is high. The policy also aims at meeting environmental requirements. The energy supply is quite diversified and energy imports cover about 60 per cent of total use. During the past three decades, energy supply shifted away from oil towards coal, and more recently, peat, nuclear and natural gas. Finland is also importing a non-negligible share of its electricity supply. Industry accounts for about half of total energy use and its share is increasing over time, in contrast to the other OECD countries. The forest industry is the largest consumer, but produces a substantial share of its needs (more than 40 per cent) by using renewables (waste wood and other by-products). The share of wood and derived products in total energy supply is indeed the highest in Europe.

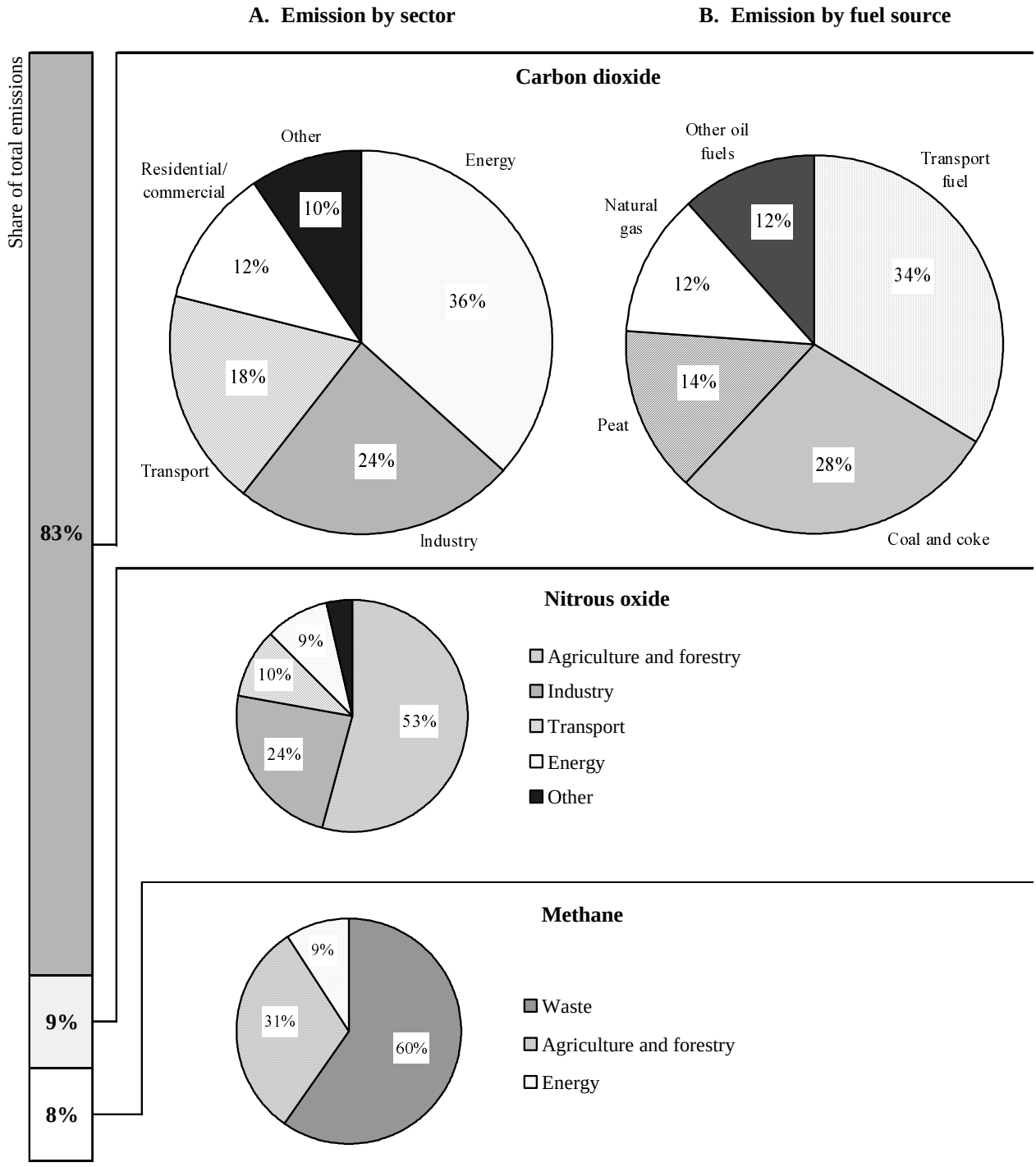
Direct government intervention to steer the choice of energy sources is scarce, apart from decisions regarding the use of nuclear power. In 1993, the Finnish Parliament overturned the Council of State's decision to construct a fifth nuclear power plant. However, economic instruments, both taxation and subsidies, have been used to improve energy efficiency and to favour the development of domestic energy sources such as peat and biomass.

Peat, in particular, as one of the few indigenous energy resources, was given substantial support in the form of research and development (R&D) and investment subsidies, and tax exemptions. Finland's peat technology is highly advanced and allows the use of wood in the same boilers. Today, peat can compete with coal and sometimes oil in combined heat and power production in the sparsely populated central, eastern and northern parts of Finland which are remote from the gas grid and from ports for coal imports, but only due to the energy tax exemption (IEA, 1999). Peat production also plays a role in supporting employment in high-unemployment regions (harvesting involves 2 100 persons yearly). However, peat causes also a number of environmentally harmful emissions, including sulphur dioxide (SO_2), nitrogen oxides (NO_x), volatile organic compounds (VOC) and, not least, carbon dioxide (CO_2). Peat emits the same amount of CO_2 as coal per unit of energy. Although peat fields also absorb greenhouse gases, CO_2 emissions from burning peat are included in the Kyoto Protocol.

In recent years, the electricity market has changed considerably. Following the United Kingdom and Norway, the Finnish electricity market has been gradually liberalised since 1995, and since 1997 Finland is effectively part of the Scandinavian electricity market with Denmark, Norway and Sweden. As a result of increased competition and improved overall efficiency, the price of electricity has been decreasing for large consumers and has started to do so for small consumers as well, for which competition was introduced in autumn 1998. This trend, which is expected to continue in the future, may result in an increase in electricity consumption and may have therefore important unintended side-effects on greenhouse gas emissions. In some cases, such as in the United Kingdom, electricity market liberalisation, combined with coal and gas supply reforms, led to a reduction in greenhouse gas emissions through a switching from coal to gas. In the case of countries relying to a non-negligible extent on non-fossil fuels, such as Finland, it may however, accelerate the shift towards a more fossil-fuel based electricity production. To avoid a surge in greenhouse gas emissions, it will probably become all the more important to have a policy in place, which internalises environmental externalities. There is already an electricity tax, but it is not differentiated by carbon content. On the other hand, more competitive markets, would have the advantage of responding more quickly to new environmental constraints (IEA, 1998).

As noted in the Finnish Government Programme for Sustainable Development, the greatest challenge for Finland's national energy policy is to succeed in reducing trade-offs due to conflicting goals, in particular, the provision of energy at internationally competitive rates and the restriction of greenhouse gas emissions. Decisions have to be taken soon on future energy supply. The potential for increasing hydropower is very limited, and the development of renewable resources cannot be expected to meet the needs. Two main options are being considered by the government: the construction of a second gas pipeline, or the building of a fifth nuclear power plant. The nuclear option has the advantage of not increasing greenhouse gas emissions, but involves other important environmental issues. Moreover, there are questions about economic efficiency in the new competitive environment where large-scale, capital-intensive facilities are likely to lose market share.[23] One major concern related to the gas option is the reliability of supply. Today, Finland depends on one pipeline and a single supplier, the Russian Federation. The long-term objective is to create a more diverse gas market, with interconnection to the European grid, which requires major international decisions. One option, hooking on to the Nordic gas grid, would extend the gas grid to the west, while the other one would provide an alternative route for Russian gas to western Europe. Which option is chosen (gas or nuclear), the additional capacity would not be operational before 2010.

Figure 4. Greenhouse gas emissions by gas and sector
1995



Source: Ministry of the Environment (1999), "Finland's National Greenhouse Gas Inventory to the UN's Framework convention on Climate Change", Helsinki; and Lehtilä and Tuhkanen (1999).

21. Finland was the first country to introduce a CO_2 tax in 1990, initially with few exemptions for specific fuels or sectors.[24] Since then, however, energy taxation has been changed many times and substantially, from a low but "pure" CO_2 tax to a much higher but much less CO_2-related tax. After a number of increases in the CO_2 tax rate, the first major change occurred in 1994, when an additional component based on the energy content of the fuels was introduced, as well as special taxes on nuclear and hydropower. Imported electricity was taxed at the average rate applied to domestically produced electricity. As noted by the Environmental Economics Committee (1994), which was set up to examine the efficacy of the various tax options to reduce emissions, the numerous changes were mainly motivated by fiscal rather than environmental concerns.

22. The second important revision of energy taxation took place in 1997, prompted by the opening of the Nordic electricity market. Domestic industries, and in particular the electricity sector, felt disadvantaged by the fact that energy-intensive sectors were exempted from the CO_2 tax in the other Nordic countries, some of which also have ample carbon-free power supply. In addition, electricity imports could not be taxed according to their carbon content. At the same time, the border tax on imported electricity was found to be out of line with the EU single market legislation. Therefore, to avoid harming the competitiveness of domestic industries, the carbon/energy tax based on fuel inputs in the electricity sector was scrapped and an electricity consumption tax was introduced, with a lower rate for industry and greenhouse cultivation (slightly above half the rate on households and service sectors). Source fuels for heating and transport continued to be taxed, but only on their carbon content, with a reduced rate for natural gas and peat. Since then, tax rates have been raised on several occasions and further exemptions added. In addition, energy excise duties paid by energy-intensive industries will be partly refunded on the condition of approval by the European Commission.[25]

23. The current system is rather complex and the link between the taxes and the carbon content in electricity generation is clearly looser than in the earlier system, thus providing little incentive for cost-effective abatement (Table 4). The electricity tax, geared to consumption, provides an incentive to

Table 4. **Energy taxation**
At 1 January 1999

	Unit[1]	Tax			Markka per tonne of CO_2	
		CO_2	Excise	Total	CO_2 tax	Total tax
Fuel						
Gasoline	Penni/litre	23.9	304	**328**	102	1 400
Diesel	Penni/litre	26.9	152	**179**	102	679
Light fuel oil	Penni/litre	27.0	10.9	**38**	102	144
Heavy fuel oil	Penni/kilogram	32.1	0	**32**	102	102
Natural gas	Markka/MWh	10.3	0	**10**	61	61
Coal	Markka/MWh	35.2	0	**35**	102	102
Peat	Markka/MWh	9.0	0	**9**	24	24
Electricity						
Industry	Penni/kWh			**2.5**		
Other	Penni/kWh			**4.1**		

1. MWh = Megawatt hour; kWh = Kilowatt hour; 1 markka = 100 pennis.
Source: Ministry of Trade and Industry.

much stronger for households than for industries, due to the differentiated rates for the electricity tax and the additional exemptions for industry — electricity represents more than 40 per cent of energy consumption. The link with the carbon content will also become loose for energy-intensive firms if the refunding scheme is approved by the Commission. Overall such a system, since it partially excludes the most energy-intensive industries and, therefore, obliges others to pay higher taxes to achieve the emission reductions, increases the overall costs of reducing CO_2 emissions. In addition, from a longer run perspective, the current CO_2 tax structure favours CO_2-intensive activities which conflicts with the objective of the tax (Box 3).

24. Apart from the CO_2 tax, a number of other measures affecting GHG emissions have been undertaken, although, as in other OECD countries, most of them were initially designed to achieve other objectives:

- To improve energy efficiency, a number of voluntary agreements have been signed recently with industries, covering now a substantial part of the sector. These agreements, which run until 2005, set fixed quantified targets for firms but not at the sectoral level. Further development of measurement methodology would be needed, however, to allow a proper monitoring of these agreements and to assess their effectiveness (IEA, 1999). Energy conservation is also promoted through subsidies to energy-saving investment (up to 30 per cent of the costs), and to energy auditing of buildings in the industry and the service sectors (up to 50 per cent). Although this has not been evaluated, there is a risk that part of these subsidies finance investments that would have been undertaken even without subsidies, and that they represent to some extent a waste of taxpayer's money. Finally, the state is supporting R&D for energy conservation.

- To promote the development of indigenous energy sources, the government has also systematically supported the development of peat (which, as noted above, is not particularly “clean”) and renewable energy sources, mainly wood. Wood combustion releases carbon, but if the wood is replaced, the CO2 balance is neutral. CO2 emissions from wood combustion are in fact not included in the Kyoto target. The following instruments are used: subsidies to investments in energy production based on these energy sources (up to 30 per cent of investment costs) and for the harvesting of energy wood; exemptions from the electricity tax; and funding of technological development related to these energy sources.[26] As for policies to improve energy efficiency, it is difficult to assess the effectiveness of this support.

- For transport, taxation has been the main instrument used. Transport fuels have been subject to the same CO2 tax as other fuels. In addition, excise taxes, although they are generally motivated by fiscal rather than environmental objectives, are also an important steering factor. Taxes on gasoline have been raised in the 1990s, while those on diesel oil have been left almost unchanged (Figure 5). To date, the tax advantage for diesel compared with unleaded gasoline is the largest in the OECD (Figure 6). This is not in line with their relative pollution effect since CO2 release is the same per litre of diesel and gasoline, while other environmental costs associated with diesel are higher than those from gasoline. A relatively high annual tax on diesel cars has prevented an increase in the number of private diesel cars. Overall, more weight is put on households (*i.e.* private cars) than on the transport of goods, reflecting, as in the case of energy taxes, concerns about competitiveness (Box 4). Taxes on the acquisition of vehicles and annual taxes are also important, amounting together to about 45 per cent of the revenues generated by the energy taxes in 1997, but they do not provide well-targeted incentives for emission reduction.

Box 3. **Competitiveness: a valid reason for suboptimal environmental taxation?**

Competitiveness issues have always been a stumbling block to the implementation of a pure CO_2 tax. Indeed, in other countries applying a CO_2 tax (*e.g.* Sweden, Denmark, Norway) energy-intensive industries have been tax-exempt from the start. The arguments traditionally used against the unilateral implementation of a CO_2 tax applied to all sectors may appear even stronger in the case of Finland. Energy-intensive industries represent about two-thirds of manufacturing output and a substantial share of their output is exported to international markets characterised by strong price competition. In addition, compared with the main competitors on the electricity market, Norway and Sweden, the energy supply is much more carbon-intensive in Finland, and a high tax on coal-produced electricity would substantially reduce the competitiveness of Finnish electricity production. On the other hand, the tax would be very effective at low levels. Given the competitiveness concerns, the Finnish authorities have often underlined the need for harmonisation of energy taxes at the European level, favouring the introduction of energy taxes at a sufficiently high level to steer behaviour (Ministry of Trade and Industry, 1997).

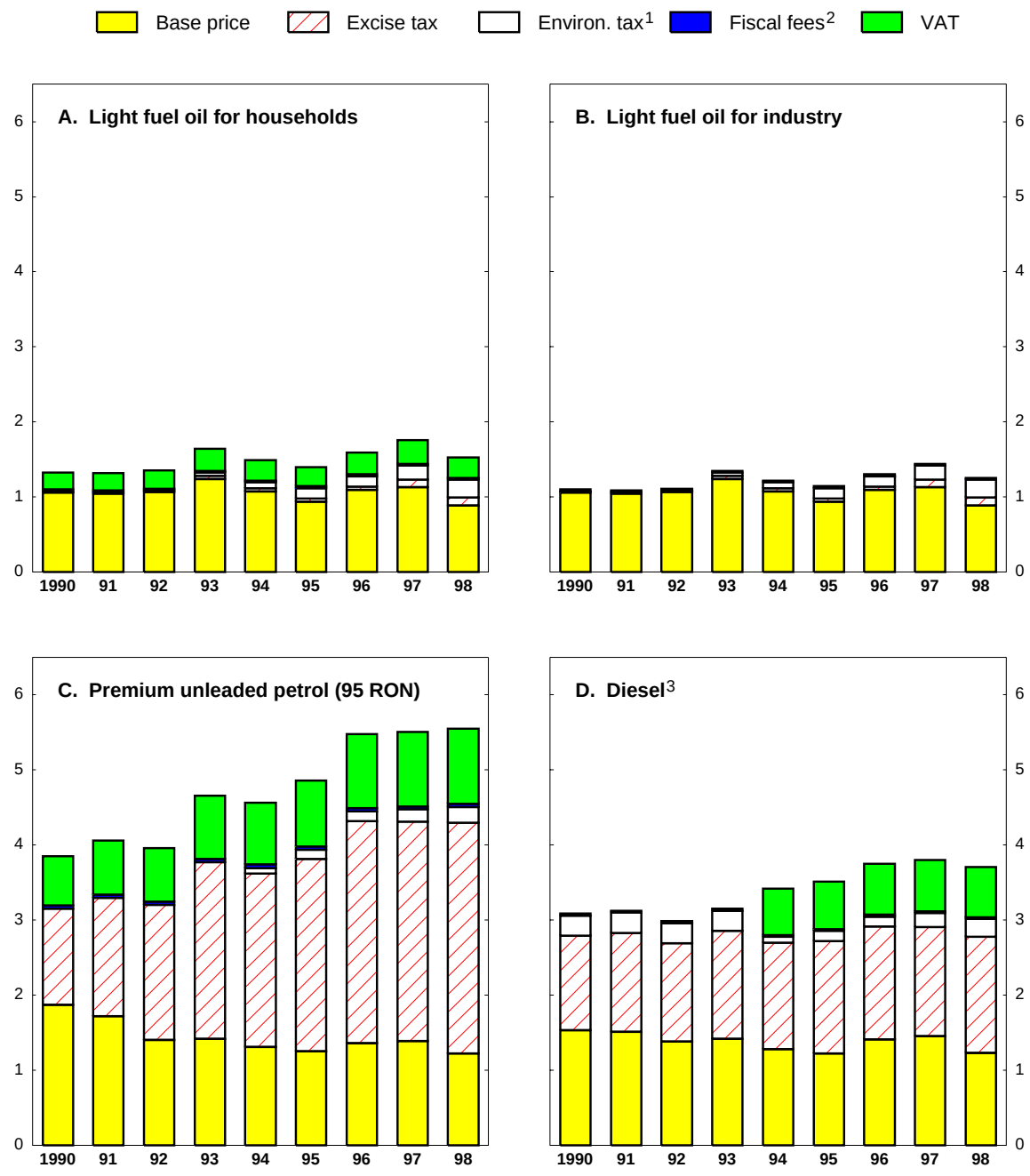
It is unlikely that such a harmonisation will take place quickly. Two proposals have been made for an EU-wide energy taxation system, without agreement so far. The first one envisaged applying broad-based minimum tax rates on all fuels (except renewables) with a CO_2 component and an energy component. It was to be phased in progressively up to a level of US$10 per barrel-equivalent. Exemptions were proposed for energy-intensive industries. The proposal met strong opposition from most of the Member countries, and was abandoned in 1996. A new proposal by the Commission in 1997 included a minimum level of taxation instead of minimum tax rates *(i.e.* the tax base could be chosen by each country), and the taxation of electricity as a final product. Member states could choose the way the tax would be calculated and energy-intensive industries could be exempted (Bill, 1999). Compared with the current Finnish tax levels, the minimum tax levels are low, except for diesel. Overall, the Commission proposal is quite similar to the Finnish system, and would suffer from the same drawbacks.

The "competitiveness arguments" should be treated with caution. First, the CO_2 tax revenues could be used to reduce other distorting taxes (such as labour taxes), which would overall favour the competitiveness of non energy-intensive industries (Barker, 1999). Second, it is well known that the effects of a CO_2 tax on the competitiveness of energy-intensive sectors are small in comparison with other factors, such as the exchange rate or the wage rate. Given its natural resource endowment, Finland has definitely a comparative advantage in the forest industry, and would probably still have one even with increased energy costs. METLA(1998) discusses the implication of increased energy costs for the forest industry, concluding that it is not obvious that it would hamper the competitiveness of the industry. In general, the approach to competitiveness is too narrow. What matters in the end is the dynamic comparative advantage and, in the long run, as witnessed by the development of the electronic equipment industry, it may not be in metal or chemicals production, which account for around 20 per cent of manufacturing output in Finland. It is, indeed, paradoxical that energy taxation, introduced with the objective to reduce environmentally harmful effects and greenhouse gas emissions in particular, ends up providing incentives in the opposite direction, *i.e.* favouring energy-intensive sectors in relative terms.

In addition, the evidence for significant leakage effects (*i.e.* the displacement of emissions from countries applying environmental regulation to countries with no or less stringent regulation) is quite weak (Adams, 1997). It is true that the uncoordinated introduction of a CO_2 tax could lead to an undesirable switching of productive capacity, which would be costly to reverse, if other countries were to introduce a CO_2 tax later on. However, a gradual phasing-in of the tax (including, for instance, a temporary compensation scheme not related to emissions) could largely avoid such unnecessary costs by giving economic actors due time to adjust and provide sufficient time for the various national authorities to co-ordinate their climate change strategy.

Alternative ways to reduce greenhouse gas emissions by economic instruments are currently discussed in international fora. An alternative to EU-wide energy taxation would be the creation of an international market for greenhouse gas emission permits. It would reduce the overall costs of meeting the Kyoto target by allowing the emission reductions to take place where abatement costs are lowest. To the extent that emission quotas can be partly "grandfathered" (*i.e.* allocated in proportion to past emissions) a trading system would reduce the cost for the industries compared with a pure CO_2 tax, therefore making it more acceptable, while at the same time providing "correct" abatement incentives at the margin. The same could be achieved with a harmonised EU-wide CO_2 tax combined with a compensation scheme or tax credit which does not modify the incentives to reduce emissions. The burden sharing already takes into account differences in marginal abatement costs, but the harmonised tax would not guarantee that individual countries' targets would be reached.

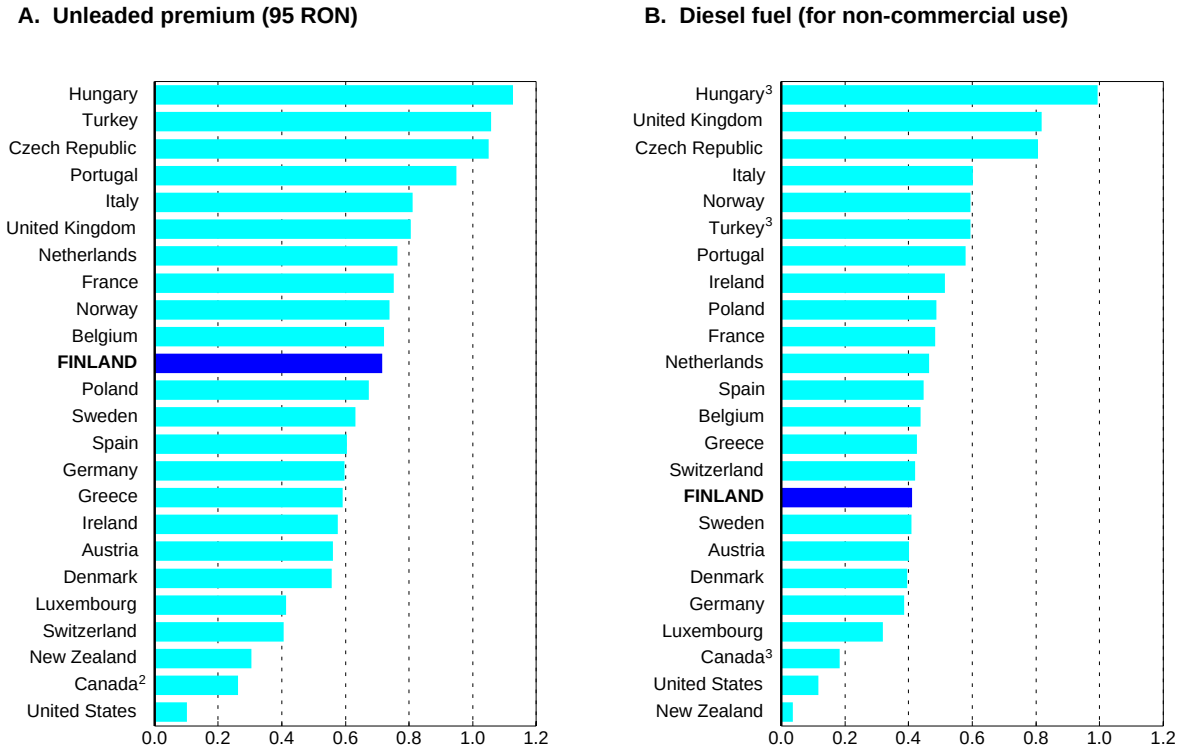
Figure 5. Prices and taxes for fuel oil and gasoline
FIM per litre



1. Environmental tax up to 1993 which was replaced by the energy/carbon dioxide tax from 1994 onwards.
2. Fiscal charges and fees covering a precautionary stock fee and an oil pollution fee.
3. Automotive diesel for non commercial use, sulphur-free quality as from mid 1994. The excise tax includes a sales tax (at the same rate as VAT) up to mid 1994, when the VAT rate was applied.

Source: IEA, Energy Prices and Taxes.

Figure 6. Petrol taxes in international comparison
Total taxes levied in 1998, US$ per litre[1]



1. Using current purchasing power parities.
2. 98 RON.
3. For commercial use.
Source: IEA, Energy Prices and Taxes and OECD, Main Economic Indicators.

- Waste policy measures, which are mostly command and control, are also of importance for reducing methane emissions. Increasing volumes of waste had been the main factor driving the increase in the past two decades. However, as a result of new regulation passed in 1993, the number of landfills has dropped and landfill management has improved. Recently, landfill gas recovery has also been made mandatory for new landfills, a move which — when combined with the use of the recovered gas for energy production — was found to be the most cost-effective waste treatment option to reduce GHG emissions (Pipatti and Wihersaari, 1998).

- Finally, as a result of agronomic measures to improve nitrogen fertilisation techniques and of reduced fertiliser use, N2O emissions from agriculture have started to decrease (see below).[27]

25. Up to now, as in most other OECD countries, no radical decisions have been taken to mitigate GHGs. As noted in Box 2, the government is considering two main options for fuel switching (*i.e.* building an additional gas pipeline or a new nuclear power plant). Apart from that, the climate change strategy consists mainly in "doing more of what already exists". In the transport sector to control road traffic volumes, the government envisages adjusting taxation. One possibility is to grade the acquisition and/or annual tax on the environmental characteristics of the vehicles. However, to control CO_2 emissions an

Box 4. **Transport is emission-intensive**

Transport volume has been growing considerably in Finland since 1970, spurred mainly by road traffic (passenger and freight). The economic recession in the first half of the 1990s has temporarily halted the rise, but the upward trend has resumed since 1996. On the other hand, public transport, mostly rail, had remained stable in the 1980s, but a substantial decline in rail freight traffic during the recession led to cuts in services, especially in low-density areas.[28] Rail, nevertheless, accounts for a market share of freight transport that is about double the European average of 14 per cent, and public transport has been recovering since 1996.

Transport is emission-intensive. Most difficult to tackle are CO_2 emissions. Although CO_2 emissions from transport still account for a smaller share of total CO_2 emissions than in other OECD countries, their importance has been growing quickly. Road traffic is the main culprit, accounting for 90 per cent of CO_2 emissions from transport, but emissions from air transport have been growing most rapidly. Emissions of acidifying gases, primarily NO_x for which transport is the main source, are causing important adverse environmental effects. They have been considerably reduced since 1990, however, with the adoption of emission standards and the progressive renewal of the vehicle stock. Local air pollution in urban areas from other exhaust gases such as carbon monoxide and of particulates is not an acute problem in Finland. Yet, threshold air quality values are exceeded on some occasions in the large towns. Finally, transport also contributes to other environmental problems such as local noise pollution, the fragmentation of ecosystems and landscapes, and waste. Official estimates are not yet available for emissions of the various gases per passenger kilometre or ton kilometre for the different transport modes, nor are abatement cost estimates.

Since 1994, Finland is implementing the Action Programme for Reducing the Adverse Effects of Transport on the Environment which covers all transport modes. Such a comprehensive approach is still quite rare in OECD countries. The plan fixes specific emission reduction targets for the year 2000, such as stabilising greenhouse gas emissions from the transport sector at their 1990 level and decreasing NO_x emissions by 30 per cent compared to 1980. These targets correspond to the national targets set for reducing these emissions, and do not reflect results of cost-benefit analysis. CO_2 emissions were still below the target in 1997, but they are projected to be 4 per cent higher in 2000 due to strong traffic growth. NO_x emissions from transport were 8 per cent lower in 1997 compared with 1980 and, according to official projections, the target should be reached with some delay around 2003.

Improving energy efficiency in the transport sector is one way of reducing emissions, but the Finnish authorities also aim at controlling traffic growth, at least for private cars. No CO_2 target has been adopted yet for 2010. Under current policies, road traffic is expected to increase by 27 per cent between 1997 and 2010, freight traffic being the component growing most rapidly, and CO_2 emissions would be 9 per cent higher than in 1990. There is no evidence on the relative abatement costs in the transport sector compared to other sectors of the economy, but unless they are much higher for transport, meeting the Kyoto target will require taking significant measures to reduce traffic growth. In this case, taxation will have to be increased and focused to a greater extent on fuel input. A radical shift from vehicle to fuel taxation both for cars and trucks would help in this respect. Vehicle taxes are very high in Finland compared with most other European countries, but they are not a well-targeted instrument and are probably slowing down the renewal of the vehicle park.

In line with the EU's approach, Finland has endorsed the principles of marginal cost pricing and full coverage of marginal social costs in the long run as part of its transport policy. Pricing transport at the marginal social costs, including the environmental costs, is necessary for the transport system to develop in a way which minimises the negative environmental effects. In principle, users should be charged operating costs, an efficient share of infrastructure costs, plus external costs (congestion, pollution and accidents). Ideally, the charges should vary according to time, place and condition. Environmental and other externality costs tend to be systematically under-covered in transport prices in most countries (ECMT, 1998).

(continued on next page)

(continued)

Cost recovery estimates including external costs (except for noise and congestion) are available for road and rail transport. They are calculated as the ratio of taxes and charges related to a given transport mode to costs and expenditure related to the same mode. Given the difficulty to value external — in particular, environmental — costs, the levels obtained in this type of calculation are uncertain, but in the Finnish case, the use of a common methodology allows interesting comparisons among the modes. The estimates show that marginal cost recovery for road transport has been substantially increased during the 1990s, and that overall, the charges imposed on road traffic are higher than marginal costs (Table 5). This tends to point to an inconsistency between the valuation of environmental costs used here and the one implicit in the Kyoto target. In any event, there is a sizeable difference in the treatment of private cars on the one hand and lorries and buses on the other, and this gap is increasing over time, largely reflecting the lower taxation of diesel fuel compared to gasoline.[29] From an environmental point of view though, lorries should be given the same incentives as private cars. This would help reducing the negative environmental impacts from transport.[30] Indeed, most of the projected increase in CO_2 emissions under current policies is coming from lorries and vans. Their share in NO_x emissions from road traffic is also increasing.

Concerning rail transport, relative prices are skewed in the opposite direction, since the marginal cost recovery ratio was estimated at 75 per cent for passenger transport and 100 per cent for freight in 1997. In the same year, with a 93 per cent marginal cost recovery ratio, road freight was charged slightly less than rail freight. Total cost recovery for rail is estimated at only 14 per cent. For shipping and air transport, cost recovery ratios including pollution costs have not been estimated. However, the fact that fuel for aviation is not taxed, as in most OECD countries, introduces a major distortion in favour of this transport mode. CO_2 emissions from international aviation are not included in the Kyoto Protocol. International negotiations to control these emissions are in progress.

Regarding rail, deregulation, which is lagging behind road freight liberalisation, may reduce rail prices and allow an increase in market share of rail freight, and favour the development of intermodal systems.

Table 5. **Cost recovery in road and rail transport**
Per cent of total cost

		Marginal		Total	
		1990	1997	1990	1997
Road	Lorries	42	93	33	63
	Buses	38	96	28	69
	Passenger cars and vans	62	163	82	162
	Total	62	142	66	131
Rail	Passenger	..	75	..	14
	Freight	..	100	..	

Source: Ministry of Transport and Communication.

increase in taxes on fuels — the CO_2 tax as first best — would be more appropriate since it is directly linked to car use and emissions.

26. One way of reducing carbon emissions is to store carbon in forests. Hence, land-use changes and forestry policies may be a complement to other mitigation policies. However, the Kyoto Protocol allows human-induced changes in take-up of GHGs by sinks to be treated as a credit only in a limited way. In practice, only afforestation (*i.e.* the human-induced extension of forest surfaces) since 1990 would be considered as a sink, and not the increment of the current growing wood stock (METLA, 1998). This is hardly an option for Finland since forests already cover 86 per cent of the country's surface. Moreover, given the time profile of carbon sequestration in forests, afforestation is not relevant for the 2010 horizon. In any case, sinks have not been included in the EU burden-sharing mechanism.

27. The Finnish government has established scenarios for the effects of the two fuel switching options (gas and nuclear power) on CO_2 emissions in 2025. The two scenarios include a number of additional restraining factors, including higher world market energy prices, higher taxation, more stringent regulatory measures, and faster penetration of new, energy-saving technologies.[31] In both cases, however, CO_2 emissions in 2010 surpass the 1990 level (by 12 per cent with the gas option and 2 per cent with nuclear power). In an update by the Ministry of Trade and Industry, the growth in CO_2 emissions in the gas scenario has been revised upwards (by 6 percentage points to 18 per cent above the 1990 level). Hence, a strategy consisting of a combination of fuel switching with "doing more of what exists already" is probably not sufficient for Finland to meet its Kyoto commitment.

28. According to a recent study, there is some evidence that abatement costs for methane and N_2O emissions are lower than for CO_2 emissions, so that an integrated abatement strategy would allow substantial cost savings (Lehtilä and Tuhkanen, 1999).[32] In any case, the marginal abatement cost of meeting the Kyoto target in 2010 would be very high, in the range of FIM 200-300 per ton of CO_2 equivalent, according to official estimates.[33] There are no official estimates of the overall costs of meeting the Kyoto target nor of the potential ancillary benefits for other environmental issues associated with it. One option to reduce the costs would be to rely more heavily on imports of electricity than is the case today, but this is not considered by the government. With the liberalisation of the electricity market, the security margins for electricity supply have diminished, and they should continue to do so in the long run with the access to a wider liberalised European electricity market.[34] Given the high level of estimated marginal abatement costs, Finland would also strongly benefit from using the flexibility mechanisms included in the Kyoto Protocol. Some projects to reduce GHG emissions in other countries (joint implementation or clean development mechanisms) are already under study, but wider gains could be achieved by buying CO_2 emission quotas abroad, if that were possible. It depends, however, on decisions made within the EU and internationally.

29. It has been decided to appoint a committee to study the feasibility of a national trading system for emission quotas as well as the use of Kyoto flexibility mechanisms. This option would have some advantages. First, a partial grandfathering of emission quotas could make it more acceptable to industry than a pure CO_2 tax, whilst giving "correct" abatement incentives at the margin. Second, it would allow for a better control of the amount of emissions. Finally, it would make it easier to participate in an international (EU or broader) trading system as soon as it is created. It might also facilitate cutting domestic emissions whenever it becomes clear that the demand for quotas on the international market exceeds the supply. On the other hand, in a small country like Finland, there is a risk that unless they are linked to an international trading system, emission quota prices could be influenced by market power.

Transborder and local pollution problems

30. The Finnish territory is affected by a number of transborder problems, most prominently acidification of inland waters and soils and eutrophication in the Baltic Sea[35] (Box 5). These problems are dealt with within the framework of international treaties, namely the Sofia and Oslo Protocol for acidification and the Convention on the Protection of the Marine Environment in the Baltic Sea for eutrophication (Table 6). In addition, Finland is co-operating bilaterally with neighbouring countries, in particular Russia and Estonia. These agreements generally fix national targets, but the associated pollution problems are of a regional nature. The design of policies is thus rather complex, since instruments have to be tailored to the damage caused in the different parts of the country.

Box 5. **Transborder pollution problems and co-operation with neighbouring countries**

During 1991-97, the Finnish government spent FIM 440 million (about 2.5 per cent of overall government spending on the environment) on reducing pollution in neighbouring countries, covering 232 investment and 560 technical assistance projects. Co-operation on environmental issues between Finland and central and eastern European countries began in the mid-1970s under the Baltic Sea Convention and has been intensified since then through several bilateral and multilateral agreements, and through EU activities such as the Baltic Sea Region Initiative. As a follow-up, in 1998, the Baltic 21 Action Programme on Sustainable Development was adopted. In 1991, the Finnish Ministry of Environment set up the East Europe Project, with local and regional partners in neighbouring countries, particularly in north-western Russia, the Baltic states and Poland. The primary objective of the project is to reduce emissions in neighbouring areas of Finland and its focus has been on air and water protection as well as on waste management. Given the size of the problems, Finland does not have the financial capacity to resolve them alone.

Transborder air pollution, mainly SO_2 and particulates originating from smelters in the Russian Kola Peninsula, has caused environmental damage in the northern part of Finland. Due to the economic slump, capacity utilisation of the smelters has been low in recent years, resulting in a drop in SO_2 emissions from 660 000 tons in 1992 to 300 000 tons in 1994 which is still more than double the total Finnish emissions (140 000 tons in 1994). Finland has subsidised environmental investment projects to reduce SO_2 emissions of the Kostamuksha mining complex in Carelia, which emitted 48 000 tons in 1994, and affects neighbouring areas in eastern Finland. It also subsidised environmental investment projects at the Narva power plant in Estonia that had SO_2 emissions equal to the Finnish total.

The St. Petersburg area is responsible for 70 per cent of the nitrate and phosphorus load to the Gulf of Finland. The gulf receives large amounts of untreated waste water from St. Petersburg, as 30 per cent of municipal waste water from this area with 5 million inhabitants is untreated, while waste water from the Tallinn area in Estonia (0.5 million inhabitants) and from Helsinki (1 million inhabitants) is biologically and chemically treated. The Finnish government is supporting the renovation of the St. Petersburg sewerage system. Joint projects are also set up to reduce the pollution of the Gulf of Finland by the industry in the St. Petersburg area (industrial waste water and hazardous waste), by pulp and paper plants in Carelia, and by industrial facilities in Estonia.

In Finland, there is concern about the safety of nuclear power plants in adjacent areas. At Sosnovy Bor (Russia) and at Ignalina (Lithuania), Chernobyl-type reactors are used. Co-operation projects are under way to improve the reliability of these and other reactors in neighbouring countries. There is also concern about radioactive pollution by Soviet-Union nuclear submarines dumped in the Barents Sea. Finland has provided an advanced facility for treatment of liquid nuclear waste in this area.

Table 6. **Finnish policy targets for transborder environmental problems**[1]

Type of emission/inputs	International targets	National targets
SO_2	Oslo Protocol (1994) • 80% reduction by 2000, base year 1980	Council of State Decision-in-Principle (1991) • 80% reduction by the year 2000, base year 1980 EU directive on large combustion plants • 40% reduction in emissions by 1998 and 60% by 2003, base year 1980
NO_x	Sofia Protocol (1988) • Stabilisation by 1994, base year 1987 Sofia Declaration • 30% reduction by 1998, base year 1980	EU directive on large combustion plants • 30% reduction in emissions by 1998, base year 1980 Action Programme for transport • 30% reduction in emissions from transport in 2000, base year 1980
VOCs	Geneva Protocol (1991) • 30% reduction by 1999, base year 1988	
Nitrogen and phosphorus	Ministerial Declaration on Protection of the Marine Environment in the Baltic Sea (1988) • 50% reduction, base year 1987	Water Protection Programme • 50% reduction in 2005 in discharges from agriculture and forestry compared with the average level in the first half of the 1990s • 50% reduction in 2005 in discharges from industry, base year 1995 • 35% reduction in phosphorus discharges from waste water in urban areas compared with the average level in the first half of the 1990s, and 60% in nitrogen when it is the factor regulating eutrophication

1. Only quantified targets are considered.
Source: OECD Secretariat.

Acidification

31. In the second half of the 1980s, the southern and central parts of Finland were suffering from acute acidification problems. Caused by atmospheric emissions of SO_2 and NO_x which through "acid rain", lead to deposition of sulphur and nitrogen in the soil and water surfaces, acidification triggered significant losses in fish populations in some lakes. The damage has built up at relatively low levels of pollution because Finnish soils and water have a low neutralising capacity (*i.e.* low "critical loads"). The bulk of the acidifying depositions stem from long-range air transport, mainly from central Europe and Russia, which means that the improvement of the situation has come to a large extent from emission reductions abroad. Part of it results from the Russian crisis, and may therefore be reversed. Indeed, some 12 per cent of the

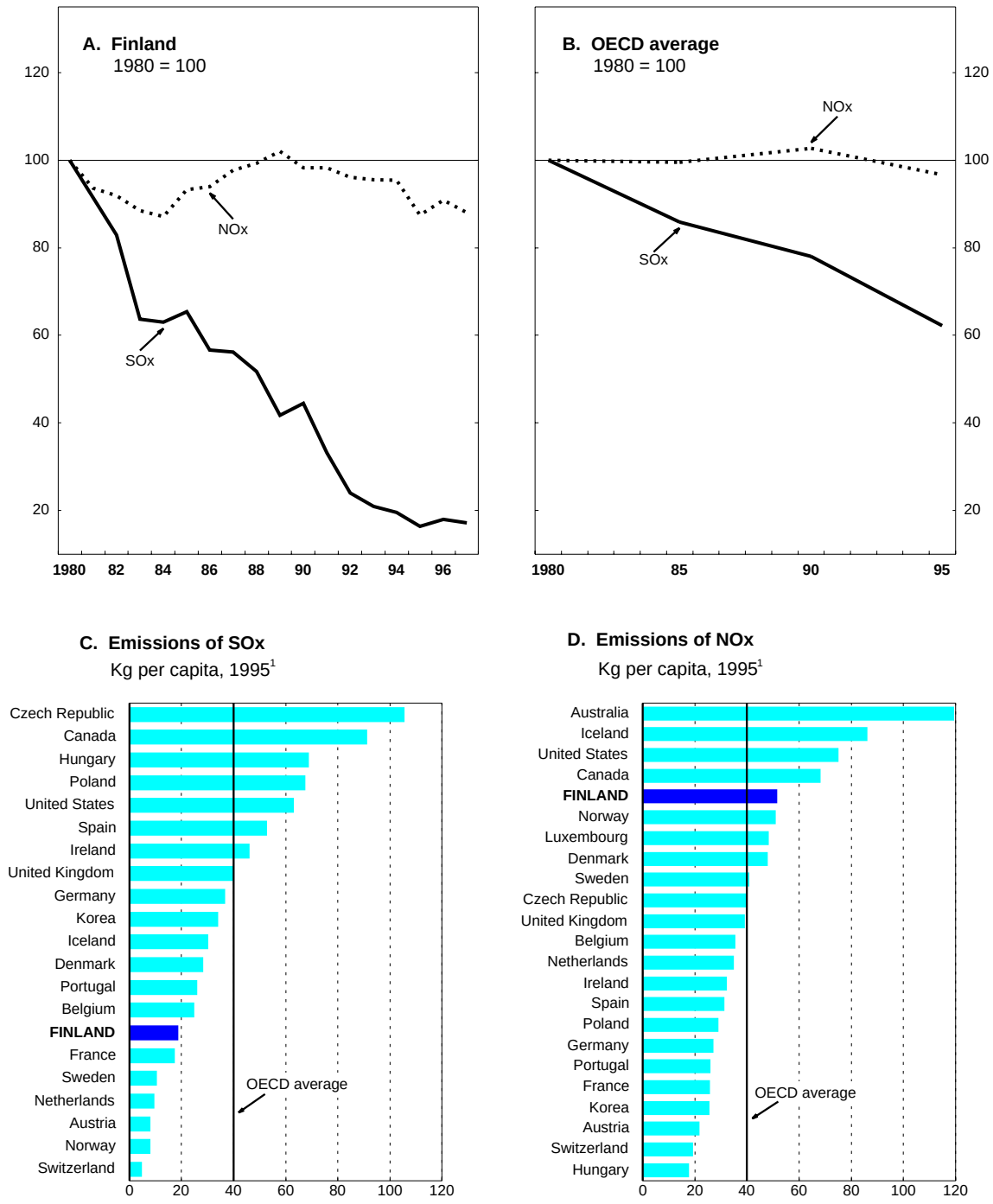
sulphur deposition and 16 per cent of nitrogen deposition occurring in Finland comes from domestic sources. Finland is a net importer of SO_2, but a net exporter of NO_x.

32. For its part, Finland has been rather successful in meeting its international targets, in particular regarding SO_2 emissions. Indeed, the 80 per cent reduction target of the Oslo Protocol for the year 2000 was already reached in 1994, and in 1997 SO_2 emissions stood 83 per cent below their 1980 level (Figure 7). This reduction resulted from various factors including a change in the structure of energy production, a shift away from the use of heavy fuel oil in industry, a fall in the sulphur content of fuels and improvements in process technology. These were brought about mainly by command and control measures, in particular (non-tradable) emission permits. Permits have been granted at the provincial or municipal level based on the best available technology for the activity concerned and taking into account the local dimension.[36] Emission standards have also been established for some stationary sources such as coal-fired power plants, and fuel quality regulations specifying the maximum sulphur content of diesel and heavy fuel oil have been adopted. The only economic instrument targeted at reducing emissions from transport (*i.e.* less than 3 per cent of total emissions) a lower rate of basic excise tax on sulphur-free diesel and reformulated gasoline.

33. It is difficult to assess the extent to which the reductions were achieved in a cost-effective manner. For large stationary sources, such as power stations, pulp and paper plants and refineries, emission reductions and necessary investments have been planned and abatement costs calculated by "Sulphur committees" set up in 1985 and 1991 by the Ministry of the Environment. Marginal abatement costs were not estimated, but the average abatement costs per ton of SO_2 vary between FIM 3 800 and FIM 26 000 among the various sectors, with a majority comprised between FIM 5 000 and 6 000. Given that there is a direct link between the sulphur content of fossil fuels and the amount of emissions generated, a tax on the sulphur content of fossil fuels, as implemented in Denmark, Norway and Sweden, would have been an appropriate instrument to enhance the cost-effectiveness of abatement.[37] Since SO_2 can be removed after combustion, the tax could have been made refundable on proof that SO_2 emissions had been reduced through the use of any technique. Emissions from industrial processes could have been monitored and also taxed, and the local dimension addressed by instruments such as regionally differentiated rates on the sulphur content of fuels. Another option would have been to establish a market for SO_2 emission quotas, as successfully implemented in the United States.

34. On the NO_x side, Finland has met its commitment in the Sofia Protocol to stabilise emissions in 1994 at their 1987 level, but did not meet the national target to reduce emissions by 30 per cent by 1998 compared with 1980, as emissions were only 8 per cent lower in 1997. Mainly due to high transport intensity, NO_x emission intensities have remained high in Finland, about 70 per cent higher than in the other European OECD countries (Figure 4). In contrast to SO_2 emissions, mobile sources account for a substantial share of total NO_x emissions (64 per cent in 1997) which makes the design of a cost-effective policy quite complex. Indeed, NO_x emission intensities depend on a combination of various factors and there is only a weak link between the amount of fuel consumed and the amount of emissions, so that a fuel tax would not be an efficient instrument. Moreover, the very high monitoring costs associated with a tax on emissions from many small mobile sources exclude this option. This means that a variety of instruments has to be used, adapted to the various processes underlying the NO_x emissions, seeking to equalise marginal abatement costs among the various sectors and sources.[38] As in most other countries, the main instrument for NO_x abatement has been vehicle emission standards for mobile sources, which have made catalytic converters necessary for new cars since 1991. To accelerate the renewal of the stock of cars, it has been complemented by a tax incentive — a tax allowance in the car tax for vehicles complying with those standards. Regarding emissions from stationary sources, the same instruments as for SO_2 have been used, namely permit procedures and emission standards for power plants.[39]

Figure 7. Emissions of acidifying gases



1. Or latest year available.
Source: Statistics Finland, OECD Environmental Indicators 1997 and OECD Secretariat.

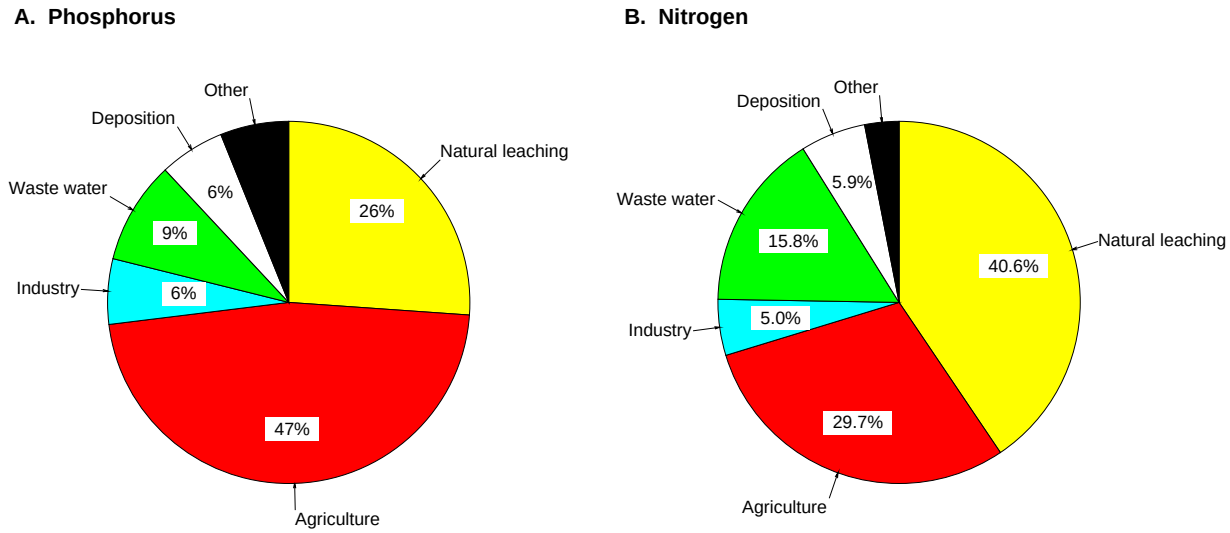
35. The situation regarding acidification has significantly improved in recent years, but problems remain in the southern part of the country where critical loads are still often exceeded. Hence, even if current policy measures are sufficient for Finland to meet the international targets, further reductions in acid depositions are required. According to the Acidification Committee (Ministry of the Environment, 1998), the cheapest domestic options for reducing SO_2 and NO_x emissions have already been used, and marginal abatement costs will increase sharply. To the extent that most depositions originate from outside Finland, the most cost-effective option would be for Finland to encourage abatement in neighbouring countries. Apart from the UN-ECE agreements, bilateral co-operation is taking place with Russia and Estonia (Box 5). However, reductions in domestic emissions in the south of the country will also probably be required. Decisions taken in connection with climate change mitigation policies regarding future energy sources will be of importance, since a shift from coal to gas (or nuclear power) will have ancillary benefits in terms of reduced SO_2 emissions.[40] Removing the favourable tax treatment for peat may also help reducing SO_2 (and to a lesser extent NO_x) emissions since emissions from peat have been growing quickly.[41] To contain NO_x emissions from power plants, a NO_x charge could be introduced to improve the cost-effectiveness of abatement. If the distributional effects of this charge should be mitigated, a compensation scheme could be introduced. Such a system has proved quite effective in Sweden. The elimination of distortions in the transport sector should also help reducing NO_x emissions further (Box 4).

Eutrophication

36. Eutrophication is an important environmental problem for Finland, in particular in the Baltic Sea where intensive algae bloom episodes are frequent.[42] Resulting from nutrient enrichment (*i.e.* release of phosphorus and nitrogen), the excessive growth of plants damages aquatic life by reducing light penetration and consuming the oxygen in water when the algae die. It is, therefore, affecting aquatic biodiversity. The Finnish contribution to the nutrient runoff in the Baltic Sea is only about 10 per cent. In the Gulf of Finland, the most eutrophic part of the Baltic Sea, 80 per cent of the load is coming from the St. Petersburg area. Domestic emissions have nevertheless a major impact on coastal areas. Agriculture is the single largest source of anthropogenic nutrient discharges, with municipal and industrial waste water accounting for most of the rest (Figure 8). In the Convention for the Protection of the Baltic Sea, Finland had committed itself to reduce its nutrient loading by 50 per cent in 1995 compared to 1987 levels, a target which was reached for phosphorus but not for nitrogen, due mainly to an insufficient reduction in loading from agriculture. Since nitrogen is the controlling factor in marine water eutrophication, this is where policy effort should focus in the coming years.[43]

37. Up to now, policy has been rather successful in reducing pollution from point sources using two main instruments: emission permits issued by the Water Courts based on the best available technology, taking into account the state of receiving waters, and water charges. Water is an abundant resource in Finland, and industries extract and discharge almost all the water they use directly rather than through the public system. The industrial sector, especially the pulp and paper industry — by far the main water polluting industry in Finland — has achieved significant reductions in nutrient discharges, well above the targets set by the Water Protection Programme for 1989-95.[44] However, it is estimated that that there is no room left to realise reductions at low cost, and that further increases in production will be associated with rising emissions (Statistics Finland, 1998*a*). Investments for water protection have been growing sharply in recent years, accounting for about half of total investments in the pulp and paper industry.[45] Water protection charges are imposed on heavy polluters on a case-by-case basis, but the amounts at stake are very small (FIM 2 million per year), so that they provide little incentive for further reductions.[46] In municipal waste water treatment, substantial decreases in phosphorus discharges have been achieved, but little improvement has been made in this sector regarding nitrogen removal (OECD, 1997*a*).[47] Municipal water charges are covering the economic (both investment and current) costs of water supply and sewage treatment, but there has been no attempt to cover the environmental costs associated with water pollution.[48]

Figure 8. Sources of nutrient loading
1995



Source: Statistics Finland.

38. Policies have been less successful in reducing nutrient discharges from diffuse sources, mainly agriculture.[49] Until 1994, a fertiliser tax based on the phosphorus and nitrogen content was applied to limit use.[50] The purpose of the tax was not strictly environmental since its revenues were earmarked to finance export subsidies for agricultural products. Together with specific agronomic measures, the tax helped to decrease significantly the use of phosphorus fertilisers and to a lesser extent nitrogen fertilisers, but not enough to meet the targets of the Water Protection Programme.[51] With EU membership in 1995, export subsidies were eliminated and, in the face of the deep adjustment that the sector had to undergo, there was strong pressure to reduce costs and the tax was removed (Box 6). At the same time, the agri-environmental aid system — half financed by the EU — was introduced, which provides subsidies conditional on compliance with certain environmental requirements including limits on the use of fertilisers and manure, and land management measures to reduce nutrient run-off. From the point of view of public finances, however, replacing a tax by a subsidy to achieve the same objective is quite inefficient. The amounts involved in environmentally related support are high, FIM 1.6 billion in 1997 (or 40 per cent of total government expenditure on environmental protection). It is estimated that about half of the support compensates for losses in the income associated with environmental management (Statistics Finland, 1998*a*). As a result, the use of fertiliser decreased between 1995 and 1997, while output grew at the same time. However, it is not yet possible to assess the environmental effects.[52]

Box 6. **Finnish agriculture and the environment**

Agricultural land covers 8 per cent of Finland's area. It is mainly concentrated in the southern and western parts of the country where the soils are richest, but dairy farming, which accounts for about half of total agricultural production, is also practised in central Finland. Farmers are generally involved in forestry activities, but have also "non-primary" activities. Only one-third of farms are run on a full-time basis. As in other OECD countries, the rural population has been declining over the last decades, and the share of primary production in rural employment has been falling. However, agriculture is still very significant in the economic activity of many rural areas, and forms an important element of regional policy.

The Finnish agricultural sector has undergone significant adjustment in recent years due to the adoption of the EU's Common Agricultural Policy. In 1995, the total producer support estimate stood at 69 per cent, exceeding the already high EU average by 20 percentage points. With EU membership, trade quotas were removed and replaced by EU tariffs. Exposure to EU competition resulted in an instantaneous halving of agricultural producer prices in 1995. To compensate for the loss in indirect support as a result of lower prices, "transitional" national support was implemented, but there was nevertheless a significant fall in farm income. Since 1995, the number of farms and employment has fallen significantly (by 10 per cent between 1995 and 1997).

Agriculture negatively affects the environment in many ways, but the most obvious direct adverse environmental effect is the runoff of nutrients, *inter alia* from fertilisers into lakes, rivers, aquifers and the sea. In 1995, agriculture was responsible for more than 60 per cent of anthropogenic phosphorus load, and about 50 per cent of the nitrogen load, and its share is increasing as pollution from point sources is reduced. The main resulting problem is eutrophication and the associated loss in aquatic biodiversity, but also impaired water quality in general. Fur farming, concentrated mainly in one western region (Ostrobothnia), is also causing elevated groundwater nitrate content. Pesticides do not pose a problem for water quality in Finland since they were never used intensively. Agriculture also causes emissions of gases contributing to acidification (mainly ammonia) and to the greenhouse effect (30 per cent of anthropogenic methane emissions come from agriculture). Finally, agriculture affects terrestrial biodiversity through the reduction in the number of habitats for wild species, and because of a specialisation of production and more uniform production practices. On the other hand, there are also some positive environmental effects of agriculture, like preserving a variety of flora and fauna, creating scenic landscapes, favouring land conservation including landslide and flood prevention (OECD, 1997*b*).

Some progress has been made over the last years in reducing these adverse environmental impacts. First, the agricultural support has progressively shifted away from market support towards direct income support (market price support represented 54 per cent of total support for EU countries in 1997, against 71 per cent in Finland in 1994). Second, an increasing share of the support (20 per cent in 1997) is tied to environmental requirements. About 90 per cent of the farmers have joined voluntary agri-environmental programmes, whereby they get financial support and advisory services in exchange for respecting limits on fertiliser use, establishing protective zones between arable land and water, etc. Support for organic farming has also been growing, and the government also provides support to farm households that diversify their earnings through other rural activities. As a result, fertiliser use has been reduced and associated agronomic practices improved. Between 1986-88 and 1994-96, the nitrogen balance (*i.e.* the nitrogen not taken up by the plants that results in runoff) has decreased by 20 per cent. However, in specific regions, levels have remained high and damage significant. Methane and ammonia emissions have been decreasing over the last years due to a reduction in the number of animals.

Most agricultural subsidisation has remained in the form of "coupled" support measures, which stimulates inputs and production. In any event, despite a strong decrease in support to agriculture (by almost 50 per cent between 1995 and 1997), the level of national support is still very high (amounting to more than 50 per cent of total agricultural value added). In addition to the climatic conditions which imply a short growing season and low yields, Finnish agriculture suffers from structural problems — mainly the small size of farms. Finland, as a country with a relatively clean environment, may have some comparative advantage in high quality agricultural products, in particular organic farming. Shifting some support to these activities would probably be a less costly and distorting way to integrate economic, regional and environmental objectives. In general, however, there is a conflict between agricultural, regional and environmental objectives: lower support would lead to a decline in the agricultural sector, and of the associated pollution. In this respect, the reform of the EU common agricultural policy (Agenda 2000), if it were to reduce the overall level of support substantially, could be expected to reduce environmental problems.

39. New discharge reduction targets by sector have been established for the 1999-2005 period, ranging from 30 to 50 per cent. Investments are planned to install nitrogen removal facilities for municipal waste water treatment and the government is financing technical research in this domain. In agriculture, a reform of the subsidy eligibility criteria is being considered. Command and control measures have been rather effective in reducing point discharges to date, but they are probably less suited for the next stage of pollution control. The measures providing relatively "easy" reductions in point discharges are probably exhausted, and the clean-up or prevention costs per unit of pollution are probably rising. Hence, uniform targets are becoming increasingly inefficient compared to economic instruments such as water pollution charges. In addition, the conflict between support to agriculture and water protection poses a major problem for realising cost-effectiveness.

Assessment and scope for further action

40. Finland has developed an extensive institutional framework for environmental management, with the Ministry of the Environment responsible for a large part of the environmental issues and various regional bodies implementing environmental policies and providing information to the public. The National Commission for Sustainable Development, chaired by the Prime Minister, has played a useful role as a forum of debate and in increasing the awareness of sustainable development issues. However, a weakness in the government's approach to sustainable development is the lack of systematic economic assessment. Such assessments by the Ministry of the Environment, accompanied by co-ordination with other key ministries, especially the Ministry of Finance, would be beneficial for the implementation of a set of comprehensive sustainable policies, especially where traditional economic instruments, like taxes or subsidies, are, or could be, involved. Moreover, environmental matters will need to be further integrated in sectoral policies and in the overall budgetary framework.

41. While overharvesting was an issue until the 1960s, the forest area has grown since then. Forest activities are no longer solely focused on sustainable wood production as practices are influenced now by wider sustainability objectives. However, protecting biodiversity and safeguarding old forests, especially in southern Finland, is on the policy agenda. The recent reform and extension of the legislative framework for forestry management is important for improving the performance in the coming years. Furthermore, the certification system is a tool that could lead to internalisation of customers' preferences for "sound" ecological products through the market. Some financial support of the government may be appropriate to start up such a system. Insofar as certification does not provide a solution, direct regulation, subsidies and public purchases of forests should be used, but in a cost-effective way. At present, however, economic assessment of the various measures for preserving biodiversity is practically absent and priorities are not clearly established. More systematic and comprehensive valuation of the costs and benefits of these measures would allow a better prioritisation in this field. The system of biodiversity indicators currently being developed could play a useful role in this process.

42. In many fields, pollution has been reduced. The extension and reform of legislation was important in this context. Air and water pollution, by the pulp and paper industry for instance, diminished substantially in the past decade due to stricter legislation and voluntary efforts by the industry. Finland has been successful in particular in reducing emissions contributing to acidification and eutrophication. Since a substantial part of harmful depositions is imported from abroad, Finland's active involvement in the negotiation and implementation of related international agreements was clearly in the country's best interest. Finland is in a very good position to meet its international commitments regarding SO_2 and NO_x emissions. Regarding nutrient discharges, the date to meet the reduction target has been postponed internationally. To some extent, the reductions in the acidification problem in the southern parts of the country, and to a lesser extent in eutrophication in the Baltic Sea, result from the fall in output over the 1990s in Russia and other countries formerly belonging to the Soviet Union, and could, therefore, be

reversed. In the future, further reductions in acid depositions and in nutrient discharges into the Baltic Sea are required. In Finland, there is not much room left for realising such reductions at low cost. Therefore, measures to reduce emissions of acidifying and eutrophying substances abroad, as already undertaken mainly in Russia and Estonia, should be pursued as they are more cost-effective.

43. However, measures are also needed to restrain domestic emissions. Up to now, command and control measures have been used successfully, especially in the case of SO_2. However, the regulatory authorities lack information about the abatement costs faced by the various sectors and firms and, given the steeply rising marginal abatement costs, command and control measures become increasingly inefficient compared to economic instruments. Regarding NO_x emissions, a charge on emissions from power plants, combined with a transitional compensation scheme, could be a cost-effective instrument, as experience elsewhere shows. Charges reflecting the environmental costs associated with nutrient release should also be applied to industries and municipal waste water treatment plants. Concerning water pollution, agricultural emissions may be more difficult to deal with. The agri-environmental measures taken so far have reduced nutrient balances, but at a high cost and not sufficiently. Further decoupling of agricultural support from production would help to reduce discharges and should therefore be pursued nationally as far as possible and promoted in EU negotiations on agricultural policy.

44. Combating climate change by reducing GHGs as agreed in the Kyoto Protocol is probably the most challenging issue. New policy measures will have to be taken in order to meet the target. Marginal abatement costs are high in Finland. This makes it even more difficult than elsewhere to decouple CO_2 emissions from GDP developments. Important energy policy decisions will have to be taken soon about fuel switching options, which could allow for substantial reductions in CO_2 emissions compared with the reference energy scenario. Nevertheless, even with a decision on a second gas pipeline or a fifth nuclear power plant, reaching the Kyoto target will probably require additional policy initiatives. Hence, to fulfil its commitment, Finland would greatly benefit from the cost-effective flexibility mechanisms allowed for in the Kyoto Protocol. Investments reducing GHG emissions in neighbouring countries like Russia would help. Finland could also benefit greatly from buying emission quotas abroad, as soon as this becomes operational.

45. Finland was the first country in the 1990s to introduce a carbon tax aimed at diminishing CO_2 emissions while contributing to the necessary fiscal consolidation. However, after many changes, the current energy tax structure is far from being cost-effective since it provides only a very loose link between taxation and the carbon content. The favourable treatment granted to the most energy-intensive industries for competitiveness reasons increases the overall costs of CO_2 emission abatement, since it obliges others to pay higher taxes to achieve the emission reductions. Moreover, it is tilting incentives towards energy-intensive activities in the long run. Refocusing the CO_2 tax so as to equalise marginal abatement costs would greatly enhance the cost-effectiveness of abatement. However, in practice, the Finnish authorities consider that EU regulations limiting the possibilities to tax imported electricity are an obstacle to applying a "pure" CO_2 tax. One solution could be to soften the consequences for industry by introducing a compensation scheme that would allow firms to adapt to the tax gradually and would avoid unnecessary adjustment costs. Harmonisation of energy taxes at the EU level would also help in this respect. At the domestic level, reducing and progressively eliminating the favourable treatment of diesel compared to gasoline could enhance cost-effectiveness. Moreover, it would have ancillary benefits on NO_x emissions. Removing the favourable treatment for peat may also reduce acidifying emissions.

46. Another possibility to improve cost-effectiveness, while bringing emission levels closer to the target, would be to create a national trading system for emission quotas that would replace, at least partly, energy taxation. This would have some advantages. First, a partial grandfathering of emission quotas could make it more acceptable for industry than a pure CO_2 tax, while providing "correct" abatement incentives at the margin. Second, it would allow for a better control of the amount of emissions. Finally, it would

make it easier to participate in an international (EU or broader) trading system as soon as it is created. It would be in the Finnish interest to support EU-wide measures, be it tradable quotas or an EU-wide carbon tax. Efforts to improve cost-effectiveness and to comply with the Kyoto Protocol should not solely focus on CO_2 emissions as abatement costs of other GHGs, especially methane, are estimated to be lower.

47. Initiatives should not be restricted to realising cost-effective environmental policies. It is also very important to improve the consistency of the various sectoral policies with respect to their environmental consequences. In many instances, it is difficult to reconcile the various objectives of agricultural, transport and energy policy with environmental goals. Concerning energy policy, peat production can be seen as an example where regional policy objectives are achieved at an environmental cost. Regarding the options considered to increase the energy supply in the future, a greater use of gas from Russia would greatly reduce the diversity of energy supply and therefore clash with an energy policy objective. The interconnection to the European grid is under discussion, but it requires various decisions in neighbouring countries as well. Furthermore, the building of a fifth nuclear power plant, although it would help in containing CO_2 emissions, has the drawback of raising other environmental issues.

48. Emissions from the transport sector, in particular CO_2 emissions, have been growing strongly in the past decades. Although some gains in energy efficiency of vehicles can be expected, additional measures to control the growth in traffic volumes will be needed to contain emissions. Further efforts should be made to bring transport prices closer to marginal social cost. Given that trucks are expected to be responsible for most of the increase in emissions, it would be important in particular to align the marginal cost coverage of trucks with that of private cars by raising for instance the taxation of diesel. The tax advantage for diesel compared with unleaded gasoline in Finland is the largest in the OECD. Given the high level of vehicle taxes, there is also room for a radical shift from vehicle to fuel taxation which would allow a better internalisation of externalities.

49. Finally, despite a decrease in its overall level and a partial decoupling from input and production, the support provided to agriculture is still among the highest in the OECD and agriculture remains a significant source of environmentally harmful emissions. The most important adverse environmental effect is the runoff of nutrients, which is the main (human-induced) cause of water eutrophication, but agriculture also produces greenhouse and acidifying gases. Since it still plays an important role in the economic activity of many rural areas, agricultural activities form an important element of regional policy. However, farming in Finland suffers from fundamental structural weaknesses, such as the harsh climatic conditions and the small size of farms. A reshaping of regional policy would raise efficiency, and a lowering of support would allow the reduction of the associated pollution and government spending.

NOTES

1. This paper was originally produced for the OECD Economic Survey of Finland, which was published in July 1999 under the authority of the Economic and Development Review Committee. The authors are indebted to Peter Hoeller, Wim Suyker, Paul O'Brien, Nils-Axel Braathen and Stephen Perkins for valuable comments and drafting suggestions and to Desney Erb and Celia Rutkoski for technical assistance.

2. In order to keep the focus on major issues for Finland, the paper does not cover fisheries, waste management and urban air and noise pollution.

3. The discussion of environmental and resource management issues draws on earlier work by the OECD's Environment Directorate (in particular, the 1997 *Environmental Performance Review* for Finland, OECD, 1997*a*). Compared with this work, which provides a detailed assessment of environmental performance with respect to domestic objectives and international commitments, this paper focuses only on a few key policy issues, but seeks to put them into a broader context. The paper also draws on work by other OECD Directorates and specialised agencies, in particular the Finland Review by the International Energy Agency (IEA, 1999), the Directorate for Food, Agriculture and Fisheries (OECD, 1999), and the European Conference of Ministers of Transport (ECMT, 1998).

4. Data on natural resource wealth are currently being developed. Consistent wealth estimates are available for Norway for the period 1970 to 2050 and include physical, human, foreign net financial assets and the oil wealth.

5. The largest share of local expenditures on environmental protection is dedicated to sewerage and waste water purification, covered mainly by user fees.

6. For a detailed description, see OECD (1997*a*).

7. Education and training; changing production and consumption patterns; financial issues and transfer of technology; socially sustainable development and local aspects of sustainable development.

8. In the same year, the government also adopted a decision-in-principle on environmental impact assessment guidelines to be applied when preparing government bills. To support this decision, an interministerial network was established.

9. In addition, several research projects have focused on the impact of forest practices on biodiversity. Information that helps in implementing forestry policy has been developed (*e.g.* National Criteria and Indicators for Sustainable Forest Management, since 1995; a proposal for a Certification Scheme for the Sustainable Management of Forests in Finland made in 1997).

10. Three Finnish multinational groups control 80 per cent of sawn timber production and 98 per cent of pulp and paper production and own controlling participation in other plants in Europe. They are Stora Enso (partly state-owned), UPM-Kymmene and Metsäliitto. See OECD (1997*c*).

11. The annual increment is the growth of wood stock, equal to annual felling minus annual drain. The increment in 1998 was 75 million cubic metres, which is proportionally distributed across the three main species (Scots pine, Norwegian spruce and birch). The area dedicated to birch is considerably smaller than that for coniferous species.

12. Although there is no clear definition of what constitutes an old forest, in the case of Finland it is usually considered as one which has not been cut for 100 years.

13. In Finland there are approximately 42 000 species of living organisms, a small number by international standards reflecting the extreme northern location of the country. Of these, 1 per cent are vertebrates, 39 per cent plants and 60 per cent invertebrates.

14. The existence value is related to the desire of people to know that some species do exist, even if they may never see them. The option value refers to the possibility that these species will be of some use in the future, even though the use is unknown for the moment. There are also other "use values" (apart from direct wood exploitation) not included in wood prices (*i.e.* recreational use or prevention of erosion).

15. Biodiversity issues also concern maritime life, but are not pursued here. Environmental policies geared at preventing or reducing water pollution are described below.

16. See OECD (1997*c*).

17. These habitats are streams, small lakes, eutrophic peatlands and herb-rich forests.

18. In this sense, it extends the scope of the old Forest Improvement Act, which supported investment in the forest sector from a purely profit-oriented point of view.

19. See OECD (1997*c*) for a thorough discussion of the alternative certification systems and of the difficulties to reach an agreement among the participants in the negotiations.

20. However, NGOs have recently withdrawn from these negotiations because of disagreement on the certification system to be used.

21. The commitment for the EU as a whole is to reduce GHG emissions by 8 per cent in 2010 from their 1990 level. Finland got a lower reduction target for structural reasons, and because 1990 was a year with an unusually mild winter and a wet year with ample hydropower in addition to a high level of electricity imports, resulting in lower CO_2 emissions.

22. Emissions of the three other GHGs included in the Kyoto Protocol are virtually non-existent in Finland.

23. A 1998 study conducted jointly by the IEA and the OECD Nuclear Energy Agency concluded that, with a 10 per cent discount rate (which is a level generally used in the gas market), coal and gas are the cheapest option for a new plant to be built between 2005 and 2010. Nuclear was found to be the most costly option, even at a 5 per cent discount rate.

24. Peat and natural gas have always had a favourable tax treatment (in the early 1990s by means of a special deduction scheme in the sales taxation or the value added tax). Wood has always been exempted from the CO_2 tax (Box 2). In addition, fuels used in industrial production as a raw material or inputs in the manufacturing of goods (*i.e.* for non-energy purposes) have always been exempted.

25. Companies that have paid more than 3.7 per cent of their value added in energy excise duties get a 85 per cent refund, if the amount involved exceeds FIM 300 000.

26. In recent years, wood-based energy has received a substantial share of energy investment support. In many instances, the production costs of new renewable energies are too high for taxation alone to make them competitive.

27. Methane emissions from agriculture depend on the volume of livestock, which is particularly important in Finnish agriculture; N2O emissions stem mainly from animal manure and nitrogen fertilisation. There, the extensive support provided to the sector is important (Box 6).

28. Support to public transport has been reduced in the first half of the 1990s (slightly more than one-third for urban transport), although much less than spending on transport infrastructure. Compared to other EU countries, the level of support is relatively low. The railway (operation) company, for instance, is profitable.

29. This gap between the cost recovery ratio for cars and trucks shows that the tax imposed on vehicles using diesel does not compensate for the lower taxation on diesel fuel for lorries. There is, however, uncertainty over cost allocation between cars and trucks.

30. A recent report from the Ministry of Transport refers to a 1998 study by Räsänen which provides an elasticity of freight volume to diesel price of about 0.05. This figure is very low by international standards. If it is correct, this could imply that a command and control approach could be more cost-effective.

31. As in the Business As Usual (BAU) scenario, a 2.5 per cent average annual GDP growth is assumed, which is slightly less than the rate observed during the past two decades. A fall in energy intensity is also assumed in the three scenarios, partly explained by a change in the structure of industry. In the two variant scenarios, taxation of fuels is assumed to be about twice as high in 2025 as it is today. In the first variant, the assumption is that natural gas will replace coal in power generation, both in conventional condensing plants and in combined heat and power plants (CHP). The second variant is based on the assumption that an additional nuclear plant is built before 2010, with less natural gas used.

32. Using a comprehensive energy system model for Finland, the authors analyse the cost-effectiveness of different technical options (but not policy measures) for reducing the emissions of CO_2, CH_4 and N_2O in the energy sector, industry, waste and agriculture. Integrated abatement is found to allow cost savings of about 20-25 per cent compared to abatement of CO_2 emissions alone.

33. Lehtilä and Tuhkanen (1999) provide an estimate of FIM 230.

34. In fact, if all countries are to achieve their Kyoto target, applying a perfect CO_2 tax without taxing electricity imports could provide an efficient solution. Indeed, in a liberalised market, the electricity will end up being produced where abatement costs are lowest.

35. Some episodes of high concentration of tropospheric ozone due to transborder movements of nitrogen oxides and volatile organic compounds do occur in some areas. Finland has committed itself in the Geneva Protocol to reduce VOC emissions by 30 per cent by 1999 compared with their 1988 level, a target which will probably be reached at a later date since emissions had only been reduced by 13 per cent in 1996. However, high tropospheric ozone, is not a major problem in Finland.

36. In the pulp and paper industry, for instance, the licensing procedure and consequent changes in production processes have reduced the substantial emissions by more than 95 per cent.

37. In 1994, the Environmental Economics Committee rejected the possibility of introducing such a SO_2 tax, on the grounds that it would not add much compared with fuel taxation. Given that there are several ways to decouple SO_2 emissions from fuel consumption, this argument seems rather weak.

38. Moreover, as NO_x emissions also contribute to other environmental problems — eutrophication, tropospheric ozone and local air pollution — the measures should be tailored to local conditions. The future NO_x Protocol, which should be concluded in 2000, will take all these dimensions into account.

39. Emission standards are differentiated for larger and smaller power plants, reflecting differences in available technologies.

40. By contrast, the gas switch scenario will have little impact on NO_x emissions, since natural gas (and wood) produces about the same amount of NO_x emissions as coal.

41. SO_2 emissions from peat have grown by 40 per cent between 1992 and 1997, while emissions from other sources decreased by 34 per cent in the same time. As a result, the share of peat in total SO_2 emissions has risen from 7 to 14 per cent.

42. The Gulf of Finland experienced two intensive algae bloom periods recently, in 1995 and 1997.

43. For eutrophication of inland waters by contrast, phosphorus loading is the main culprit.

44. The Water Protection Programme for 1989-95 set quantitative targets for reductions in phosphorus discharges in 1995 compared to 1986 (25 per cent for the pulp and paper industry, 14 per cent for municipal waste water and 50 per cent for agriculture). The objective for nitrogen was qualitative, the aim

being to "substantially" reduce total nitrogen discharges (OECD, 1997*a*). Over the period 1987-96, of relevance for the targets of the Baltic Sea Convention, industries have reduced their phosphorus discharges by more than 60 per cent and their nitrogen discharges by almost 40 per cent (Statistics Finland, 1998*a*).

45. In 1995 and 1996, investment for water protection accounted for about 55 per cent of total environmental protection investment (Statistics Finland, 1998*b*).

46. The proceeds are earmarked for water protection activities. A fish management charge (about FIM 4 million in 1993) is also levied on polluters, whose actions might have an adverse impact on fish stocks. This charge is earmarked for fish conservation expenditure.

47. Nitrogen removal efficiency is still only at 30 per cent (OECD, 1997*a*), compared to 93 per cent for phosphorus (Statistics Finland, 1998*a*).

48. Some of the investments in water management (mostly in rural areas) are financed by state subsidies, amounting to FIM 44 million in 1997 or only 1 per cent of total water expenditure.

49. Forestry is another diffuse source, but changes in forestry practices and a very strong reduction in fertilisation have substantially brought down the contribution of this sector to eutrophication.

50. Introduced in 1979, the tax was initially a general tax on fertilisers, to which an environmental tax on phosphorus fertiliser was added in 1990. In 1992, the two were combined and an environmental tax on nitrogen fertilisers was also introduced.

51. Phosphorus fertilisers' use was reduced by half between 1989 and 1994, and that of nitrogen fertiliser by about a quarter (OECD, 1997*a*).

52. Compared to 1995, nitrogen loading from agriculture is estimated to have fallen by 3 to 14 per cent in various watersheds (Grönroos *et al*., 1998).

GLOSSARY OF ACRONYMS AND TERMS

Acidification	Caused by atmospheric emissions of sulphur dioxide and nitrogen oxides which, through "acid rain", lead to deposition of sulphur and nitrogen in the soil and water surfaces (causing damage to aquatic life and forests)
Acid rain	Describes a type of pollution which washes out of the atmosphere as dilute sulphuric and nitric acids
Anthropogenic	Describes an object or disturbance to the environment which is man-made or which follows from the emissions of harmful substances as a result of human activities
BAU	Business As Usual
Biomass	The total quantity or weight of organisms in a given area or volume
Biotope	The smallest subdivision of a habitat, characterised by a high degree of uniformity in its environmental conditions and in its plant and animal life
CH_4	Methane
CHP	Combined heat and power plants
CO_2	Carbon dioxide
EU	European Union
Eutrophication	A process of pollution that occurs when a lake or stream becomes over-rich in algae or aquatic plants which kill animal life by depriving it of oxygen
FIM	Finnish markka
GDP	Gross domestic product
GHG	Greenhouse gas
ha	Hectare
NGO	Non-Governmental Organisation
N_2O	Nitrous oxide
NO_x	Nitrogen oxides
Particulates	Tiny flecks of soot and similar substances in the atmosphere; a principal source of particulates is black exhaust from road vehicles
R&D	Research and Development
Sink	In this context, a place where, or a process by which, greenhouse gases are removed from the atmosphere
SITC	Standard Industrial Trade Classification
SO_2	Sulphur dioxide
SO_x	Sulphur oxides
UN-ECE	United Nations — Economic Commission for Europe
VAT	Value added tax
VOC	Volatile Organic Compound

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