OECD Economics Department Working Papers No. 218

Sustainable Economic Growth: Natural Resources and the Environment in Norway

Paul van den Noord,

Ann Vourc'h

https://dx.doi.org/10.1787/210018060005

OECD

Unclassified **ECO/WKP(99)10**

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

OLIS : 28-Jul-1999
Dist. : 05-Aug-1999

English text only

ECONOMICS DEPARTMENT

ECO/WKP(99)10
Unclassified

SUSTAINABLE ECONOMIC GROWTH : NATURAL RESOURCES AND THE ENVIRONMENT IN NORWAY

ECONOMICS DEPARTMENT WORKING PAPERS N0. 218

by
Paul van den Noord and Ann Vourc'h

80280

Document complet disponible sur OLIS dans son format d'origine
Complete document available on OLIS in its original format

English text only

ABSTRACT/RÉSUMÉ

This document examines Norwegian policy on managing natural and environmental resources. These issues, and more generally the challenges of sustainable development, are primary concerns of the authorities in Norway, a country richly endowed with natural resources. Substantial action has been taken, as can be seen in the development of an integrated institutional framework and in the major efforts undertaken to co-ordinate government policies in this area. The investment of a large share of the rent from oil and gas in foreign financial assets should help ensure the inter-generational balance. Norway's leading role in fostering international co-operation on fisheries and environmental management — where problems often extend beyond national boundaries — also reflects an engagement mindful of the needs of present and future generations. Within the country, the government has succeeded in reducing the emissions of a large number of pollutants. But measures still need to become more cost-effective, especially in areas where the desire to preserve the competitiveness of traditional economic activities, and the policy goals of a particular region or sector (transport, agriculture), have outweighed cost-effectiveness considerations.

*****

Ce document examine la politique norvégienne en matière de gestion des ressources naturelles et environnementales. Ces questions, et plus généralement la problématique du développement durable, constituent des préoccupations centrales des pouvoirs publics dans ce pays amplement doté en ressources naturelles, qui se sont traduits en pratique. En attestent le développement d'un cadre institutionnel intégré et les importants efforts de coordination des politiques des administrations publiques dans ce domaine. L'investissement d'une forte proportion de la rente pétrolière et gazière dans des actifs financiers extérieurs répond au souci d'équilibre intergénérationnel. La forte implication de la Norvège pour stimuler la coopération internationale dans la gestion des pêches et de l'environnement constitue également un investissement conforme à l'intérêt des générations présentes et futures, compte tenu du caractère souvent international des problèmes rencontrés. Au niveau national, les autorités sont parvenues à réduire les émissions d'un grand nombre de polluants. Cependant, des progrès restent à faire pour augmenter l'efficacité par rapport aux coûts, en particulier dans un certain nombre de domaines où le souci de préserver la compétitivité des activités économiques traditionnelles et les objectifs des politiques régionales et sectorielles (transport et agriculture) l'ont emporté sur ces considérations de coût-efficacité.

JEL codes: Q25, Q28, Q38, Q48
Keywords: Norway, sustainable development, environment policy, natural resource policies

TABLE OF CONTENTS

Boxes

Tables

Figures

SUSTAINABLE ECONOMIC GROWTH: NATURAL RESOURCES AND THE ENVIRONMENT IN NORWAY

Paul van den Noord and Ann Vourc'h[1]

Introduction

1. Since 1989, sustainable development has become a cornerstone of policy-making in Norway and it has recently been made a top priority area for the work of the OECD (Box 1). Sustainable development touches on a wide range of policy issues, including how to raise human and physical capital and how to manage natural resources. OECD country surveys have always covered a wide range of policy issues concerning potential output growth, the sustainability of pension systems or of the macroeconomic policy setting. While these issues are important in ensuring sustained economic growth, this paper looks to a broader set of issues concerning natural resource management, including non-renewable and renewable resources as well as the environment, which are also necessary for ensuring sustainable development.

2. The management of natural resources involves fairly extensive public policy decision making. The key economic policy objectives concerning non-renewable resources in Norway, of which crude oil and natural gas are the most prevalent, are two-pronged. First, economic policy aims at maximising the wealth associated with the non-renewable resource, by choosing an extraction path and achieving cost-effectiveness. Other things equal, conditions of great uncertainty over future market developments tend, rationally, to encourage relatively rapid extraction. Second, economic policy is geared towards achieving a fair distribution of wealth across present and future generations, *i.e.* by establishing a mix between present and future consumption which maximises long-run economic well-being. This has entailed setting up a vehicle through which the resource wealth can be transmitted to future generations. The policy objectives associated with renewable resources, of which fisheries are the most important, are not fundamentally different. However, the ecological dynamics involved and the international sharing of stocks form additional conditioning factors. To date, economic policies in Norway have by and large achieved these objectives, but there remains scope for further improvement.

3. The environment is largely a public good which is available to all, despite its exhaustible character. Hence economic policies are needed to ensure that an optimal production level and structure is achieved, taking into consideration the (properly valued) effects of economic activities on the environment (*i.e.* ensuring externalities are properly recognised). Environmental targets set by national choice or international agreements should reflect these objectives, and economic policies should subsequently contribute to attaining these targets in a cost-effective way. There is no simple rule for ensuring cost-effectiveness, but it is, to a certain extent, a function of the choice of environmental policy instruments. Direct regulation, which relies on emission, process and product standards, is sometimes appropriate — for example in the case of heavily toxic substances. In other instances the use of economic

instruments, such as taxes, subsidies and tradeable emission rights may be preferable as they leave more freedom for economic actors to seek the cheapest method of abatement and contribute to continuing innovation. Several economic instruments (taxes, auctioned quotas) raise revenue for the government in a non-distortionary way and thus may have an impact on overall economic performance by enabling a lower tax burden on human and fixed capital. Conversely, economic policies in other domains than the environment can have significant consequences for the environment, agricultural and transportation policies being prominent examples. Given the complex interactions, the Norwegian authorities have set up an extensive framework for co-ordination of economic and environmental policies, which aim at a sustainable development of environmental resources and at reducing policy conflicts.

4. The discussion of non-renewable resources in the first section of this paper draws on earlier OECD work (the 1995 *Economic Survey* and the International Energy Agency's [IEA] 1997 *Norway Review)*.[2] The environmental section that follows also builds on previous OECD work (1993 *Environmental Performance Review* for Norway).[3] Compared to the IEA and the OECD *Environmental Performance Reviews*, which provide more detail on energy provision and environmental performance *per se*, this paper focuses on sustainable development in its broadest economic sense — including, for example, considerations of inter-generational equity and cost-effectiveness — and are thus complementary. The paper concludes with an overall assessment in the light of the challenges that lie ahead.

Box 1. **The OECD's work on sustainable development**

In a paper for the 1998 meeting of Ministers from OECD countries, the Secretary-General outlined a three-year work programme on this topic, covering four key aspects: follow-up of the Kyoto agreement; analysis of how prices could better reflect the social costs of environmental damage, including through subsidy reduction; the role of better exploitation of knowledge, technology and innovation for resource productivity; and improved measurement of performance. For instance, in the field of climate policy, one important objective for the OECD is to assess developments and facilitate discussion on good practice as Member countries are developing policies to achieve Kyoto targets.

As part of this programme, a series of in-depth special chapters in the OECD *Economic Surveys* are planned. They will focus on how countries go about achieving their environmental and resource management objectives with a view to strengthening sustainable economic growth in the long run. An important aspect in this context is to aim at a comprehensive policy approach, for instance, a better integration of sectoral policies. An analytical framework for these chapters will be established by spring 1999. It will subsequently provide a benchmark for policy analysis in the following *Surveys*. The experience gained from the reviews of individual countries will then be presented in a report to OECD Ministers in 2001. In this process, the present paper on Norway is a pilot case, with the Norwegian experience influencing the work on the general framework. This choice has been motivated by Norway's strong focus on sustainable development. Indeed, already in its 1989 *Long-Term Programme* the Norwegian government adopted sustainable development as an overriding goal of economic policy.

The policy issues — an overview

What is sustainable development?

5. The 1987 Brundtland Report (UN, 1987) defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". Concerns over equity between and within generations are central to this definition in particular as the world's resources (including global natural resources) are so unequally distributed, but the focus to date has mostly been on inter-generational equity. Hence a policy for sustainable development is typically defined as one that leaves future generations with the opportunity to attain similar or higher levels of well-being than the present one. In an economic sense, "opportunities" left to future generations depend on the total stock of wealth they inherit, including natural (resource and environmental) capital as well as man-made physical and human capital. "Social capital", *i.e.* the whole system of social values and institutions, could also importantly influence sustainable development, but is less amenable to economic analysis and beyond the scope of this paper. Nonetheless, institutional aspects bearing on the setting of resource and environmental objectives and policies are covered.

6. A key issue is the degree of substitutability of the various forms of capital. To the extent they are substitutes, sustainability can be achieved by offsetting a decline in natural capital by a proportionate increase in man-made capital. This is the "weak" concept of sustainability. The "strong" concept requires that some level of the stock of natural capital be preserved under any circumstance. In reality some forms of natural capital are critical for development and can be replaced with man-made capital to only a limited extent, while others are more fully substitutable. Most non-renewable resources are of the former category, as are renewable and environmental resources that are prone to very slow regeneration processes (fishery, forestry, biodiversity, ozone layer, etc.). As long as science is unable to provide reliable rules for sustainable depletion paths or viable alternatives for these forms of natural capital, their depletion could present a high cost for future generations, because of irreversibility.

7. Natural capital other than the non-renewable resources are virtually impossible to value, but skimming the large amount of indicators below suggests that national assets of this sort may have decreased until the early 1980s and are likely to have risen again since. Market valuations of non-renewable resources and man-made capital are to some extent available. According to official estimates, the decline in oil and gas stocks in recent decades has been outstripped by far by the simultaneous substantial increase in human, financial and fixed capital (Figure 1). Of these, human capital has shown a significant increase, rising from NKr 3.7 million per capita in 1970 (1997 prices) to NKr 4.2 million in 1997, while on current projections it could soar to NKr 7.7 million per capita (1997 prices) by 2050. As discussed in the 1997 OECD *Economic Survey* of Norway, educational qualifications of the population in Norway have risen strongly and are now among the highest in the world. The fact that Norway's mainland potential output growth has been relatively subdued by OECD standards in recent decades mirrors the comparatively low rate of return on human capital in the extensive public sector, which may be associated with a lack of market scrutiny (OECD, 1997). Nevertheless, overall per capita GDP, including oil and gas output, is close to the top in the OECD.

How to raise wealth accumulation?

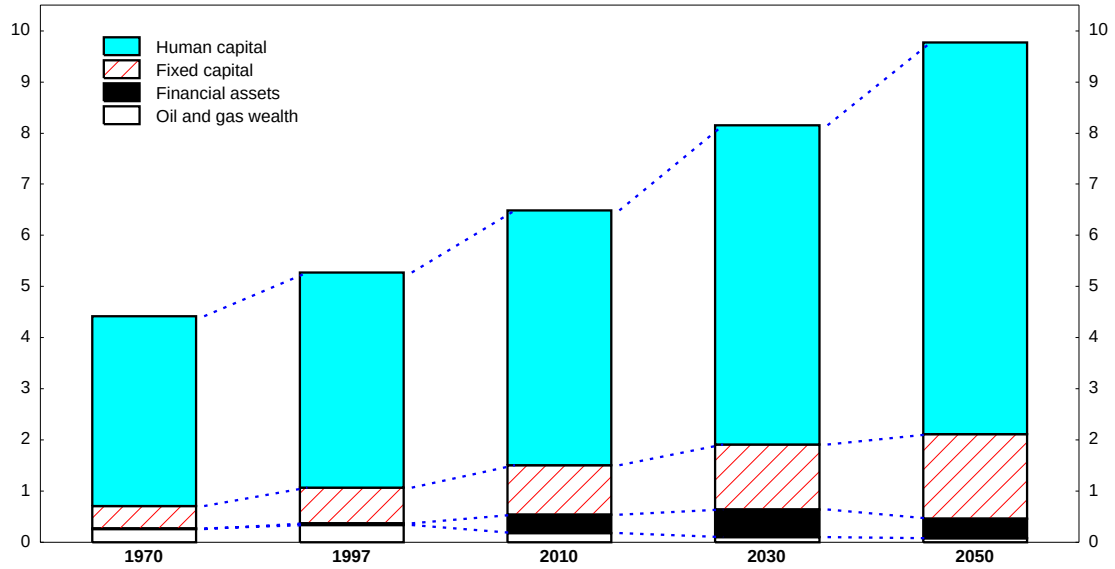
8. Sustainable development as defined above constitutes a major goal for policy, but does not necessarily imply that the welfare of both current and future generations is maximised within the constraints imposed by sustainability requirements. Cost-effective policies aim to correct market failures, by properly pricing the use of natural capital while prompting cost minimisation by the individual

economic actors. Cost-effective policies, moreover, ensure that the extraction of the proceeds from the use of natural capital (the "rent"), and their distribution among present and future generations does not conflict with the objective of optimal allocation. Cost-effectiveness is, indeed, vital to achieve sustainability, as it will allow faster wealth accumulation. In this respect, the OECD has always cast its net widely. Major examples concern the horizontal work on ageing, labour and product markets. Concerning Norway, in the *Economic Surveys*, work with a clear connection to sustainable development in recent years concerned special chapters on the environment, the oil and gas sector, pensions and human capital formation. In addition, the major aim of the structural surveillance chapters is to analyse structural conditions and to encourage policies that boost potential output growth.

Policies interact

9. Policy goals can conflict. There is, for instance, a strong emphasis on regional policy in Norway. As part of regional policy, a high degree of agricultural subsidisation not only boosts agricultural output, but also emissions to the soil and air, while the rent of the fishing industry is not taxed because of the desire to generate income for fishermen. At a minimum the cost of such policies should be made transparent, so as to be better able to evaluate trade-offs. In many cases, there should also be possibilities to design better policies which will reduce distortions, while keeping to the initial goals. Policy goals can also be mutually reinforcing. Taxing the natural resource rent or environmental externalities provides government revenues which are not distorting and can be used to reduce other taxes, which could influence potential output.

Figure 1. National wealth
Million NKr per capita, 1997 prices



Source: Ministry of Finance, Long-term Programme 1998-2001.

Resource management

10. Norway is endowed with major non-renewable and renewable resources. These comprise the important crude oil and natural gas resources on the Norwegian continental shelf, a very large hydro capacity, substantial forest resources and significant fish stocks in the Atlantic Ocean and the North Sea.[4] The government is strongly engaged in the management of these resources and, in the case of oil and gas, draws significant rents from it. Yet, it is difficult to design strategies for the sustainable development of these resources:

- Since the government is the sole owner of the oil and gas stock, it could, in theory, aim to maximise the associated wealth by optimising the pace of extraction in view of the expected development of oil and gas prices over time. In practice, however, the uncertainty over future price developments has been overwhelming and, moreover, the size of the resources has been systematically underestimated. The pace of production of oil and gas fields has, therefore, largely been left to market forces, with the government acting as a regulator.

- Since the early 1990s, the government has transformed part of the rent from the development of the oil and gas resources into foreign financial capital in order to improve the options open to future generations. In contrast, in the 1970s and 1980s, priority was given to investing the rent domestically in physical, in particular infrastructure, and human capital. All along, moreover, the oil and gas rent was also used to expand the public sector and subsidise economic activities — including most notably fisheries and agriculture.

- In the case of fisheries, property rights are subject to international agreements on shared stocks and quotas. The imperfect design of these agreements has implied that overfishing problems have not been resolved. The implementation of quotas in Norwegian waters is embedded in an extensive regulatory framework, which is mainly geared towards achieving sustainable harvesting — with fish stocks recovering since the 1980s — and regional policy objectives.

Non-renewable resources — oil and gas

Government policies allow market forces to determine oil and gas extraction rates

11. Norway is endowed with a large oil and gas wealth (see Annex), but at current extraction rates and technology, oil reserves could be exhausted in the next 20 years, while gas reserves are likely to last much longer (more than 80 years). An optimal management of the petroleum wealth involves decisions on the speed of oil and gas extraction, as well as when and how the rent should be distributed. These decisions are, in principle, separable. The optimal speed of extraction is determined by comparing the return on "keeping oil and gas in the ground" to the return from extracting it and investing the rent. An income maximising producer will increase extraction if the returns from investing the net proceeds from additional oil and gas sales exceed the appreciation of the oil reserves in the ground and *vice versa*. The introduction of uncertainties modifies the optimal extraction rate. For example, the risk of sustained price declines of fossil fuels due to environmental policies, provides an incentive to increase the speed of extraction. On the other hand, political economy arguments — governments may be short-sighted in the use of the oil wealth — would argue for a slower speed of extraction.

12. In practice, the Norwegian government has chosen not to steer the extraction rate according to these text book principles. When production on the shelf started in the 1970s, the dominant view was that

reinvesting the oil and gas rent in financial assets was more risky than preserving the petroleum stock itself and hence would not be a viable option. Calls to slow down the issuance of licences in the 1970s also stemmed from inter-generational considerations, while currently such calls are also based on the climate change issue. The point of view of the early "oil conservation adepts" has been superseded by subsequent developments: a faster extraction rate than actually realised combined with a policy of reinvesting the proceeds in securities would have yielded higher returns. After the oil price collapse in 1986, the idea of transforming the oil and gas stock into financial capital emerged. The world-wide bull run on stock markets since the 1980s raised hopes that the conversion of the oil and gas stock into financial capital would be very beneficial (see below).

13. Oil and gas resources are state-owned, regulation being based on the Petroleum Act. Licenses awarded by the state give companies the right to explore, produce and sell the resources for a certain period of time. Afterwards, ownership reverts to the state, unless the license is extended.[5] When issuing acreage licences for exploration, the authorities invite companies who meet high standards of security, solvency and reliability to participate in a consortium. Following new discoveries, production licenses are granted if exploitation is profitable. Licences are not auctioned off, unlike in some other oil and gas producing countries in the OECD area, such as the United States (Gulf of Mexico), Canada and Australia. Companies may apply in groups in the Barents Sea and in the North Sea, while they are obliged to apply individually in the Norwegian Sea. However, the authorities usually grant a joint licence to a group of companies designated to form a consortium also in the Norwegian Sea.

14. In recent years, Norway's approach to developing oil and gas fields has evolved in a number of areas, providing a clearer distinction between government regulatory functions and those of commercial operators, including the state-owned ones. In particular, the government has reduced its direct involvement in the set-up of consortia for field development. Some of the changes are related to the need for compliance with competition rules of the European Economic Area (EEA), and some are aimed at providing incentives for exploration and development in frontier regions.[6] The joint applications for blocks in the Barents Sea in 1997 and in the North Sea in 1999, rather than the government designating the consortia (so-called "arranged marriages") is a reflection of the evolution of Norway's policy in this regard. Moreover, from the 1996 15th licensing round, the state-owned operator Statoil is no longer awarded an automatic share of every license (see Annex).[7] The price of crude oil is determined in the global market, and the government does not directly control exports of oil (apart from adhering to oil sanctions decided by the United Nations [UN]). There are no quotas, tariffs, product or crude restrictions.

15. The authorities have argued that the strong state involvement in gas sales and contract allocation can be justified by the fact that there is a need for co-ordination of the development of gas fields and gas pipelines due to economies of scale, in order to make gas development economically viable and to ensure optimal resource management. Recently governments in a number of EU countries have stated that they are opening up their local energy markets to increased competition, and the current structure of the EU gas market may change significantly as a result — *i.e.* become more "atomistic". This could have a substantial impact on Norway's market for future gas sales. It is, thus, important for Norway to keep under review the existing structure for gas transport and sales so that it is consistent with good resource management and changing market conditions. Such a review could provide an assessment of the pros and cons of different ways of managing the gas transportation grid and negotiating gas contracts.

The government increasingly transforms the oil and gas wealth into financial capital

16. The stock of oil and gas in the continental shelf represents a large source of wealth. In managing this wealth, the Norwegian authorities have aimed to: *i)* channel a substantial part of the revenues

originating from the production of oil and gas through the budget to ensure that the whole society benefits from it at a given point in time; and *ii)* preserve an equitable share of these revenues for future generations through the build-up of public assets.[8] In line with these objectives, the government has set up an extensive welfare system while ensuring a comfortable net asset position. In this respect, Norway is a unique case in the OECD area. However, as has been highlighted in previous *Economic Surveys*, vigilance is needed as the projected fall in oil production in the first half of the next century will coincide with an expected increase in public welfare expenditure as the population ages.

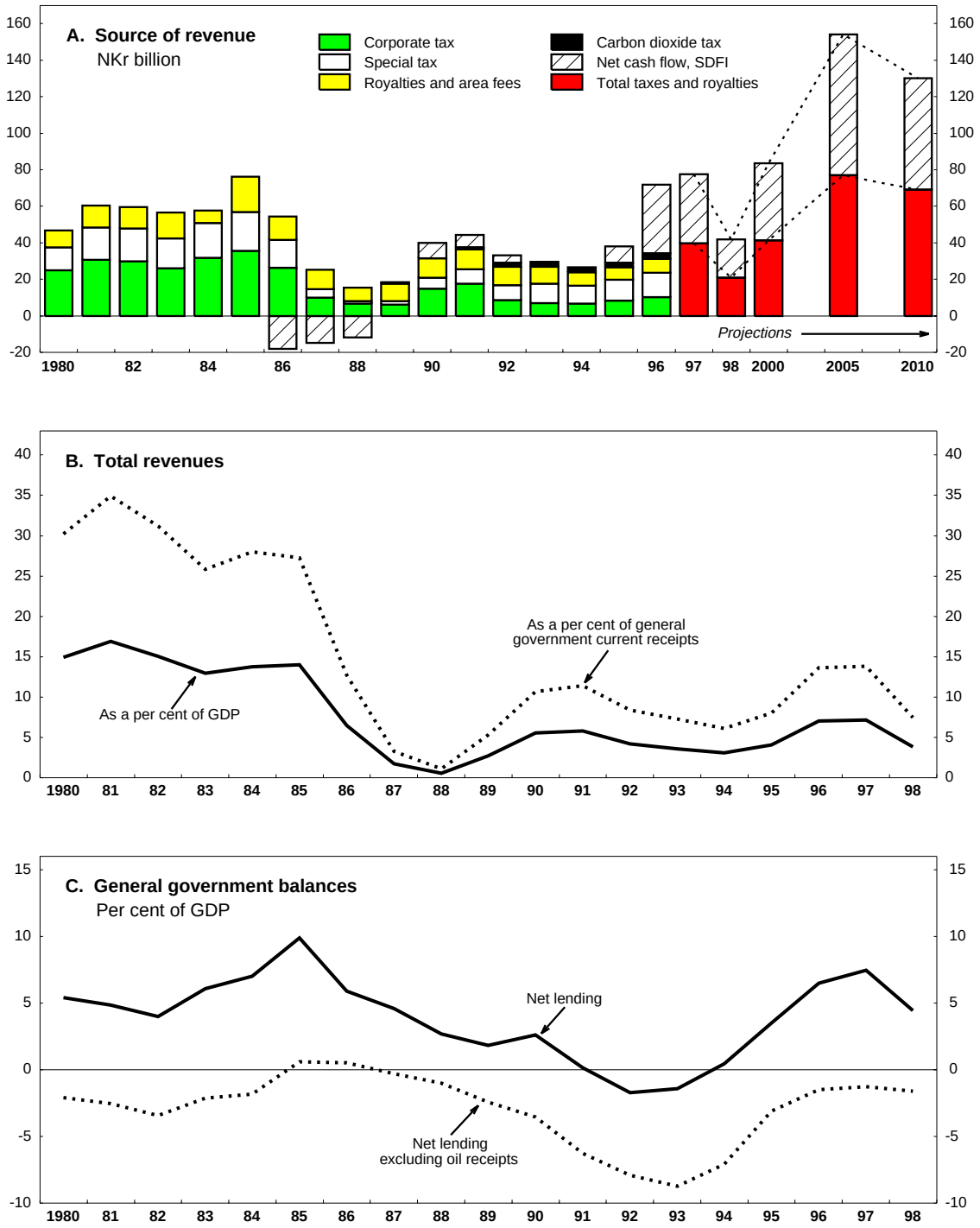
17. Significant revenues accrue to the government due to the transfers of net income from the State's Direct Financial Interest — the SDFI — and the special tax regime applying to oil companies, including the fully state-owned company Statoil (see Annex). In the past, government revenues stemming from the oil and gas sector have shown large swings (Figure 2). In recent years, for instance, they soared from 3 per cent of GDP in 1994 to 8 per cent in 1997, before plummeting to an estimated 4 per cent in 1998 in the wake of the recent oil price collapse.

18. Producers of petroleum earn a rent as profits will exceed average profits in other industries because they are given access to a scarce resource.[9] In principle, all the oil and gas rent should accrue to the government. The government can achieve this *via* the auctioning of licenses, taxation or by developing the resources on its own behalf. In practice, the Norwegian approach aims at extracting the rent *via* taxation and by the use of the SFDI. Estimates by Statistics Norway, however, indicate that about 80 per cent of the cumulative rent accrued to the government between 1980 and 1995. An alternative would be to combine these instruments with auctioning of exploration rights. This would also partly transfer the risk concerning the flow of oil revenues away from the state to the producers and reduce taxation non-neutralities associated with the need to maintain two different tax regimes: offshore and onshore (see Annex). However, it is also very important for the companies to have the right balance between risk and reward. Higher price risk for companies associated with auctioning could imply a lower level of exploration, while the government's tax system spreads the risk over a large number of wells.

19. The view that not only present but also future generations should benefit from the oil and gas activities has led to the estimation of the remaining "petroleum wealth in the ground", both of the nation as a whole and the part which accrues to the government in the form of future petroleum proceeds — roughly 80 per cent of the total. Estimates of the petroleum wealth have tended to be volatile as they are very sensitive to oil price developments: in the 1980s and 1990s, they have varied between half and 2½ times GDP.[10] Until the mid-1990s such wealth estimates were used to set rules for the amount of spending out of government petroleum revenues that would not affect the wealth position of future generations. For example, the revised national Budget of 1992 stipulated that the non-petroleum deficit (the fiscal balance excluding petroleum revenues) should not exceed the implicit return on the assessed value of the remaining petroleum wealth, estimated at the time to be in the range of 5 to 7 per cent of mainland GDP.

20. Such rules of thumb have received less attention in recent years as the non-oil fiscal deficit virtually disappeared. Instead, budgets routinely include "generational accounts" as a way to assess the inter-generational distribution of government policies, including petroleum proceeds.[11] These accounts suggest that, on current demographic projections, social transfers and government services such as health, pensions and education, major inter-generational imbalances are unlikely to emerge. Such estimates are, however, very sensitive to the underlying assumptions with regard to the oil price and the projected social expenditure entitlements.

Figure 2. Net petroleum revenues of the government



Source: Ministry of Petroleum and Energy, and OECD Secretariat.

21. The preservation of petroleum wealth for future generations calls for a vehicle for transmission of the wealth to future generations. While the government had accumulated significant financial assets prior to the adverse oil-price shock in 1986, it was reluctant to create a fund, but finally established the Government Petroleum Fund in 1990. It initially remained empty due to the recession, but the favourable fiscal outcomes later on prompted the government to start transferring assets into the Fund in 1996. By design, the annual allocations to the Fund correspond to the fiscal surplus of the central government, and have been of the order of 5 per cent of GDP per year. As a result, by mid-1998 the capital in the Fund amounted to a market value of NKr 136 billion, or 14 per cent of GDP and is officially projected to grow to NKr 600 billion (close to 46 per cent of GDP) by the year 2002.[12] The Fund, as currently managed by the central bank in co-operation with external fund managers, invests exclusively in foreign currency denominated assets in order to: *i)* offset the impact of the currency inflow associated with oil exports on the exchange rate; and *ii)* avoid the risk of a combined fall in oil prices and the market value of domestic assets, as many domestic asset values are highly correlated with the oil price.

Renewable resources — fisheries and forestry

Fisheries

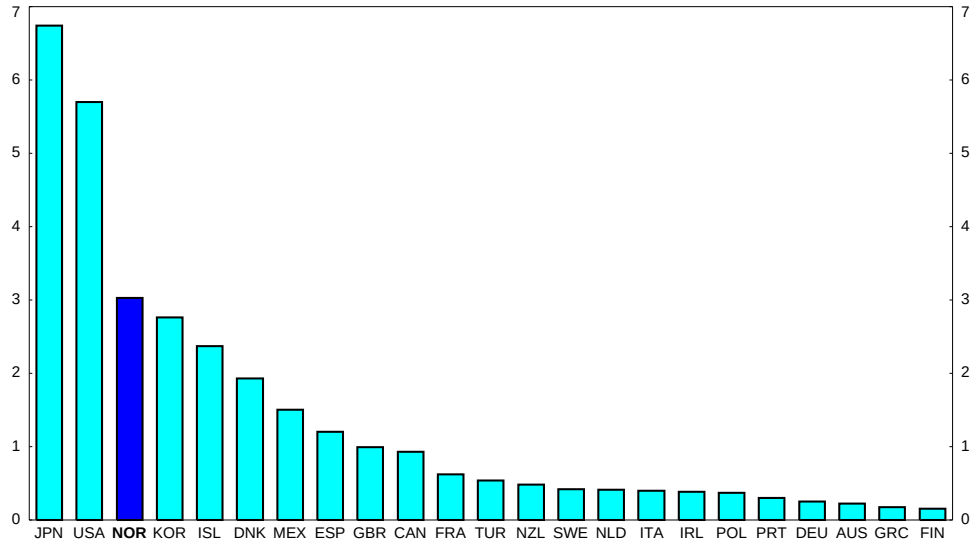
22. Norway is the tenth largest fishing nation in the world and the third largest in the OECD, after the United States and Japan[13] (Figure 3). Norway is, moreover, the world's leading producer of farmed Atlantic salmon (serving 50 per cent of the world market). The bulk of Norwegian fish is exported: Norway is the second largest seafood exporter in the world, following Thailand. The fishing industry, including the fish-farming industry, is Norway's second-biggest export industry — but it represents only one-tenth of oil and gas exports. Other key features of the Norwegian fishery sector are the limited processing activities, which are small scale and decentralised, the remoteness from markets (and closeness to resources); and its seasonal character. Fishery activities involve 50 000 workers (2¼ per cent of total employment), including fishermen, fish farmers, workers in processing plants and marketing agents. The fishing industry underpins the coastal area's economic activity, including private and public services. The total catch has grown considerably during the 1990s, from a trough of 1.6 million tonnes in 1990 to 2.8 million tonnes in 1997 even though the number of fishermen has continued its long-run decline.

23. Fish catches in Norway are constrained either by nationally fixed targets or by the internationally-agreed Total Allowable Catches (TACs) to prevent overfishing — *i.e.* the collapse of harvestable stocks.[14] These TACs are based on scientific research of the size and age composition of each stock as well as changes in migratory patterns, although the estimates have not been very robust to date. International agreements have increasingly been used to settle disputes concerning the distribution of TACs for such species as the Atlantic herring, which migrates seasonally and unpredictably between the Norwegian, Faeroese and Icelandic 200 mile exclusive economic zones as well as the "Ocean Loop" outside the 200 mile zones.[15] Apart from the international Atlantic Herring Agreement, Norway has bilateral agreements with Russia and the EU on the sharing of fish stocks. For herring, for example, the second most important species for Norwegian fisheries, the country received 57 per cent of the Atlantic herring quota in 1997 while the rest was distributed among the EU countries, Russia, Iceland and the Faroe Islands. The use of TACs to limit fishing in the North Atlantic region remains the dominant management tool. They do not, however, avoid incidental catches of unwanted fish of other species and young fish, or of illegal "black-fish" landings. Overfishing in the North Sea remains a serious problem, as several species have almost been driven to extinction and the ecosystem is severely damaged, as reflected in increasing fishing mortalities. The tendency towards overfishing in this region is heightened by the overcapacity in the European fishing fleets. Indeed, both in the EU and in Norway, over-capacity is considered to be the single most urgent issue hindering the transition towards sustainable fisheries.[16]

Overall, existing fishery control policies and measures are either inadequate or not sufficiently enforced.[17] Despite failures, the overall resource and economic situation of the Norwegian fishing industry has improved. Some fish stocks have been rebuilt, for instance, Atlantic herring from practical extinction in the late 1960s to the biggest North Atlantic fish stock in 1997, while government financial transfers to the fishing industry peaked in 1981 (at 25 per cent of the export value) and has been reduced to practically zero in 1997.

24. The right to fish in the Norwegian 200 mile zone by Norwegian fishermen, is based on a quota system to allocate the TACs, managed by the Ministry of Fisheries.[18] The Norwegian quota system allows a fleet of traditional small fishing boats to operate alongside a fleet of larger and capital intensive ships (trawlers and purse seine vessels), with small vessels receiving the largest quotas in proportion to their capacity. In addition, vessels registered in the remote northern counties enjoy a favoured treatment. The quotas require renewal from the ministry each year and are not transferable at the sale of fishing boats and ships. Since 1996, however, owners who agree to withdraw a vessel from the fleet in perpetuity have been allowed to allocate part of their quota to the remaining fleet for a period of 13 years in order to achieve scale economies. This has induced owners of bigger vessels to buy smaller ones in order to combine two licenses for one ship, and has sparked a sharp price increase of ships with a license. While contributing to greater cost effectiveness, this system implies that the increased rent is reaped exclusively by the fleet owners. Not surprisingly, the current system of allocating the annual fish quotas for free among owners on the basis of historic rights is debated. A system of auctioned and freely tradeable quotas would allow a further re-allocation of production to the most efficient suppliers and would transfer the rent to the public coffers. These objectives could also be achieved by other means, for instance, tradeable licences and fees or resource taxes. The rent is currently estimated to be of the order of NKr 1.5 billion, if fisheries were managed in an efficient way. Given the inefficiencies generated by the current set-up, the actual rent is probably much smaller.

Figure 3. Fish catches in OECD countries
Per cent of total world catch, 1996[1]



1. Marine catches of fish, crustacea and molluscs.
Source: FAO Fisheries Department, 1998.

Forestry

25. Forests cover 37 per cent of the Norwegian land area, with 80 per cent privately owned. After suffering from excessive harvesting, the volume of timber has doubled since 1900. Since 1920, the aim of policy has been to increase the forestry resources and to improve their condition. More recently, policy has focused on environmental aspects, in particular biodiversity. Employment considerations in rural areas also play an important role. The measures to achieve these objectives include legislation, taxation, financial support and training. The authorities justify subsidisation by the very long growing period for trees in Norway (70 years on average). Subsidies have decreased in nominal terms since 1990 (from NKr 350 million to NKr 250 million). Over-harvesting is not an issue and there were only marginal changes in forest area over the last decade.

Environmental management

26. Norway probably has the most extensive framework for environmental policy of all countries in the world:

- It was among the first countries to establish a Ministry of Environment, in 1972. The ministry is responsible for identifying environmental problems, assessing and reporting on environmental trends and proposing cross-sectoral measures and national goals. It is assisted by several environmental management bodies under its authority, including the important State Pollution Control Authority which, pursuant to the Pollution Control Act of 1981, rules on emission permits for industrial activities and monitors compliance, either directly or on the basis of annual environmental reports of companies that have set up their own emission control and monitoring procedures. In clear cases of violation, companies are prosecuted and fined and profits may be confiscated.

- Co-ordination on environmental matters is supported by various inter-ministerial committees, that aim to: *i)* establish a common knowledge base on the environmental effects and their valuation in a wide range of policy areas, and *ii)* ensure that this knowledge feeds through into official policy proposals.[19] Such co-ordination is important so that, as far as possible, policy objectives of other ministries do not conflict with environmental goals. In particular, government support to economic activities in environmentally vulnerable remote areas, including fishery, agriculture, mining and heavy industries, have been susceptible to such conflicting goals.

- In the late 1980s, the Ministry of Environment, in co-operation with the Ministry of Finance, established a framework for an annual document annexed to the National Budget examining the "Environmental Profile of the State Budget", identifying all expenditure items that are wholly or partly motivated by environmental policy objectives. For this purpose, the spending ministries have been asked to classify outlays by "result areas", *i.e.* according to the environmental policy goals they should help achieve. There are no attempts to calculate a "green Net Domestic Product" (GDP corrected for depreciation of natural capital). However, environmental expenditure was estimated in the OECD *Environmental Performance Review* 1993, showing outlays of 1.2 per cent of GDP.

27. The main body of environmental legislation was established in the 1970s and early 1980s. Most importantly, the Pollution Control Act of 1981 and subsequent amendments instituted integrated pollution control for all stationary sources (industry, agriculture, municipalities and the continental shelf), endorsing

four main principles: *i)* avoid irreversible developments and decisions (precautionary principle); *ii)* give priority to prevention over restoration; *iii)* assess the environmental properties of products at all stages, including their production, use and disposal; *iv)* seek cost-effective solutions. The Act contains provisions on implementation, enforcement, inspection, penalties for non-compliance, civil fines and compensation for environmental damage. Polluters must meet regulations, respect limits set by emission permits or pay taxes on certain emissions. Moreover, the Constitution was amended in 1992 to include considerations relating to the right to a clean environment and natural resource management, and several new Acts were legislated.

28. Since the early 1990s, an ongoing evaluation effort of environmental policies has been undertaken. The government has mandated several high level committees to investigate ways to improve the policy framework. In 1992, the *Environmental Tax Commission* published its report "Towards more cost-effective environmental policies in the 1990s: principles and proposals for better pricing of the environment" (Ministry of Finance, 1992). The report called for a differentiation of several environmental taxes to better take account of polluting substances contained in fuels and other products, in order to enhance the cost-effectiveness of these tax measures. This was followed up by the *Environmental Policy Instruments Committee* (Ministry of Environment, 1995*a*), which recommended to improve the cost-effectiveness of a wide range of environmental policies. The *Green Tax Commission* established in 1994 released in 1996 its report "Policies for a better environment and high employment" (Green Tax Commission, 1996). It suggested ways to capture better the "rent" from the use of natural capital. It recommended, *inter alia*, to impose a rent tax on hydro power stations, which was actually implemented in 1998, and to examine the possibility of auctioning emission and catch quotas. It also proposed changes to a number of existing environmental taxes, most prominently to extend the carbon dioxide (CO_2) tax to all sources exempted to date, and to introduce new environmental taxes, *inter alia* on waste. Being a large net importer of air-borne pollution and a small open economy, Norway has a clear interest in international co-operation and co-ordination of environmental policies and the country has been very active in this regard. Indeed, the implementation of, and compliance with international agreements figures very high on the political agenda.

29. The extensive institutional framework for environmental policy has helped to integrate policies and to build a consensus about the need to make these amenable to sustainability in the long run. However, there remains considerable scope for improvement, which may not be easy to achieve since policies pursuing sustainability in the long run can conflict with vested interests in the short run.

Global environmental problems

Climate change

30. Norway has been one of the main proponents of putting climate change on the international agenda and has actively participated in the conclusion of the Kyoto Protocol for reducing greenhouse gas emissions (see Box 2). Prior to the Protocol, moreover, Norway was one of the five countries to implement a carbon tax to curb CO_2 emissions which are the main source of climate change. Norway's active stance on climate change policies may seem at odds with its small contribution to global greenhouse gas emissions and its interests as a major oil and gas exporter (even though its hydropower industry would benefit from increased demand for clean energy sources). However, irreversible change in the earth's climate is an important preoccupation of the Norwegian people, even though the country is not particularly vulnerable to a sea level rise.

Box 2. **The Kyoto Protocol**

As a follow up to the 1992 Convention on Climate Change at the Earth Summit in Rio de Janeiro, it was decided to hold a Conference in Kyoto in December 1997 to agree on legally binding quantitative targets. The result was a protocol which involved the following major provisions:

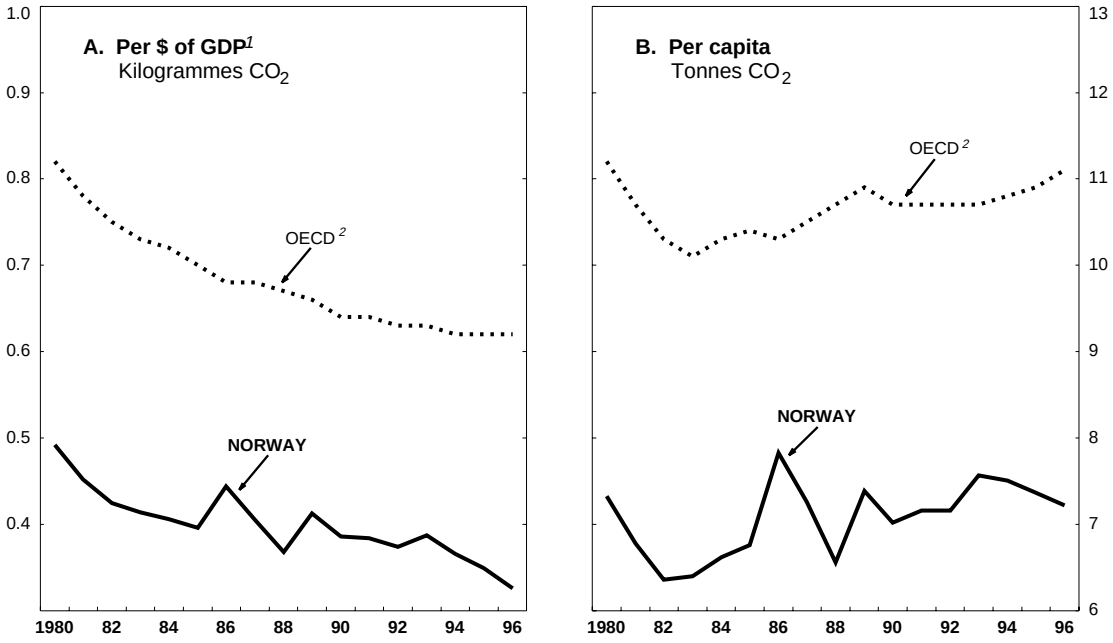
- Annex I group countries (OECD countries except Mexico, Korea and Turkey, plus Russia, Belarus and the countries of central and eastern Europe) will cut their greenhouse gas emissions by at least 5 per cent relative to the 1990 level in the 2008 to 2012 period. The reduction commitments are differentiated by country, but the protocol mentions that they can be met individually or jointly. The reduction targets range from an increase in emissions of 10 per cent in Iceland to reductions of 8 per cent in the European Union. Norway is one of the few countries that has been granted an increase in greenhouse gas emissions (1 per cent relative to 1990 outcomes), with the rationale that Norway's relatively clean system of power generation (hydro power), leaves limited scope for further reductions in CO_2 emissions at reasonable cost. The Protocol covers a basket of six greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and three synthetic fluorinated compounds (SF_6, HFCs and PFCs).

- The Protocol allows for emission trading and joint implementation among Annex I countries. Emission reductions can be "banked" in the sense that countries that more than meet their commitments in the "first commitment period" (2008-12) can use the surplus reductions for future commitment periods (to be defined). In addition, the Protocol contains a provision whereby abatement investments in a non-Annex I country financed by an Annex I country could count against the target of the latter (Clean Development Mechanism) but rules for such a mechanism are yet to be defined. Similarly, to some extent changes in a country's absorption of CO_2 emissions due to a change in its land use and forest surface, would count against its abatement requirement set by the Protocol.

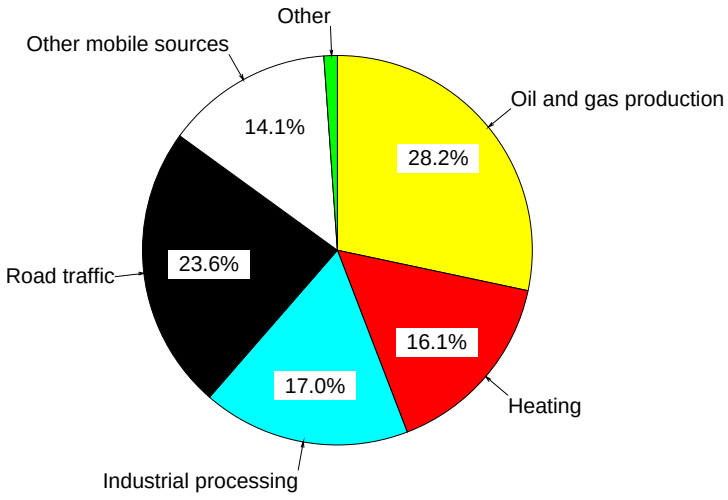
- The Protocol will enter into force 90 days after 55 Parties accounting for 55 per cent of total CO_2 emissions of Annex I countries in 1990 have ratified it. Future meetings will define rules and guidelines for emission trading; ways to verify compliance with agreed commitments; and other specific rules for implementation of the Protocol.

31. As in most countries, carbon dioxide is by far the most important greenhouse gas emitted in Norway, accounting for 70 per cent of total emissions in 1996. Norway is a median OECD country when it comes to CO_2 emission per capita, and in the lower range with regard to emission per unit of GDP — in part reflecting the mainland economy's reliance on hydro power (Figure 4, Panels A and B). The extraction and transportation of oil and gas on the continental shelf generate large greenhouse gas emissions (Figure 4, Panel C). Hence, the decline in CO_2 emission per unit of GDP achieved since the early 1980s is remarkable in view of the soaring oil and gas production, and reflects strong improvements in energy efficiency. Carbon dioxide emissions have, nevertheless, continued to rise in absolute terms since 1990. As concerns other greenhouse gases, Norway has significantly reduced the emissions of perfluoridised carbons (PFCs) and sulphur hexafluorides (SF_6) in the aluminium and magnesium industries to a considerable extent due to the implementation of "no-regret" measures which were financially beneficial as well (Figure 5). By contrast, emissions of hydrofluorocarbons (HFCs) have been increasing since 1990 due to the banning of the ozone-depleting gases (chlorofluorocarbons [CFCs] and hydrochlorofluorocarbons [HCFCs]). Nitrous oxides and methane emissions have been roughly stable in the same period.

Figure 4. Carbon dioxide emissions

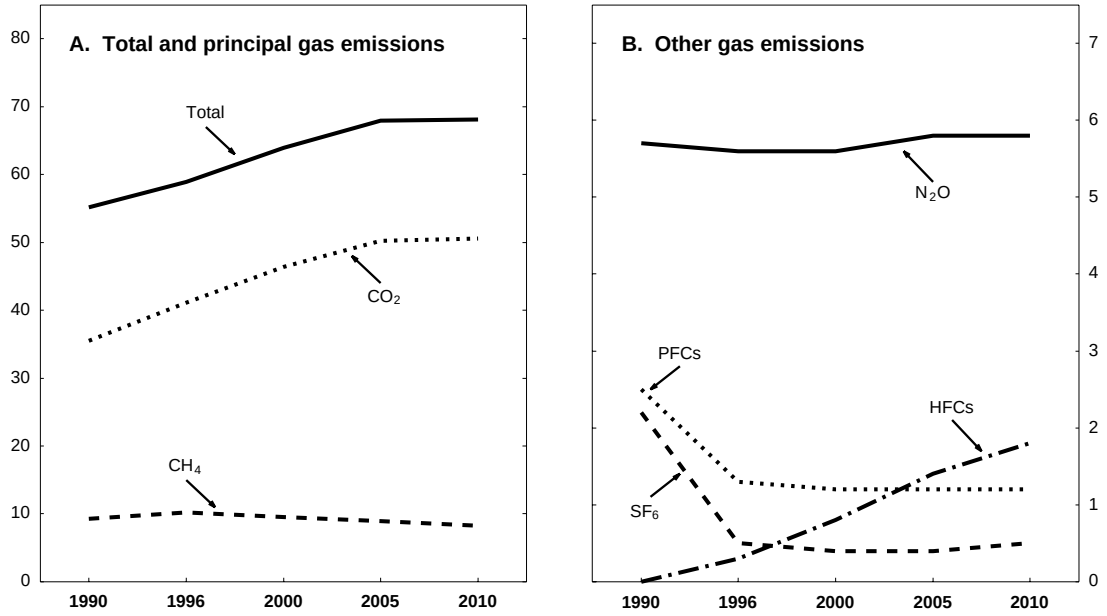


C. By source
1996



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; Statistics Norway and OECD Secretariat.

Figure 5. Projections for greenhouse gas emissions
Million tons CO_2-equivalents



Source: Ministry of Finance and State Pollution Control Authority.

32. Under the Kyoto Protocol, Norway has been permitted a 1 per cent increase in greenhouse gas emissions in the period 2008 to 2012 relative to the 1990 outcome, while the national baseline projection points to an increase of 23 per cent. Thus, a reduction of 18 per cent from the baseline will be required. The rise in the baseline scenario is mainly due to increasing carbon dioxide emissions (Figure 5). Oil and gas production is largely responsible for the bulk of the projected increase. The rest of the expected increase in CO_2 emissions stems from mainland economic growth, changes in production structure and the possible introduction of gas-fired power generation.[20] The emissions of the other greenhouse gases are expected to remain broadly stable in aggregate, but this masks diverging tendencies among them. In particular, methane emissions from waste deposited in landfills and animal manure are expected to fall whereas emissions of HFCs will continue to increase as ozone-depleting gases are phased out.[21]

33. The key climate policy instrument used to date is the *carbon dioxide* tax introduced in 1991. The tax rate differs across fossil fuel category and geographic location of the activity (mainland and offshore), see Table 1. Process emission from several export-oriented mainland manufacturing industries, such as the ferro-alloy, aluminium, fertiliser, petro and other chemicals industries have, moreover, been exempted. Exemptions are also granted to the fishing fleet, aviation, coastal shipping of goods and international shipping.[22] As a result, only about 60 per cent of CO_2 emissions are subject to the tax, and only about 20 per cent of emissions from manufacturing. The exempted manufacturing sectors are all heavy CO_2 emitters and most of them are strongly exposed to international competition. Similar arrangements exist in the other countries with a CO_2 tax, and are motivated by concerns over international competitiveness of individual firms. In Norway such concerns are heightened by the aim to maintain

Table 1. **CO_2 tax structure and coverage**

1 January 1998

	Tax rate[1]	Tax per ton of CO_2 emission NKr	*Memorandum:* As a per cent of total CO_2 emissions in 1995
Mainland			
Petrol	0.890	384	13.8
Mineral oil			
Heavy oil	0.445	143	23.8
Light oil	0.445	168	
Pulp, paper and herring meal	0.222	n.a.	
Air transport	..	..	11.7
Shipping of goods[2]	..	..	
Supply fleet in the North Sea	..	..	
Shipping fleet[2]	..	..	
Coke and coal			
Coal used for energy purposes	0.445	183	0.4
Coke used for energy purposes	0.445	382	
Production of cement and leca	..	..	1.3
Coke and coal used for non-energy purposes	..	..	13.3
Gas	..	..	7.5
Offshore			
Oil	0.890	336	18.9
Gas	0.890	382	

1. NKr/l for petrol and mineral oil; NKr/kg for coke and coal; NKr/scm oe for offshore oil and gas.
2. Coastal fishing and coastal goods transport are fully compensated for the CO_2 tax paid on fuel oil consumption.

Source: Ministry of Finance, St prp nr 54 (1997-98), *Grønne skatter*, Oslo.

industrial activities in remote areas — CO_2-intensive industries being particularly important there. As noted by the Green Tax Commission, it is difficult to avoid a loss in competitiveness in individual sectors, but this could be offset by overall tax reductions in a revenue-neutral tax reform package.[23] It also pointed out that structural change is the inevitable consequence of the introduction of a CO_2 tax, as its basic aim is to change industrial structures and consumption patterns. An introduction of a relatively high and broad-based carbon tax could prove costly if similar policies are not adopted by a significant number of other countries, *e.g.* in the framework of internationally binding commitments. This could imply adjustment in the medium term which may prove undesirable in the long term, if other countries introduce similar measures later on. The industry argues that, in addition, the closing and relocation of CO_2-intensive production to other countries resulting from such a unilateral broad-based CO_2 tax would be ineffective in terms of reducing global emissions. Norwegian companies prefer "voluntary agreements" with the government to reduce greenhouse gas emissions over a CO_2 tax. One exempted industry

(aluminium) has recently concluded such an agreement.[24] As with all such agreements, the government lacks a legal basis to enforce them.

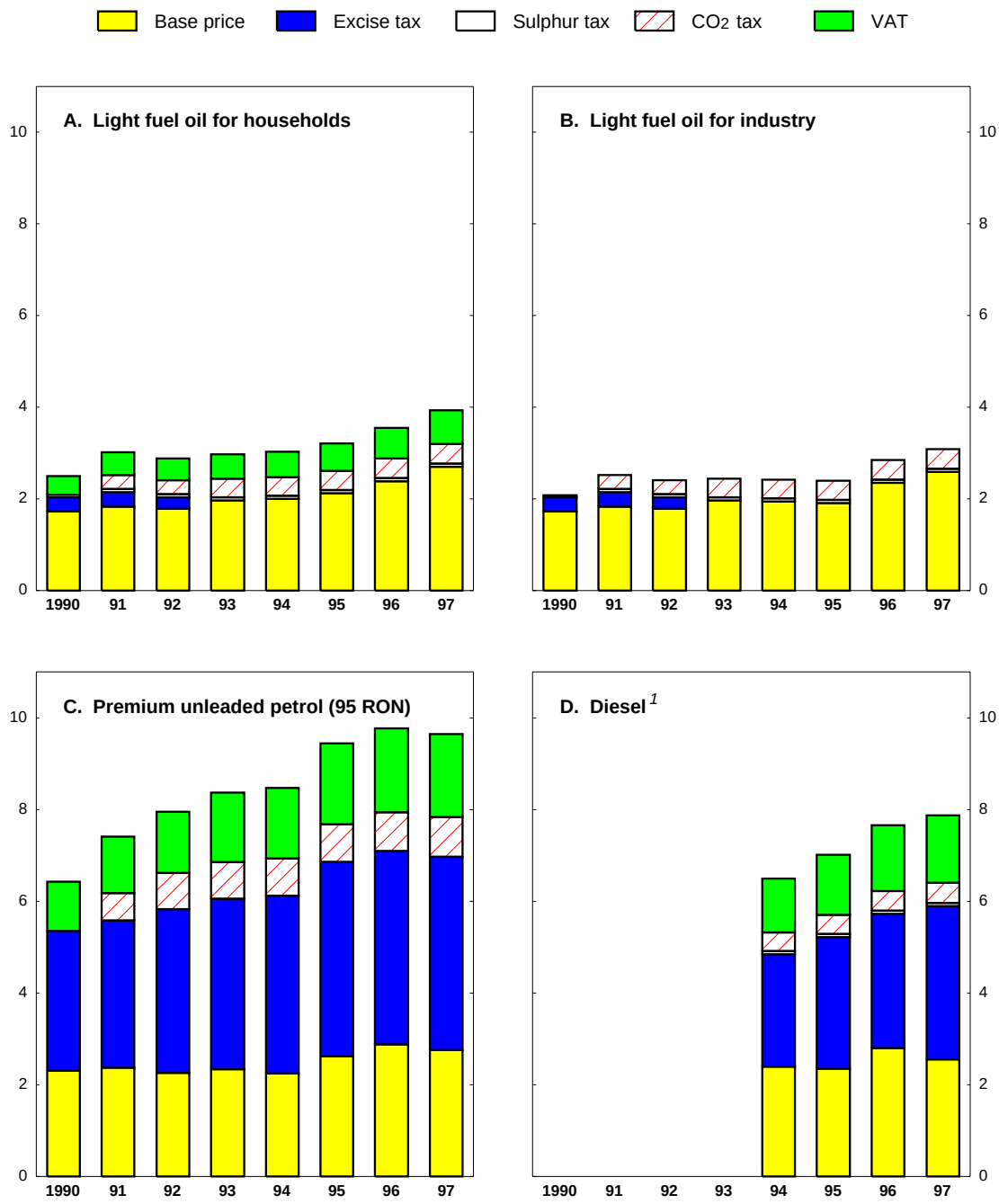
34. Taxes on fossil fuel consumption typically take the form of excise duties and value added tax (VAT), and represent up to 70 per cent of the market price (Figure 6). Although these taxes do not primarily aim at reducing emissions, they provide the same type of incentive as the CO_2 tax, even though they do not take into account the emission content of the fuel. Taxes are lowest for fuel consumption in industry and highest for car fuels, mostly affecting households. Whereas other tax elements on mineral oil products have been eliminated in steps after the introduction of the CO_2 tax, the taxation of petrol has increased. Norway, therefore, has a relatively high level of petrol tax compared to the North American and Pacific OECD countries although it is in line with the European average (Table 2).[25] By contrast, the purchase tax on cars is high compared to other European countries and since 1996 has been differentiated according to car weight, engine output and engine volume.

35. The size of the impact of CO_2 and related taxes on the emission of greenhouse gases is uncertain. A study by Statistics Norway suggests that the CO_2 tax may have reduced CO_2 emissions from households, transport and stationary sources by 3 to 4 per cent in the period 1991-93. There is, moreover, evidence suggesting that the CO_2 tax has prompted lower CO_2 emissions on the Norwegian continental shelf by encouraging the use of energy-efficient gas turbines and the replacement of pilot flames for flaring by electronic ignition systems.

36. Even if the CO_2 tax may have contained growth in CO_2 emissions, studies by the Environmental Tax Commission in 1992 and the Green Tax Commission in 1996 show that the structure of the carbon tax should be adapted to raise cost-effectiveness. The exemptions and the weak link between the rates of taxation and the carbon content of products imply that the incentives for reducing carbon emission are weakest in industries where marginal abatement costs are lowest. The overall cost of meeting a given CO_2 reduction target, therefore, tends to be too high — in any case higher than if the tax were levied in proportion to carbon emissions and applied across the board.[26] The majority in the Green Tax Commission thus advocated a rapid change to a carbon tax system without exemptions. The weak incentives for emission reduction in the exempted sectors is also conflicting with goals of stimulating environmentally-friendly technological change and may lead Norwegian households and businesses to move towards more polluting economic activities. Although they are probably of less importance compared to environmental policies *per se*, some transport subsidy schemes provided to agriculture, the fisheries and petroleum products used in remote areas as part of regional policy were also identified by the Green Tax Commission as environmentally harmful.

37. Policies focusing on curbing emissions of *methane* have relied essentially on changing waste treatment, as waste disposal in landfills has been the main source of rising emissions in recent years. Since 1994, landfills generating large amounts of combustible gas have been equipped with systems to extract gas for heating purposes or flaring, a technology which has proved successful in reducing emissions. Limiting landfilled waste through greater emphasis on separation, recycling, composting and incineration of waste will also contribute to reducing methane emissions. By contrast, methane emissions from animals in agriculture have not been tackled to date, and the shift from production-related subsidies to subsidies per animal are unlikely to lead to an improvement. Nor have the authorities established policies to reduce emissions of the other greenhouse gases, apart from a voluntary agreement with the aluminium industry to reduce emissions of PFCs, even though the abatement costs per CO_2 equivalent of these other gases may be lower than for CO_2. The authorities have, however, for many years had a close dialogue with industries including the possibility to reduce these emissions.

Figure 6. Prices and taxes for fuel oil and petrol
NKr per litre



1. Automotive diesel for non commercial use.
Source: IEA (1998), Energy Prices and Taxes and OECD Secretariat.

Table 2. **Petrol prices and taxes in international comparison**
US$ per litre,[1] 1996

	Diesel fuel			Unleaded premium		
	Price excluding tax	Tax	Price including tax	Price excluding tax	Tax	Price including tax
Norway	**0.26**	**0.32**	**0.58**	**0.22**	**0.58**	**0.80**
Austria	0.22	0.24	0.46	0.23	0.46	0.70
Belgium	0.22	0.26	0.48	0.21	0.56	0.77
Denmark	0.20	0.15	0.35	0.20	0.46	0.66
Finland	0.21	0.24	0.45	0.20	0.60	0.80
France	0.18	0.32	0.50	0.17	0.67	0.84
Germany	0.18	0.26	0.44	0.18	0.49	0.67
Greece	0.20	0.27	0.48	0.23	0.50	0.73
Ireland	0.46	0.34	0.80	0.28	0.53	0.81
Italy	0.25	0.41	0.66	0.26	0.72	0.98
Luxembourg	0.19	0.22	0.41	0.20	0.37	0.57
Netherlands	0.31	0.29	0.60	0.23	0.60	0.83
Portugal	0.29	0.41	0.69	0.31	0.76	1.07
Spain	0.25	0.31	0.56	0.26	0.54	0.80
Sweden	0.25	0.23	0.48	0.19	0.52	0.71
United Kingdom	0.20	0.47	0.66	0.18	0.58	0.76
Australia	0.20	0.08	0.28	0.22	0.27	0.50
Canada	0.23	0.16	0.39	0.22	0.21	0.42
Czech Republic	0.45	0.48	0.93	0.54	0.85	1.39
Hungary	0.35	0.63	0.98	0.38	0.72	1.10
Japan	0.14	0.17	0.31	0.24	0.29	0.53
Mexico	0.35	0.05	0.40	0.47	0.07	0.54
New Zealand	0.24	0.00	0.25	0.27	0.25	0.52
Poland	0.35	0.21	0.55	0.32	0.47	0.79
Switzerland	0.11	0.31	0.42	0.15	0.33	0.48
Turkey	0.36	0.57	0.93	0.44	0.85	1.29
United States	0.18	0.10	0.29	0.24	0.09	0.33

1. 1991 prices and PPPs.
Source: IEA-OECD.

38. In April 1998, the government proposed a reform of environmental taxes which was only partly endorsed by parliament. The proposal comprised the following measures:

- To introduce a CO_2 tax of NKr 100 per ton of CO_2 for the previously exempted sectors in line with the recommendations of the Green Tax Commission. The processing industries (aluminium, ferro-alloy, carbides, etc.), however, would be granted a flat rate compensation per ton of output for carbon emissions unrelated to combustion.[27] Fisheries and air transport were also to be compensated. The compensation schemes aim at avoiding a fall in profitability, but do not undo the incentives for CO_2 emission abatement. The compensation was proposed to be gradually phased out after the entry in force of the Kyoto Protocol, and to be abolished by 2010.[28]

- To introduce a tax of NKr 300 per ton of waste delivered to landfills or combustion plants in order to reduce methane emissions.[29]

- To exempt investment in renewable energy sources (biofuels, windmills and heat pumps) from the 7 per cent investment tax, and to remove the exemption of the automobile diesel tax on diesel oil used in buses, with a compensation scheme for bus services to avoid negative effects on public transport.

39. The proposed extension of the CO_2 tax to the exempted mainland industries met strong opposition in parliament, which decided to limit the extension of the tax to air traffic (with a compensation), cargo shipping in coastal waters and shipping activities on the continental shelf. Parliament also requested the government to appoint a special Committee to prepare a national system of tradeable emission quotas, and proposed a CO_2 emission reduction target of 30 per cent for the currently exempted mainland industry for the 1990-2010 period (corresponding to 12 per cent for the economy as a whole). This Committee, which should report by the end of 1999, is mandated to examine several options, as a minimum including the introduction of tradeable emission quotas in mainland processing industries, currently exempted from CO_2 tax.[30] The domestic quota system shall be linked to the Kyoto-mechanisms. In addition, a choice needs to be made between handing out emission quotas for free — which amounts to a subsidy from other parts of society — or to capture part or all of the "resource rent" by selling the quota, either at a pre-set rate or through auctioning or tendering.[31] Parliament endorsed the government proposals on diesel, waste and tax exemptions for renewable energy sources. Since the reform is intended to be revenue neutral overall, the net proceeds should slightly reduce non-environmental income taxes.[32]

40. Even if Norway could achieve the target of reducing CO_2 emissions by 30 per cent in mainland industry by 2010, this would not suffice to comply with the Kyoto target. In fact, to achieve it through a broad-based CO_2 tax would impose a significant burden on the economy, as this would require an estimated tax rate in the range of NKr 250 to NKr 350 per ton of CO_2, a level which is currently attained only in the offshore oil and gas sector and for car petrol.[33] Such a tax rate would dwarf the theoretical world-wide quota price of NKr 125 per ton of CO_2,[34] reflecting the much higher abatement costs in Norway. On the other hand, a CO_2 tax would also have ancillary benefits by leading to reductions in other pollutants. Norway would greatly gain from buying CO_2 emission quotas abroad if that were possible. Indeed, the Ministry of Finance estimates, in a partial exercise that does not include the response of other signatories, that attaining the Kyoto targets by using emission trading and other "flexibility mechanisms" (investing in clean-up projects abroad to obtain additional emission rights) would reduce the annual costs of compliance with Kyoto to a third (from 0.6 to 0.2 per cent of GDP), compared to the most cost-effective domestic solution (Table 3).

Table 3. **Macroeconomic effects in 2010 of meeting the Kyoto Protocol obligations**
In million tons CO_2 equivalents as compared to the reference scenario

	Scenario 1 Cost-effective using flexible mechanisms	Scenario 2 Cost-effective domestic solution
Total greenhouse gas emissions	68.1	68.1
Reduction in non-CO_2 greenhouse gases	3.7	4.2
Reduction in CO_2	1.5	8.1
Emission reduction abroad through different flexibility mechanisms	7.1	0.0
Total yearly costs[1] (1997 billion NKr)	2.0	6.0

1. Change in real net disposable income in Norway compared to the reference scenario as a result of: abatement and adaption costs in reducing CO_2 emissions, abatement costs in reducing emissions of other greenhouse gases and costs following the use of the flexibility mechanisms.

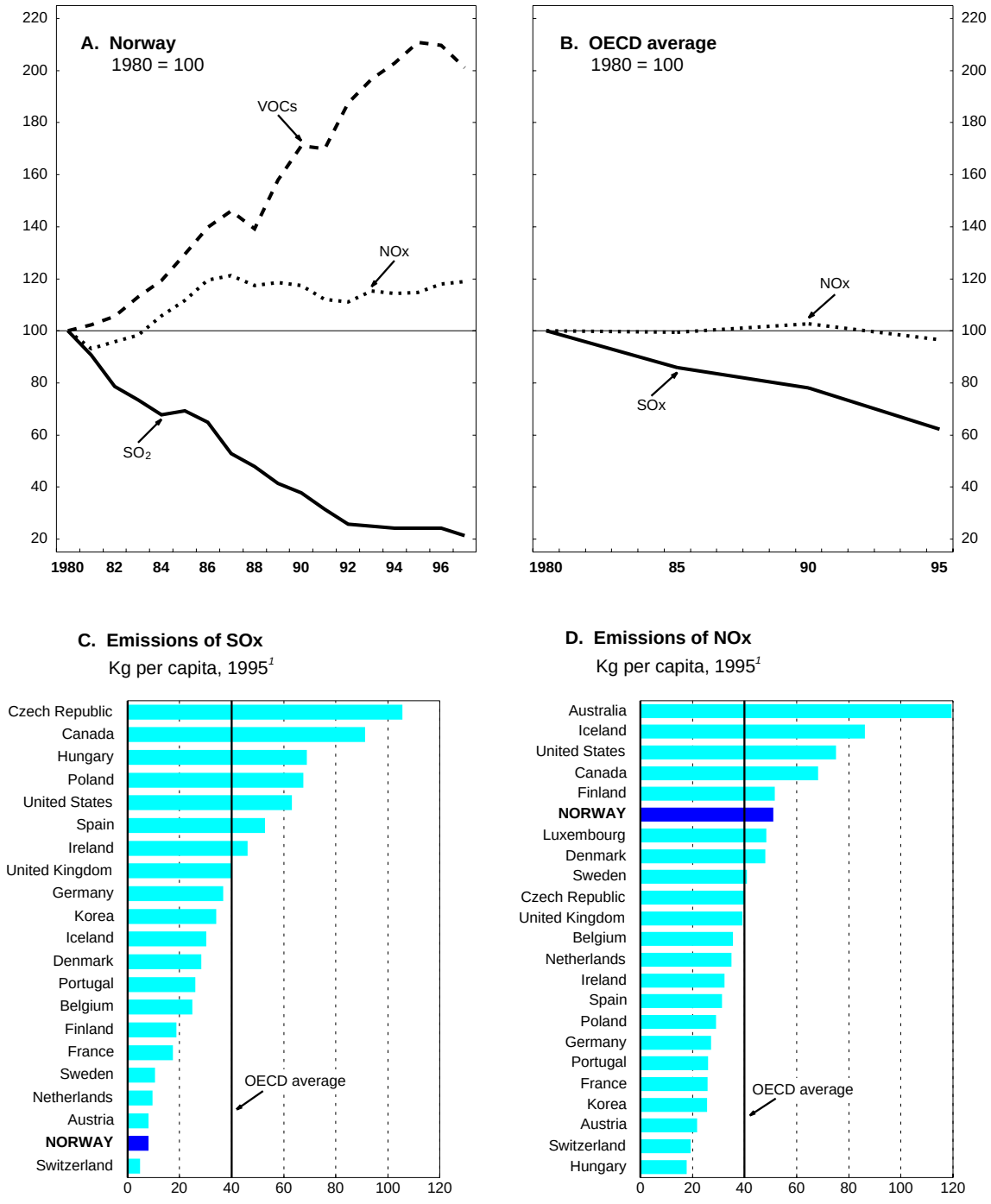
Source: Ministry of Finance.

41. If all signatories to the Kyoto agreement were to faithfully implement reduction targets, this could have a considerable effect on the oil and gas price. The impact is highly uncertain, however. It would, for instance, strongly depend on whether countries implement cost-effective policies or not. In a partial exercise, excluding Norway's response to climate change, contained in the Long-term Programme 1998-2001, it was assumed that crude oil prices could fall by 15 to 20 per cent in 2010, while gas prices would not be influenced. Such an oil price fall would reduce real national income by NKr 15 to 20 billion. Adding the two partial exercises suggests that the overall income loss could be more than 2 per cent of GDP, thus imposing a heavy burden on the economy.

Ozone depletion

42. Subsequent to the Montreal Protocol signed in 1987 and revised in 1995, Norway has reduced and gradually eliminated consumption of all substances susceptible to depleting the stratospheric ozone layer protecting the earth from UV radiation. The most important ozone-depleting substances are chlorofluorocarbons (CFCs) and halons which are used mainly in cooling systems, dry cleaning and fire-extinguishers.[35] National regulations in Norway imply a faster phasing out for several substances relative to the Protocol's timetable, in line with EU regulation.[36] As a result, the imports of newly-produced halons and CFCs have been entirely eliminated, while recycled substances are still accepted.[37] The tight timetable required strict regulation and reduced the scope for the use of economic instruments such as a tax.[38] However, a tax to meet the reduction targets for ozone-depleting substances with a longer phasing out period — *e.g.* extending to 2015 for HCFCs — is being considered.

Figure 7. Emissions to air



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

Transborder pollution problems

43. The Norwegian territory is affected by a number of transborder environmental problems, most prominently:

- *Acidification*, especially in the southern and western parts of the country and close to the Russian border, 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. The damage in Norway is relatively important due to its lime-poor rocks and thin soils which have little capacity to neutralise acid deposition — *i.e.* low "critical loads". This combination of factors has caused death of aquatic life in surface waters and weakened the vegetation resistance capacity against drought, cold and frost, of Norwegian forests.[39] The bulk of the sulphur and nitrogen deposition, 95 and 86 per cent, respectively in 1994, stems from long-range air transport from the United Kingdom, Central Europe and Russia. Domestic emissions, in turn, play a relatively minor role, mainly because there is no sulphur dioxide (SO_2) emission from coal and oil-fuelled power generation, as reflected in a low SO_2 emission intensity by international standards (Figure 7).

- High concentrations of *tropospheric ozone.* Ozone is formed in the lower layers of the atmosphere when nitrogen oxides (NO_x) and volatile organic compounds (VOC) react when exposed to strong sunlight. A too high concentration of ozone in the air can cause respiratory problems and damage to vegetation and the ecosystem at large. Contrary to acidification, pollution by ozone in the lower atmosphere is less pronounced in Norway than in the rest of Europe, due to the specific climate conditions in the region.[40] Ozone concentration in Norway is largely due to long range transport of ozone from other European countries and varies widely from year to year, depending on emissions abroad and meteorological conditions. The highest ozone concentrations are found in southern coastal areas of Norway.

- *Eutrophication* in the North Sea area. The release of nitrogen and phosphorus lead to nutrient enrichment which promotes the growth of plants and algae; the algae reduce light penetration and, when they die, consume oxygen in the water, thereby damaging marine life. Both Norwegian discharges and long-range transport of nutrients by ocean streams contribute to marine eutrophication but, unlike the cases of acidification and ozone, Norwegian sources are predominant in the areas most affected — including municipal and industrial waste water, fertilisers and animal manure.[41] Norway's use of fertilisers is rather intensive compared to other OECD countries,[42] owing partly to its highly protectionist agricultural regime. A recent shift in agricultural subsidies from price support to income support related to acreage size has reduced the incentive for intensive cultivation somewhat. The Norwegian Producer Subsidy Equivalent has remained one of the highest in the OECD, however, and is likely to be a major influence on production and environmental pressures. In addition, it is largely offsetting the effect of the fertiliser tax.

44. Transborder pollution problems are dealt with within the framework of international treaties (Table 4). Norway is co-operating with other European countries, the United States and Canada under the framework of the United Nations - Economic Commission for Europe (UN-ECE) Convention on Long Range Transboundary Air Pollution (CLRTAP). The Sofia and Oslo Protocols deal with the acidification problem, and the Geneva Protocol with tropospheric ozone. With the 1987 North Sea declaration, North Sea countries addressed the problems of eutrophication and pollution with toxic substances in the North Sea. Apart from these international agreements, Norway has co-operated bilaterally with Russia, regarding

Table 4. **Norwegian policy targets for transborder environmental problems**

Type of emissions/inputs	International targets	National targets
Sulphur	Oslo Protocol (1994) - 76 per cent reduction by 2000 with 1980 as a base year	
NO_x	Sofia Protocol (1988) - Stabilisation by 1994 with 1987 as a base year	30 per cent reduction by 1998 with 1986 as a base year
VOC	Geneva Protocol (1991) - 30 per cent reduction by 1999 with 1988 as a base year	
Nitrogen and phosphorus	North Sea Declaration (1987) - 50 per cent reduction with 1985 as a base year in the nine North Sea countries	

Source: OECD Secretariat.

air pollution produced by a Russian nickel smelter located near the Norwegian border, in the arctic Finmark region.

45. Once targets are agreed among the countries concerned, the design of policies to reduce the emissions is rather complex, since the gases and substances contributing to transborder pollution problems have different local pollution effects. Hence, policy instruments should be differentiated according to the damage they cause in the different parts of the country. The best way to proceed would be to solve local problems as a priority, and use national instruments if necessary to respect the international commitment. Norwegian policies in this regard, indeed, apply this principle to a certain extent.

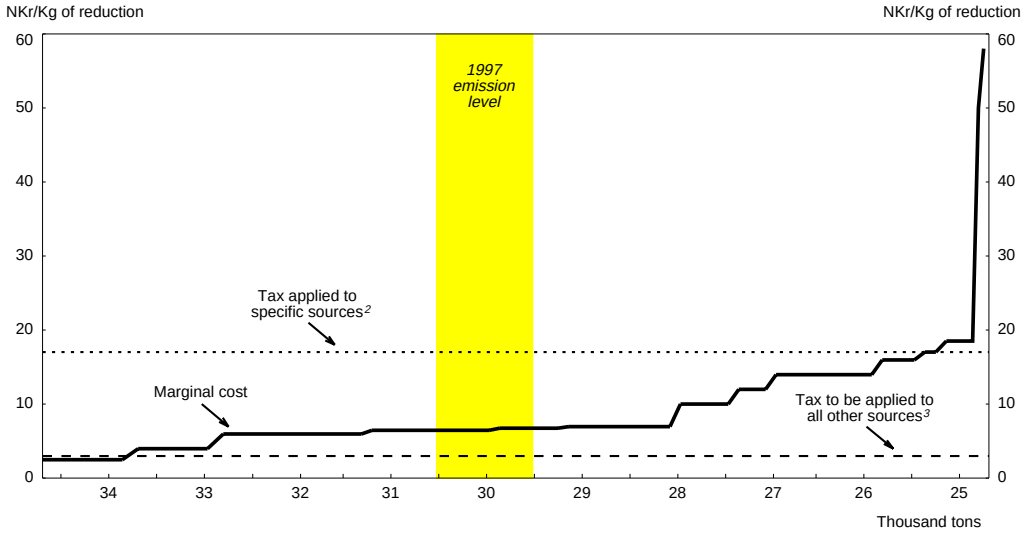
Acidification

46. Prompted by its exposure to acid rain from foreign sources, Norway has been a major driving force behind the protocols on acidification. The early protocols (Helsinki 1985 and Sofia 1988) set uniform targets for participating countries for reducing SO_2 and NO_x emissions, and hence were not geared towards a cost-effective solution. In order to raise cost-effectiveness, Norway supported the initiative for the more recent Oslo (sulphur) Protocol, which established targets per country according to critical loads and abatement costs, and participated in the scientific underpinning of the protocol.[43] For Norway, this implied a reduction target of sulphur emissions of 76 per cent by 2000 relative to the 1980 level. In the same spirit, Norway is strongly involved in the preparation of the future NO_x Protocol, which is expected to be concluded in 1999. This protocol is to be multi-target, coherent and science-based, covering acidification, eutrophication and tropospheric ozone, and including emissions of NO_x, SO_2, ammonia (NH_3) and VOCs. Helped by the various protocols, European emissions of SO_2 have declined steadily since the early 1980s while a less rapid fall in nitrogen emissions has been observed since 1990.

47. The Norwegian authorities have concentrated major efforts on reducing SO_2 emissions from large industrial sources. In 1996, 60 per cent of the SO_2 emissions originated from these sources, particularly heavy metal industries, while the remainder was due to stationary combustion and mobile sources, contributing 25 and 13 per cent of total SO_2 emissions, respectively. Pursuant to the Pollution Control Act, discharge permits have been the main instrument used to reduce industrial emissions.[44] Emissions from stationary combustion have been reduced mainly through ceilings for the sulphur content of heating oil, which are differentiated by region to reflect variation in local problems associated with sulphur emissions.[45] To supplement the sulphur content regulation, the tax on sulphur in heating oil, in use since 1975, has been gradually increased up to a level of about NKr 17 per kg of SO_2.[46] The tax covers about 70 per cent of the combustion emissions of SO_2 or around 20 per cent of total emissions. Coke and coal are not subject to the tax, and non-combustion emissions from industrial processes are exempted. Tax exemptions are motivated by the fear of competitiveness losses of heavy energy-consuming industries — the same as with the CO_2 tax.

48. These measures have allowed Norway to reduce its current SO_2 emissions below the target set by the Oslo Protocol, as SO_2 emissions decreased by 78 per cent between 1980 and 1997, slightly more than the target set for the year 2000 (Figure 8). However, emissions are expected to rise again towards the year 2000, due to a projected increase in fuel oil consumption. Hence, more needs to be done to respect the Oslo Protocol. The creation of a market for SO_2 emission quotas has been considered as an alternative, but would, among other things, imply higher administrative costs than a SO_2 tax and distortions may arise due, for instance, to market power, given the small size of the market. Last spring, following the recommendation of the Green Tax Commission, parliament approved the extension of the SO_2 tax to the sectors and products previously exempted, at a low rate of NKr 3 per kilogramme of SO_2. Moreover, refineries will be taxed directly on the basis of their emissions. For the time being, the level of the tax is, however, too low to have a strong effect on emissions given that the rate is above marginal abatement costs only for small emission reductions (Figure 8).

Figure 8. Marginal cost of reduction in sulphur dioxide emissions[1]



1. Calculated in 1994-95, starting out from an emission level of 36 000 tons.
2. Primarily covering diesel oil and heating oil.
3. The parliament has decided to implement a tax of 3 NKr/KgSO_2 for sources not covered by the current tax as from 1 January 1999.

Source: Ministry of Environment.

49. While SO_2 emissions in Norway have been substantially reduced to date, NO_x emissions have increased by 19 per cent since the early 1980s. Mobile sources generate 75 per cent of the NO_x emissions — more than half of it from shipping and the rest from road traffic — while the oil and gas sector on the continental shelf is the dominant stationary source for NO_x emissions. The quantity of emissions depends on the combination of four main factors: the nitrogen content of the fuel, the combustion technology used, the operation and maintenance of the equipment and, since NO_x can be removed, the purification technology. Hence, there is only a weak link between the amount of emission and the amount of fuel combusted, and therefore a fuel tax is highly inefficient. At the same time, since the emissions originate mostly from mobile sources, which are very difficult to monitor, a tax based on measured emissions would also be costly. This means that the instruments need to be adapted to the processes underlying the NO_x emissions, and based on an analysis of the costs and benefits associated with the abatement options available for each sector. Moreover, as NO_x emissions contribute to a range of environmental problems — acidification, eutrophication, tropospheric ozone and local pollution — the measures should be tailored to local conditions.

50. In order to comply with the target set in the Sofia Protocol — the stabilisation of NO_x emissions at their 1987 level by 1994, a variety of instruments have been implemented in Norway:

- As regards *road traffic*, the major focus has been to reduce NO_x emissions through exhaust emission criteria for vehicles, which has resulted in a decline in emissions from gasoline-powered motor vehicles since 1987. Since 1989, all new gasoline-powered cars have had to be fitted with a three-way catalytic converter, but due to the relatively long lifetime of private cars[47] in Norway, only 39 per cent were equipped by 1997. In the years ahead, emissions from road traffic are expected to decrease further as the car park is renewed.

- Emissions from *stationary combustion* have been tackled by discharge permits for some industrial plants.

Limited measures have been taken regarding shipping, even though emissions associated with shipping have become the dominant source of NO_x emissions: emissions of NO_x per person-kilometre of traditional passenger ships and high speed passenger ships are, respectively, three and 14 times those of private cars and buses (Table 5). In the case of gas flaring on the continental shelf, emission reductions of NO_x have been achieved as a side effect of the introduction of the CO_2 tax. Emissions from the petroleum sector are, nonetheless, expected to rise due to increased activity. The authorities have given priority to reducing NO_x emissions from urban traffic and from combustion for heating as their impact on the local environment is important. On the other hand, the government has preferred to protect the shipping industry, including fishing, for regional policy purposes. Fishing vessels, however, do receive a subsidy targeted on increasing energy efficiency.

Excessive concentration of tropospheric ozone

51. In combination with NO_x, VOC emissions generate tropospheric ozone. VOC emissions have risen steeply in Norway since the late 1970s with the development of the offshore oil and gas fields. Indeed, per capita emissions of VOCs are currently among the highest in Europe. Offshore VOC emissions, which account for more than half of the total in Norway, result from evaporation during the shipment and transfer of crude oil in the North Sea. To date, government action has focused on support for research and development to reduce these emissions.[48] The main onshore source of VOC emissions is road traffic. These emissions have been contained in the 1990s by the adoption of catalytic converters,

emission standards for trucks and measures to reduce emissions during filling at petrol stations. Despite these measures, the target of reducing VOC emissions by 30 per cent from 1988 to 1999, established in the Geneva Protocol, will be largely missed.[49] Development of new technology which will make it possible to mitigate these emissions has taken longer than expected. However, rapid deployment of such technology is expected to be stimulated through the agreement under preparation between the government and the petroleum industry. The emission of VOCs from loading crude oil accounts for 60 per cent of total emissions.

Eutrophication in the North Sea

52. To ease the marine eutrophication problem, the North Sea countries have agreed to a series of far-reaching commitments in the North Sea Declaration to reduce discharges of nutrients.[50] Norway is committed to reduce discharges of nutrients by about 50 per cent compared to 1985 levels in areas of the southern part of the country.[51] A series of measures have been taken:

- Since the mid-1980s, the construction and upgrading of sewage water treatment plants is facilitated by government loans and grants to cover the capital costs of the required investments.[52] Consequently, the density and quality of the waste water treatment capacity in the North Sea region is much higher than in the rest of the country. Moreover phosphate detergent has been banned.[53]

- To reduce nutrient runoff in agriculture, regulations for better utilisation of animal manure have been adopted, and support is given to farmers for leaving areas that are particularly vulnerable to erosion under stubble during the winter. The use of fertilisers, moreover, is taxed, at a rate of 19 per cent of the purchase price for nitrogen and 11 per cent for phosphorus. As noted above, the current agricultural subsidisation scheme tends to offset the effect of the fertiliser tax.

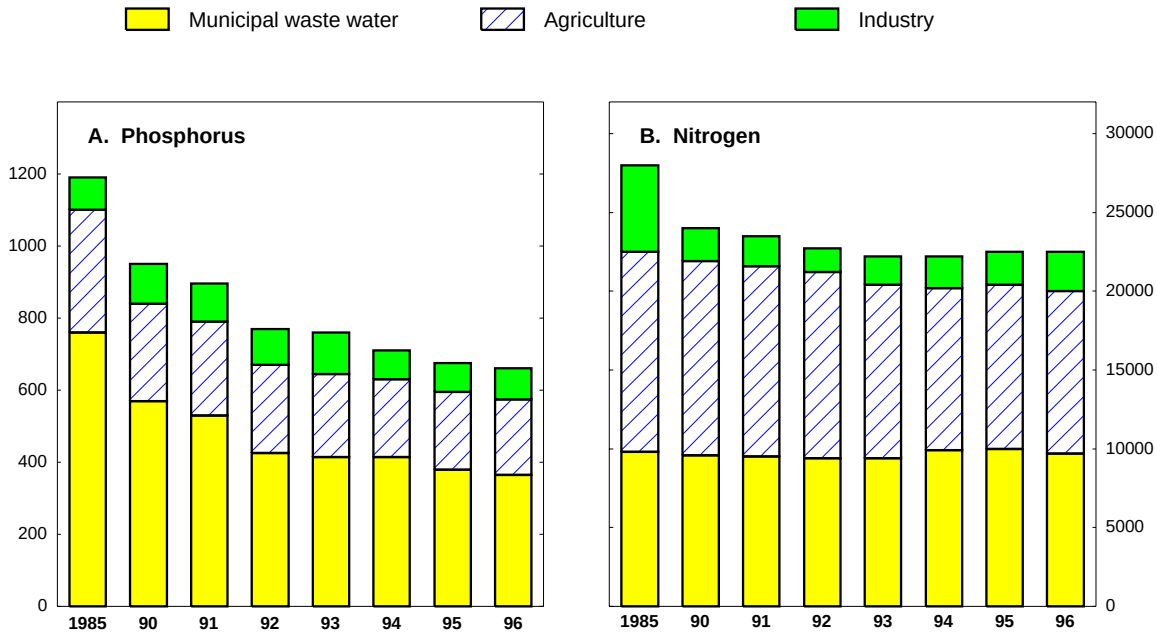
Table 5. **Emission intensity of various forms of transport**
Emissions per person/kilometre, 1993/94

	CO_2 gram	NO_x mg	Particulates mg
Air transport	182	516	..
Train[1]	61	189	20
Cars using petrol[2]	106	606	11
Cars using diesel	86	313	119
Buses[3]	80	950	62
Car ferries	926	14 600	146
Other passenger ships	818	18 060	129

1. Estimates based on electricity produced in gas-powered plants.
2. High emissions of NO_x are due to the fact that only a minor part of the fleet was equipped with catalytic converters at this time.
3. Average of 11.32 passengers.

Source: Institute of Transport Economics, 1997.

Figure 9. Water pollution
Waste input to the North Sea coastal area, in tons[1]



1. The area from Østfold to Vest-Agder. Calculated inputs to the coastal zone outside this area, particularly from agriculture, are uncertain.
Source: Norwegian Institute for Water Research.

53. Nitrogen discharges to Norwegian North Sea coastal water were reduced by 22 per cent between 1985 and 1995, with the bulk of the reduction originating from industry while discharges from agriculture and municipal waste water remained more or less constant (Figure 9). North Sea discharges of phosphorus, however, have decreased by 44 per cent in the same period, reflecting the emphasis of the policy effort in this regard, which is justified by the fact that phosphorus has been the critical factor of eutrophication in Norwegian rivers and lakes. In agriculture, phosphorus fertilisation has been substantially reduced since the 1980s, whereas nitrogen fertilisation has only marginally decreased — which partly explains why runoff of nitrogen has been reduced less than that of phosphorus. Recent research indicates that a significant reduction of nitrogen runoff in the agricultural sector could be achieved by combining an increase of the tax on nitrogen fertilisers with specific agronomic measures adapted to local conditions.[54]

Local environmental problems

54. Norway is privileged by its geographical situation which, together with a low population density, implies a limited burden on the local environment. Local problems, nevertheless, exist:

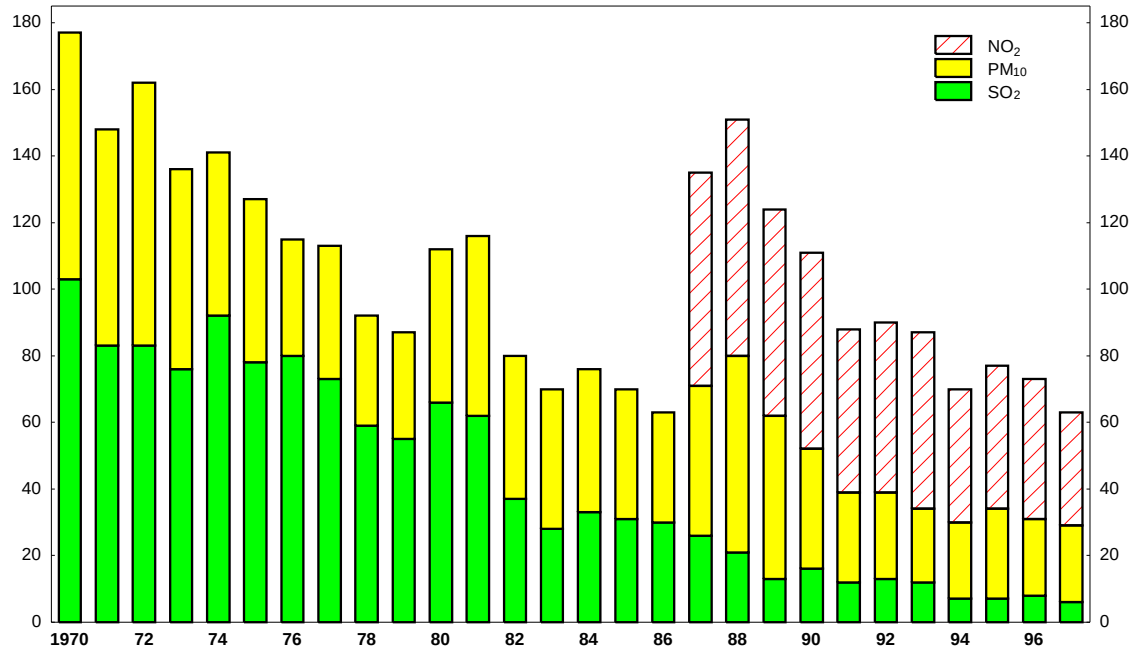
– *Urban air and noise pollution*. Local air and noise pollution concern mainly the urban areas which are concentrated in the southern part of the country. Overall, air quality as measured by the annual average concentration of pollutants in Norwegian cities is relatively good, and

the concentration of SO_2 and lead in urban areas has been substantially reduced over the last decades (Figure 10).[55,56] The Norwegian Pollution Control Authority estimated the annual cost of damage to health resulting from air pollution at NKr 3.8 billion in 1998 for Oslo and Bergen only, and NKr 2.5 billion due to noise for the whole country.

– In addition, according to the State Pollution Control Authority, about 25 per cent of the population experience noise as a problem at their homes, and 260 000 persons suffer from serious discomfort as a result of road-traffic noise. While road traffic is by far the most important source of local air pollution and noise, there are two emission sources of particles which are specific to Norway: heating systems for buildings — wood-burning stoves in particular — and the use of studded tyres.

– The emission and accumulation of *hazardous substances*, which potentially represent the most acute threat to human health and the environment, and also contributes to transborder pollution, has been significantly reduced. In the past, some fjords were heavily polluted by discharges of toxic substances by local manufacturing industries, which seriously damaged the marine life. However, these "point source" emissions have been significantly reduced through discharge permits, and the most hazardous substances have been banned. Lead emissions are being reduced as leaded petrol is progressively disappearing from the market.

Figure 10. Air pollution in Oslo[1]
Midwinter, urban area, µg/m^3



1. The data concerning particles is the measurement of black soot at one location in the period 1970/71-1994/95, and of PM_{10} at another location for the years 1985, 1986 and 1989-97. The two series are not directly comparable. The stations are not directly influenced by road traffic and show background values.

Source: Luftforurensninger i Oslo, Årsrapport 1998.

– *Waste*, although not an environmental problem *per se*, can give rise to various environmental problems and health damage. As in most other OECD countries, waste production has been increasing exponentially since the 1970s, reflecting production and consumption trends.[57] Hazardous waste represents slightly more than 1 per cent of total waste, which needs to be treated separately.[58] Non-hazardous waste, however, may also pollute water, soil and air. Waste deposited in landfills causes leakages into groundwater and the soil, smells, and generates emission of methane and other damaging gases. The incineration of waste, moreover, generates emissions of acidifying substances and toxic gases.

Urban air and noise pollution

55. In 1998 the Norwegian government has adopted new national goals for the reduction of urban air pollution. New goals were adopted for SO_2, benzene, NO_2 and particulate matter.[59] Regarding *road traffic* which, as noted, is the most important source of air pollution and noise, the Norwegian authorities have deployed a large number of instruments, both national and local. A *first* group of measures aims at reducing emissions per vehicle-kilometre in line with EU regulations. Emission standards have been fixed, which led to the introduction of catalytic converters for the removal of a substantial part of NO_x, VOC and CO_2 emissions from petrol-fuelled cars — but much less so for diesel-driven cars. The standards on the sulphur content of oil, the sulphur tax and the tax on the lead content of petrol have helped to reduce sulphur and lead emissions. Noise criteria for cars have also been adopted. A *second* group of measures aims at limiting the volume of road traffic by increasing its price *vis-à-vis* other means of transport. As noted earlier, taxes on petrol have been raised, but less so on diesel. Toll systems for all inbound vehicles have been established around the city centres of Bergen and Oslo. While these toll rings merely serve to raise funds for investment in the local road infrastructure to reduce congestion,[60] the toll ring in Trondheim is to some extent used for traffic management, as the toll fee is somewhat higher during peak hours and seasonal tickets are not available.[61]

56. Total support to public transport (subsidies and transfers to buy transport services) amounts to close to NKr 4 billion per year. These subsidies are not primarily directed towards solving local environmental problems, which means that a reallocation of support could have substantial environmental benefits. Support is, among other things, provided to air transport, bus transport in remote areas and high-speed passenger ships, all of which give rise to high emissions per person kilometre (Table 5).

57. Aside from road traffic, a series of other measures have been taken in recent years to improve the air quality in urban areas. Emission standards for wood-burning stoves have been included in the new building regulations, and they are expected to reduce emissions from this source by 70 per cent in the long-run. Standards for studded tyres have also been adopted and the local measures to reduce the use of studded tyres is currently discussed. Moreover, parliament passed legislation last spring to entitle local authorities to impose charges on the use of these tyres. An inter-ministerial report concluded that a sharp reduction in the use of studded tyres in the four major urban areas could provide a net benefit of around NKr 500 million per year due to *e.g.* improved health and less corrosion. To address a specific noise pollution problem around the airports of Oslo and Bodø, a charge on aircraft noise has been introduced: the aircraft landing and departure fees are differentiated according to the noise level they create and the noise problem. This charge is earmarked for use within the sector, in contrast with most other environmental taxes in Norway. The opening of a new airport outside Oslo replacing the Fornebu airport has reduced the associated noise problem, but no decisions have yet been taken concerning the aircraft noise charge.

Hazardous substances and waste

58. The problems regarding air and surface water discharges of hazardous substances by industry have been largely resolved in the past decade. Increasingly, the authorities are focusing on emissions from the use and disposal of hazardous chemical products and substances such as solvents, anti-fouling paint and batteries. This requires the use of instruments which are targeted on the individual substances. Systems of classification, labelling, registration and, if needed, banning of hazardous chemicals have been implemented and appear to function well. The Green Tax Commission, however, saw some scope for greater use of taxes to reduce these product-related emissions, or emissions from individual substances. A refund deposit scheme for nickel/cadmium batteries and a tax on various other products, such as fodder used in fish farming which contains antibiotics, should also be considered.

59. The overall waste management policy objective, as set out in a 1992 report to parliament, is to ensure that waste problems are solved in a way that minimises environmental and health problems, and also minimises the use of resources. The strategy of the Norwegian authorities to reach this objective is to *i)* minimise waste generation; *ii)* promote the re-use and recycling of material and the extraction of energy from waste; and *iii)* ensure that remaining waste is disposed of in an environmentally sound way. The Norwegian authorities also have specific targets, such as for the recycling of packaging waste which, in line with EU directives, requires that between 50 and 65 per cent of the total packaging waste should be recycled.

60. Since 1995, the Pollution Control Act requires that municipalities charge fees for waste treatment that fully cover their expenses — an objective that has been largely achieved[62] — and that promote waste reduction and recycling. The introduction of stricter standards for landfills and incineration in line with EU directives has contributed to increase the costs of waste treatment, and as such gives incentives to recycle. To reduce litter and illegal disposal of hazardous waste and encourage recycling, state-run deposit-refund systems have also been established for lubricating oil and scrapped cars. A tax on beverage containers has been introduced and consists of two elements: *i)* a general tax on all containers differentiated by the degree of recycling potential; and *ii)* a surtax on containers which are not re-useable.[63] The first tax element gives producers an incentive to establish a deposit-refund system. Such systems were introduced for glass (currently 98 per cent return) and plastic beverage containers. The latter tax has turned out to be prohibitive for beverage cans, so they were not introduced. In fact, recycling beverage cans rather than glass would be more friendly to the environment. The government has tried to change the current incentive structure several times, but parliament never passed the legislation.

61. The Norwegian authorities have also made an active use of regulatory measures, "voluntary agreements" and subsidies to promote waste recycling. If voluntary schemes do not produce satisfactory results, the Ministry of Environment has a mandate to require the municipalities to introduce sorting of waste at source. Industry, which treats 85 per cent of its waste on site or through private waste management companies, may also be required to recycle their waste. "Voluntary agreements" have been signed between various industry branches and the Ministry of Environment regarding paper, cardboard, glass, lead accumulators and car tyres. The government is also providing financial support to municipal recycling and source separation projects.[64] These measures have resulted in a steep increase in the proportion of waste recycled from municipal collection schemes, from 9 per cent in 1992 to 22 per cent in 1996 for households, and from 8 to 18 per cent for industries.

62. The cost-effectiveness of increased recycling is in doubt. A recent study by Bruvoll (1998), based to a large extent on United States empirical data, for example, suggests that recycling of paper and plastic waste, except for commercial paper waste, is probably less cost-effective than incineration or landfilling. There is some evidence that the costs of collection, transport and production processes

associated with recycling, as well as the environmental costs of emissions from transport may be underestimated. Moreover, new technologies have reduced the environmental costs of incineration and landfill. These conclusions may not be valid for every single municipality, as they depend on, for example, the density of population and the distance to the various treatment facilities. The use of purely national targets for recycling are, in any event, inappropriate. Hence the necessity to examine the various options at the local level.

63. The above-mentioned study also suggested that waste minimisation at the source is the most cost-effective alternative for the categories of waste examined. This could be achieved by a tax at the source — *i.e.* the products which generate the waste — with the rate varying according to the marginal treatment costs. The introduction of a tax of NKr 300 per ton of waste deposited to landfills or incinerated approved by parliament last spring — as recommended by the Green Tax Commission — constitutes an important step in this direction. The tax level does not cover all environmental costs of waste involved, and is still very crude as there is no differentiation with regard to the treatment cost.[65] However, the introduction of a differentiated tax would be quite complex and costly in practice, while raising the overall tax level would provide a stronger incentive to deposit waste illegally.

Biodiversity

64. Biodiversity derives its importance from the interaction of mankind with other forms of life, for instance, for recreational reasons, use of genetics by industry or the existence value of species. It is estimated that about 40 000 species of plants and animals exist in Norway. Human-induced extinction of species has continued. About 45 species are known to have become extinct in the last 50 years, and almost 500 are considered to be endangered or vulnerable. Loss of biological diversity is caused by a wide range of factors which influence the environment, such as land use, over-exploitation or pollution. The expansion of towns and the agricultural area has implied serious losses of areas of natural habitat, swamp forests, wetlands and other ecosystems. Policy aims at protecting endangered and vulnerable species, and to restore biodiversity, where possible, for instance, by expanding the area of national parks to 13 per cent of the total Norwegian area by 2008. In addition, ensuring that agriculture, forestry and fisheries are harvesting in a sustainable way is of particular importance. Currently, no cost-benefit analysis is pursued in this area, which would allow prioritisation. Even though uncertainties are large, there is probably scope to establish broad guidelines.

Assessment and challenges ahead

Ensuring sustainability

65. The evolution of human and fixed capital, of the oil and gas wealth as well as its transformation into financial capital, and of forests, suggests that total national wealth has increased in the past. While trends are much more difficult to judge, natural capital apart from the oil and gas stock and forests appears to have also risen overall since the early 1980s. However, the dwindling of fish stocks has only been partly reversed, keeping biodiversity intact is not easy and local environmental problems persist. While total wealth has probably increased in the past, it could have accumulated faster — or, conversely, consumption could have been higher — with greater cost-effectiveness of policies in various areas and a better integration of different policies. Finally, the implementation of climate change policies poses a formidable challenge.

66. Norway is in the very privileged position of possessing a large national wealth in the form of its oil and gas stores and the financial assets ensuing from its development. The move towards channelling a greater part of the rent from the oil and gas sector into foreign financial assets, initiated several years ago, should help ensure the inter-generational balance by providing more freedom of choice for future generations. Accordingly, the generational accounts for Norway, which are routinely updated for every national Budget, suggest that the government's strategy to achieve sound public finance in the long run could succeed. There are some concerns, however, that the government has not fully succeeded in capturing the entire natural resource rent associated with the oil and gas stock. Other countries have chosen to capture some of this rent through auctioning of production acreage rather than only taxing the rent — the approach which is prevalent in Norway. The Norwegian authorities should be encouraged to examine the possibility of auctioning, the more so since a shift from pure taxation to auctioning would reduce the volatility of the annual flow of revenues associated with variations in the oil price.

67. Norway, being the world's second largest fish exporter, has a clear interest in the application of international agreements to curb overfishing in the northern Atlantic area. Fish stocks fell considerably between the 1960s and early 1980s, when several species were almost driven to extinction and the marine ecosystem severely damaged. Even though the situation has improved since then, overfishing, in particular in the North Sea, remains a serious problem. The use of Total Allowable Catches to limit fishing remains the dominant international management tool, but there are strong incentives for fishery nations to lobby for large quotas which in aggregate are unsustainable — due mainly to excess capacity of fishing fleets. Moreover, fishery control policies and measures are often either inadequate or not sufficiently enforced. There is little Norway can do on its own, apart from reforming policies that have led to excess capacity in its own fishing fleet.

68. Over the last two decades, environmental policy in Norway has been fairly successful in reducing the emissions of a wide range of pollutants. In a few areas, however, environmental pressures have continued to rise. Since a substantial part of pollution in Norway is imported from abroad, policy also focuses on negotiating, implementing and complying with international agreements. In this regard, Norway stands out by its valuable efforts to stimulate international co-operation on global and transborder environment policies. In many domains, this is clearly in the country's best interest, given its vulnerability to *e.g.* acidification and marine pollution originating from neighbouring countries. In other cases, for instance, climate change agreements, this may conflict with Norway's national interest because it is a major global oil and gas exporter. However, climate change has been an important preoccupation of Norwegian governments, and this preoccupation is shared by the overwhelming majority of the people.

69. Improvements in Norway's local environment are to some extent interlinked with policies geared towards complying with international agreements addressing cross-frontier pollution — *e.g.* acidification and eutrophication. Local environmental policies are, moreover, in many instances aligned with EU regulations following Norway's membership of the EEA. Pollution from hazardous substances due to industrial activities along the fjords has been significantly reduced, while the most hazardous substances have been banned. Progress in the area of waste reduction and treatment aimed at reducing emissions and leakage into the environment has been marked as well. Nevertheless, from time to time the few urban areas in Norway face serious air and noise pollution associated with car traffic. There are also concerns that the expansion of towns and agricultural activities contributes to further losses in biodiversity. The scope for enhancing the environmental sustainability of local economic activities thus remains significant. Policies in this regard should be guided by extensive and systematic cost-benefit analysis.

Fostering cost-effectiveness

70. The current policy framework could be improved upon in many respects, which would either raise wealth accumulation and future consumption potential or allow higher current consumption. As concerns oil and gas extraction policies, the elaborate regulatory framework for the licensing of exploration and development acreage has created favourable conditions for participation of foreign operators and participants on the shelf. Foreign companies often welcome a certain degree of state involvement, including the presence of a large state company on national territory. However, there is scope for improvement. In particular, companies bidding in licensing rounds should be allowed to form their own partnerships also in the Norwegian Sea, as the system of "arranged marriages" by the government in which the fully state-owned company Statoil frequently participates does not necessarily yield the best team. In particular, the government should allow a greater variation in participants in each license, possibly based on auctioning of licenses (see above). Concerning licensing in the fishing industry, the existing system of transferring fish quotas between licensees could be changed by de-linking quotas from vessels to facilitate re-allocation of quotas to the most efficient parts of the fleet. As a further step, the government could consider the auctioning of the fish quotas to vessel owners in order to increase and extract the resource rent. Such a reform would, however, clash with regional policy objectives.

71. Climate change policies in Norway will be geared towards meeting the commitments arising from the Kyoto Protocol concluded in 1997. There is a potential for enhancing cost-effectiveness of these policies which resides in a greater use of instruments geared to equalising marginal abatement costs across all economic activities. At present, about 60 per cent of all CO_2 emissions are taxed. Exemptions are still granted to heavy industries, fishing and international shipping.[66] Moreover, rates of taxation vary considerably and are unrelated to the carbon content of products and activities. Ironically, the incentives for reducing carbon emission are generally weakest in industries where the marginal abatement costs are lowest. Moreover, the current tax structure may lead to a bias towards CO_2-intensive activities in the longer run, which conflicts with the objectives of the tax. The new CO_2-taxes with effect from January 1999 have slightly raised cost-effectiveness. However, inefficiencies remain since most of the mainland's energy intensive activities will still be exempted from the CO_2 tax. A market for CO_2 emission quotas is being prepared, but will need to be underpinned by clear rules for trading, banking, verification and compliance, which have not yet been established. Finally, emission permits should be auctioned or tendered, because otherwise the associated scarcity rent would be left in the hands of existing companies. This would penalise new entrants and rob the government of the opportunity to cut distorting taxes. If a unilateral tradeable quota system appears not to be feasible in Norway, a uniform CO_2 tax rate applied to all sectors, at a lower level, should be considered until further international decisions are taken. Compensation schemes for the currently exempted industries, as proposed by the government in April 1998, could provide the necessary time to adapt. Model simulations show that utilisation of the Kyoto-mechanisms would reduce the cost of complying with the Kyoto target significantly — by as much as two thirds compared with an approach based only on domestic measures.

72. While Norway has succeeded in fulfilling its commitments arising from international agreements on transborder pollution, there is scope for improved cost-effectiveness also in this area. As concerns acidification, the Norwegian authorities may now need to refocus their efforts towards NO_x abatement, as the scope for SO_2 abatement at reasonable cost has been largely exploited. Increased emphasis on NO_x abatement also opens up opportunities for positive side-effects on tropospheric ozone formation and local air pollution. With regard to NO_x policy, the authorities have so far given priority to reducing emissions from road traffic and combustion for heating as its impact on the local environment is important. To date, measures have been implemented in the areas where the regional and local damage caused by NO_x emissions are the highest. In the future, however, further reductions will probably call for measures in the sectors left unaffected until now, in particular coastal shipping and fishing vessels.

Applying an annual tax on all mobile sources based on their NO_x emission intensity could be a cost-effective way to do this. The introduction of such a tax for vehicles has been considered by the Norwegian authorities, but has so far not been adopted. In any event, an extensive cost-benefit analysis of all sectors is needed. Concerning SO_2 policy, the extension of the sulphur tax to sectors previously exempted represents an important step in the direction of enhanced cost-effectiveness. Current plans for a uniform tax rate should be adopted with priority, especially since the targets of the Oslo Protocol may call for a higher overall level of the tax.

73. Rebalancing the policy mix may also be useful with regard to eutrophication and waste treatment. Eutrophication policies should now be re-oriented to nitrogen in order to exploit abatement cost differentials that have opened up between nitrogen and phosphorus. An increase in the tax on nitrogen would be a cost-effective way of dealing with this. Concerning waste, the adoption of the state tax on waste is welcome, but the national strategy should be underpinned by a better balance between the various waste treatment options based on region-specific cost-benefit analysis, and the prevention of waste should be sought.

74. The policies aimed at a reduction of pollution caused by road traffic are subject to debate in Norway. Several issues stand out:

- The current level of car fuel taxes is controversial. The official policy stance is that the tax on car fuels should be used to internalise all external costs of car use and that the region-specific external costs of driving a car should be covered by local taxes and measures tailored to local problems.

- While there is considerable scope for the use of local instruments to restrict car use, their introduction meets resistance. For example, the existing toll-rings could be revamped into road pricing systems — by adopting fees which vary according to the type of car (its polluting properties) and the time of the day or week of the trip. As a first step, the season tickets on the Oslo and Bergen toll rings could be suppressed and time-differentiated fees be introduced. Research by the Institute of Transport Economics indicates that a well designed road pricing system could double the benefits to society as compared to the current situation. Although EU-led test programmes have demonstrated that the technology is available, the operating costs are still considered to be too high and the electronic surveillance system may create privacy problems. Concerns about the distributional impact of road pricing and disagreements on the earmarking of the proceeds are also obstacles to its implementation. Nevertheless, parliament is in favour of the introduction of such variable tariffs in principle. Further initiatives in this regard are planned.

- As elsewhere, the much lower taxation of diesel as compared to petrol is particularly cost-ineffective in environmental terms since the local air pollution generated by diesel cars (NO_x and particles) is greater than that of petrol driven cars. A study by Statistics Norway estimated that the average social costs of burning one litre of diesel in Oslo is at least 6 to 20 times higher than for a litre of petrol. The low diesel tax — including the CO_2 tax which is also lower for diesel as compared to petrol — has, moreover, induced a shift towards more diesel cars (as in other countries), a tendency which is expected to be exacerbated in the future.

75. Cost-effectiveness could be enhanced in a number of domains by moving from “command and control” to the use of economic instruments, such as taxes, deposit-refund schemes and tradable quotas. The introduction of taxes, differentiated by the emission properties of the capital equipment should be

considered for all mobile sources, with the rate differentiated according to NO_x emission intensity. The taxation of remaining ozone-depleting substances, several hazardous substances and the greenhouse gas HFC, should also be encouraged. Deposit-refund schemes could be envisaged for products containing hazardous elements, such as nickel/cadmium batteries. In addition, the possibility of combining taxes with discharge permits should be further examined.

Policy interactions are important

76. Environmental and resource management policies in Norway aim to strike a balance between considerations of cost-effectiveness, international competitiveness of individual industries and regional development — with the latter two considerations often overriding environmental and cost-effectiveness concerns. Fishing policies, for instance, have been geared towards maintaining existing settlement patterns by redistributing the resource rents towards smaller vessels registered in remote areas. Environmental policies have been designed so as to limit the impact on the economic performance of industries that are exposed to foreign competition and that are mostly based in remote areas. Hence, there are cases where the scope for cost-effectiveness is not being exploited. It is important that the economic costs and benefits of these choices are carefully evaluated and made transparent to guide future decision making.

77. There are also interactions between transport policy and environmental pressures. Transport policy aims *inter alia* to provide transport infrastructure. In principle, the user should pay for the use of the infrastructure, and not the tax payer, and congestion fees should be levied to align private and social costs. Concerning road transport, petrol-driven cars probably come close to paying the use of infrastructure and even for externalities (environmental and accidents). This is not the case for diesel-driven cars and even more so for trucks. Raising taxes on diesel would not only make for a better transport policy, but also reduce environmental pressures. At the same time, reductions in support provided to bus transport in remote areas and high-speed passenger ships could yield substantial environmental benefits.

78. Agricultural policies have also important environmental ramifications. Agricultural subsidisation is particularly high in international comparison. While its major aim is to keep farm communities intact, the link between subsidies and production gives incentives to farm intensively, for example, by heavy use of fertilisers. A recent shift in agricultural subsidies from price support to more neutral support has reduced this incentive for intensive cultivation. A further move in this direction would lead to a considerable further reduction of environmental pressures from intensive farming and enhance the sustainability of agricultural production.

79. Norway has an extensive institutional framework to foster sustainable development geared towards resolving policy conflicts. In addition, since the early 1990s, an ongoing evaluation effort of the sustainability of policies is underway. This has, for instance, led to the compilation of inter-generational accounts. It has also helped to integrate policies and to build a consensus about the need to foster policies which are sustainable in the long run. While clearly in the interest of society as a whole in the long run, policies pursuing sustainability can clash with vested interests in the short run. Agricultural or transport policies are a case in point. Furthermore, structural policies, financed in part by the oil and gas proceeds, have often served to perpetuate historical patterns of economic activity and settlements that may prove unsustainable once the oil and gas proceeds decline. Hence, even if generational accounts for Norway suggest inter-generational equilibrium of public finances — in itself an important achievement — there is a risk that many forms of public support may turn out to carry a low return in the long-run.

NOTES

1. This paper was originally produced for the OECD *Economic Survey* of Norway, which was published in February 1999 under the authority of the Economic and Development Review Committee. The authors are indebted to Christian Averous, Nils Braathen, Andrew Dean, Jørgen Elmeskov, Mike Feiner, Peter Hoeller and Tom Radahl for valuable comments and drafting suggestions and to Desney Erb and Mee-Lan Frank for technical assistance.

2. OECD (1995) and IEA (1997).

3. OECD (1993).

4. Policies concerning fresh water management are not discussed, because they do not currently raise major sustainability concerns.

5. Parliament has the responsibility for the approval of major developments, while the government is authorised to approve smaller development projects. The overall administrative responsibility for the operations rests with the Ministry of Petroleum and Energy. The Norwegian Petroleum Directorate (NPD), subordinate to the Ministry, has supervisory and administrative responsibility.

6. The new Petroleum Act adopted by Parliament in 1996 entered into force in 1997, and introduced more administrative flexibility in several areas, including acreage management, in order to ensure the attainment of these policy aims.

7. Statoil's regulatory framework was set up in order to manage the public assets on the Norwegian continental shelf. However, the EU license directive prohibits governments giving priority to a national company, and as a result Statoil is now in open competition with other companies on the Norwegian continental shelf. The directive has also created new opportunities for Statoil abroad. Statoil and Norsk Hydro are extending their reach to Russia and other states of the former Soviet Union (in particular the countries surrounding the Caspian Sea where reserves are estimated to be in the range of 50 and 100 billion barrels or two to three times the size of the Norwegian continental shelf). These companies are deemed to no longer need protection within their core Norwegian market.

8. In the early 1970s when the significance of the petroleum resources had become clear, the government stipulated that the profits from the operations on the shelf should "benefit the entire population" and should be used to "create a better society" through increased public spending on social security, culture, education and infrastructure, as well as the development of rural areas. Lower taxes on mainland economic activities, a shorter working week and an increase in development aid were also considered as priority areas, see *Stortingsmelding* nr. 25, (1973-74).

9. The rent is defined as the market price of oil and gas minus the marginal cost of extraction (including capital cost).

10. For example, after the second OPEC shock, the petroleum wealth jumped from NKr 590 billion in 1979 to NKr 2 273 billion in 1981, only to collapse to NKr 694 billion when the oil price plummeted in 1986 (see Thøgersen, 1994).

11. The accounts were set up by Auerbach *et al*. (1993).

12. Based on the assumption that the oil price will recover in real terms by 20 per cent from its 1998 level (see the 1999 Budget proposal released in October 1998).

13. The major fishery nations in the world are China (27 million tonnes per year) and Peru (10 million tonnes per year). Norway catches 3 million tonnes per year.

14. There are a few fish resources considered exclusively Norwegian national stocks of which coastal cod and North-East Arctic saithe are the major ones. For such stocks TACs are determined by the Norwegian authorities.

15. Atlantic herring is a so-called "straddling" stock, *i.e*. various stocks mix on the feeding grounds in the Norwegian and North Sea and it is, therefore, difficult to distinguish between the catches from the Icelandic, Faeroese and Norwegian stocks. At the close of the Third UN Conference on Law of Sea, 1982, straddling fish stock was hardly a problem, as 90 per cent of the world catch was taken within the zones. By the late 1980s a crisis had developed: as stocks in the zones were fully utilised, there was persistent fleet over-capacity and high sea fishing became more profitable. There was growing alarm over the straddling fish stock problem and a UN General Assembly established the UN High Seas Fishery Conference in April 1993. The UN Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks concluded in December 1995 that straddling fish stocks should be managed by regional organisations. If this system succeeds, straddling stocks will be managed as shared stocks and high seas adjacent to 200 mile zones will become high sea in name only.

16. When Norway negotiated the European Economic Area agreement with the EU Commission in 1993, it was agreed to introduce a five-year moratorium on investment by firms in this sector. At the discretion of the EU, this agreement may be reopened for negotiation in 1999.

17. European Environment Agency (1998).

18. These national TACs are set as a level consistent with bilateral agreements between Norway, Russia and the EU allowing for fishing in each other's 200 mile zone.

19. Important decisions are taken by the Cabinet, based on proposals by these committees.

20. A consortium of Naturkraft, owned by Statoil, Statkraft and Norsk Hydro is in the process of developing two gas-fired power plants at Karstø and Kollsnes. Norsk Hydro has, however, announced that it could develop such a plant using new technology to eliminate 90 per cent of the CO_2 emissions by re-injecting CO_2 in oil fields.

21. The reduction in emissions of PFCs and SF_6 (or "the other gases") are expected to continue, albeit at a much slower pace. N_2O emissions, stemming from fertilisation in agriculture and production of nitric acid, are projected to remain stable.

22. International shipping is not included in the emission commitments.

23. This was proposed by the government but rejected by the parliament.

24. In June 1997, the aluminium industry signed a voluntary agreement with the Ministry of Environment to reduce greenhouse gas emissions per unit of aluminium by 55 per cent in the period 1990-2005, most of which has already been achieved.

25. See OECD (1998), pp. 91.

26. A key feature of greenhouse gases is that the marginal damage of emission is always the same wherever it originates from.

27. In the aluminium industry, for example, greenhouse gas emissions are due mostly to the chemical reactions underpinning the production of aluminium from aluminium oxide.

28. The CO_2 tax extension net of the compensation was estimated to add NKr 1 billion to the NKr 7.7 billion of the total expected CO_2 tax revenues for 1998.

29. Combustion plants utilising methane from waste for energy purposes would pay a lower rate, even though methane emissions will not be reduced.

30. For CO_2 or possibly all greenhouse gases.

31. A combination of several of these possibilities could also be envisaged.

32. With parliament's amendments, the reduction will be less than the 0.1 percentage point decrease in labour tax rates initially calculated by the government.

33. A domestic tax-based solution which would leave the energy intensive sectors unaffected would require even higher tax rates in the non-exempted sectors.

34. Estimate provided in *Storting Prp No. 54*. The study provided a range of between NKr 50 and NKr 200 per ton of CO_2.

35. Other important ozone depleting substances are methyl chloroform, carbon tetrachloride, methyl bromide, hydrobromofluorocarbons (HBFCs) and hydrochlorofluorocarbons (HCFCs).

36. Moreover, additional restrictions on specific uses have been imposed.

37. To enforce the regulations, parliament decided to impose a tax on CFCs if consumption is not reduced. Before the CFC regulations came into force, the industries concerned had organised a reception system for used CFCs. Similar regulations have been used for implementing the phasing out of the other substances with a strong depleting potential.

38. Establishing a market for emission quotas, as in the United States, was also not viable given the small number of potential participants.

39. Critical load is defined as the highest load/deposition in soil or surface water that will not damage the ecosystem. In the mid-1990s, critical loads for the acidification of surface water were exceeded on 37 per cent of the Norwegian territory, and on more than 90 per cent of the southern-most counties area (Aust and Vest-Agder). Between 1960 and 1990, 20 per cent of the fish stocks were lost, and another 20 per cent damaged, in the rivers and lakes of the 12 southern counties. The critical loads for acidification of forest soils are also exceeded in the southern-most parts of the country.

40. The population warning threshold defined by the EU ozone directive has never been reached and the population information threshold is exceeded only a few days a year.

41. There is also nutrient runoff from uncultivated land, partly natural, and partly resulting from nitrogen deposition from long-range transported air pollution.

42. A better measure concerning environmental effects — nitrogen surplus — was developed in the context of the OECD agri-environmental indicators activity. It counts all nitrogen, including animal manure, which passes into the environment. On this indicator, Norway is about average in the OECD, even though the trend is upward.

43. In addition to the stabilisation target of the Sofia Protocol, Norway has, as laid down in the Sofia Declaration, the national goal of reducing NO_x emissions by 30 per cent in 1998 compared to 1986. The Declaration's target is thus more ambitious than that in the Protocol, but not binding.

44. Several plants have been required to install equipment to control emissions, and some of the most polluting plants have been closed.

45. There are regimes for the Oslo region, the twelve most southern counties and the rest of the country.

46. NKr 0.07 per 0.25 per cent of sulphur content per litre of mineral oil.

47. The long lifetime of cars is mainly due to high taxes on car purchases.

48. The decrease in VOC emissions observed in 1997 is partly explained by the installation of a recovery facility for oil vapour at one of the oil landing terminals.

49. In fact, VOC emissions have grown by more than 40 per cent between 1988 and 1997.

50. The North Sea Declaration also includes emission targets for toxic pollutants.

51. The initial timetable for achieving this target was abandoned by the signatories of the Declaration. The Declaration also included a commitment to set up secondary treatment facilities for discharges from municipal sewage treatment plants serving areas of over 5 000 people (in population-equivalent terms).

52. Grants cover between 20 and 35 per cent of the capital costs with the remainder financed through government loans.

53. Indeed, in 1996, treatment plants removed 91 per cent of the phosphorus from waste water in the southern part of the country, against 37 per cent in the rest.

54. A reduction in the nitrogen runoff can be achieved by the introduction of "catch crops" along the coast that absorb the nitrogen in the soil and leave land that is vulnerable to erosion out of crop during the winter (winter "stubbling").

55. Industrial processes were the main source of emissions to air, particularly of SO_2, but their contribution to local air pollution in urban areas has substantially decreased over time. There are, however, emissions of heavy metals and toxic substances in some industrialised areas.

56. Nevertheless, local pollution peaks are sometimes observed in the winter season. Peak values may be very high. The maximum concentrations of the main pollutants (NO_2 and particles), recommended by the Norwegian Pollution Control Authority, are occasionally exceeded for at least 700 000 persons in recent winters.

57. More than 5 million tonnes of waste are generated yearly in Norway — excluding waste from mining, building and construction. 1.3 million tonnes are from private households.

58. Part of hazardous waste is exported, largely to other surrounding Nordic countries in order to reduce hazards from transportation. Other waste exports are small, except for old newspapers, which cannot be treated in Norway because no de-inking facility exists yet.

59. By 2005, the 24-hour mean concentration of sulphur dioxide shall not exceed 90 µg/m^3; by 2010, the annual mean concentration of benzene shall not exceed 2 µg/m^3 (urban background value); also by 2010, the hourly mean concentration of nitrogen dioxide shall not exceed 150 µg/m^3 for more than 8 hours per year; and by 2005, the 24-hour mean concentration of particulate matter (PM_{10}) shall not exceed 50 µg/m^3 for more than 25 days per year and by 2010 not more than 7 days per year.

60. In Oslo, moreover, 20 per cent of the toll ring proceeds accrue to public transport and the construction of bicycle tracks.

61. Some impact on travel patterns has been observed in Trondheim, with a slight shift in the timing of car trips towards toll-free periods. In Oslo and Bergen, season tickets are available. In Oslo, the toll fees are not differentiated during the day, while in Bergen no tolls are collected during the night.

62. Overall, the income-to-cost ratio of municipal waste collection systems reached 95 per cent in 1995, and it was between 90 and 110 per cent in more than two thirds of the Norwegian municipalities.

63. Packaging of milk and milk products is fully exempted.

64. Pilot projects for waste recycling are also conducted by the Norwegian pollution control authority (SFT) in some municipalities.

65. The tax level was set so that the methane emissions would be taxed in line with the average rate of taxation of CO_2.

66. However, international shipping is not covered by the Kyoto agreement.

GLOSSARY OF ACRONYMS

bcm	Billion cubic metres
CFC	Chlorofluorocarbon
CH_4	Methane
CIS	Community of Independent States
CLRTAP	Convention on Long Range Transboundary Air Pollution
CO_2	Carbon dioxide
EEA	European Economic Area
GFU	Gas negotiation committee
GSC	Gas supply committee
HBFC	Hydrobromofluorocarbon
HCFC	Hydrochlorofluorocarbon
HFC	Hydrofluorocarbon
IEA	International Energy Agency
N_2O	Nitrous oxide
NGLs	Natural gas liquids
NH_3	Ammonia
NO_x	Nitrogen oxides
NPD	Norwegian Petroleum Directorate
OPEC	Organisation of the Petroleum Exporting Countries
PFC	Perfluorocarbon
PPP	Purchasing Power Parity
scm	Standard cubic metres
scm oe	Standard cubic metres of oil equivalent
SDFI	State Direct Financial Interest
SF_6	Sulphur hexafluorides
SFT	Norwegian pollution control authority
SO_2	Sulphur dioxide
TAC	Total Allowable Catches
UAE	United Arab Emirates
UN	United Nations
UN-ECE	United Nations - Economic Commission for Europe
UV	Ultra Violet
VAT	Value Added Tax
VOC	Volatile Organic Compound

BIBLIOGRAPHY

Auerbach, A.J., J. Gokhale, L.J. Kotlikoff and E. Steigum (1993),
Generational Accounting in Norway: Is Norway Overconsuming Its Petroleum Wealth?, mimeo.

Bruvoll, A. (1998),
The Costs of Alternative Policies for Paper and Plastic Waste, Statistics Norway Reports, No 98/2.

European Environment Agency (1998),
Europe's Environment: The Second Assessment, Office for Official Publications of the European Communities, Elsevier Science Ltd.

Green Tax Commission (1996),
Policies for a better environment and high employment - An English summary, Oslo.

IEA (1997),
Norway 1997 Review, Energy Policies of IEA Countries, OECD, Paris.

Ministry of Environment (1995*a*),
Evaluation of Environmental Policy Instruments in Norway, Report from a committee appointed by the Ministry of Environment in October 1992, February.

Ministry of Environment (1995*b*),
Report to the Storting No. 41 (1994-1995) on Norwegian Policy to Mitigate Climate Change and Reduce Emissions of Nitrogen Oxides (NO_x) - Summary.

Ministry of Environment (1997),
Norway's second national communication under the Framework Convention on Climate Change, April.

Ministry of Environment (1998),
Assessment Report on Fisheries and Fisheries-Related Species and Habitat Issue, Fifth International Conference on the Protection of the North Sea, Oslo.

Ministry of Finance (1992),
Towards More Cost-effective Environmental Policies in the 1990s — Principles and Proposals for Better Pricing of the Environment (Report of the Environmental Tax Commission to the Minister of Finance).

OECD (1993),
Environmental Performance Review of Norway, Paris.

OECD (1995),
Economic Survey of Norway 1995, Paris.

OECD (1997),
Economic Survey of Norway 1997, Paris.

OECD (1998),
Towards Sustainable Development, Environmental Indicators, Paris.

SFT (1996),
Norwegian Pollution Control Authority, *Pollution in Norway*, Oslo.

Statistics Norway (1997),
Natural Resources and the Environment 1997, Oslo-Kongsvinger.

Statistics Norway (1998),
Natural Resources and the Environment 1998, Oslo-Kongsvinger.

Thøgersen, O. (1994),
Economic Policy, Macroeconomic Performance and the Norwegian Petroleum Wealth: A Survey, NHH and SNF, Bergen (mimeo).

UN (1987),
Our Common Future, New York.

ANNEX

NORWAY'S OIL AND GAS WEALTH

The oil and gas resources

1. Norway possesses significant oil and gas resources on the continental shelf below the North Sea, the Norwegian Sea (along the Atlantic Coast) and the Barents Sea (close to the polar circle). The oil and gas reserves amounted to 3.0 billion standard cubic meters of oil equivalent (scm oe) in 1997, of which more than half, or 1.8 billion scm oe, consisted of crude oil (including natural gas liquids or NGLs) and the remainder of natural gas (Table A1).[1] Although the Norwegian reserves are large compared to the other oil and gas producing countries around the North Sea (the United Kingdom, the Netherlands and Denmark), they represent only 1.1 per cent of the total oil and gas reserves in the world.[2] By comparison, the Community of Independent States (CIS) and the eastern European countries control over one-fifth of world oil and gas reserves, and the Organisation of the Petroleum Exporting Countries (OPEC) three-fifths. Yet, Norway is the second largest oil exporter in the world, after Saudi Arabia, and is also a major gas provider to western Europe — Norwegian gas accounts for 10 per cent of total gas consumption in western Europe, with the remainder largely provided by Russia, Algeria and the Netherlands (Figure A1).[3] This suggests that Norway maintains a very high rate of extraction compared to the other major oil and gas producing regions in the world.

2. Given the high extraction rate, the production has quickly matured. Most major oil discoveries date from the late 1960s and early 1970s in the North Sea and are close to depletion (Table A2).[4] Hence, extraction activity has moved to newer fields which are smaller, notably in the Norwegian and Barents sea areas.[5] On the other hand, the sharp increase in oil production since the mid-1980s has been coupled with rising estimates of the resources in fields under development, owing to improved exploration and extraction technology — including three-dimensional seismic mapping, the use of flexible drills and floating platforms to develop "satellite" fields in the neighbourhood of existing infrastructures, and the injection of gas or water to maintain pressure. In fact, the enhanced recovery in existing fields, rather than the discovery of new fields, has been the single most important source of growing reserves in the past decade. A main constraint on the use of enhanced recovery technology in the future, however, could be its high energy and hence CO_2 emission intensity.

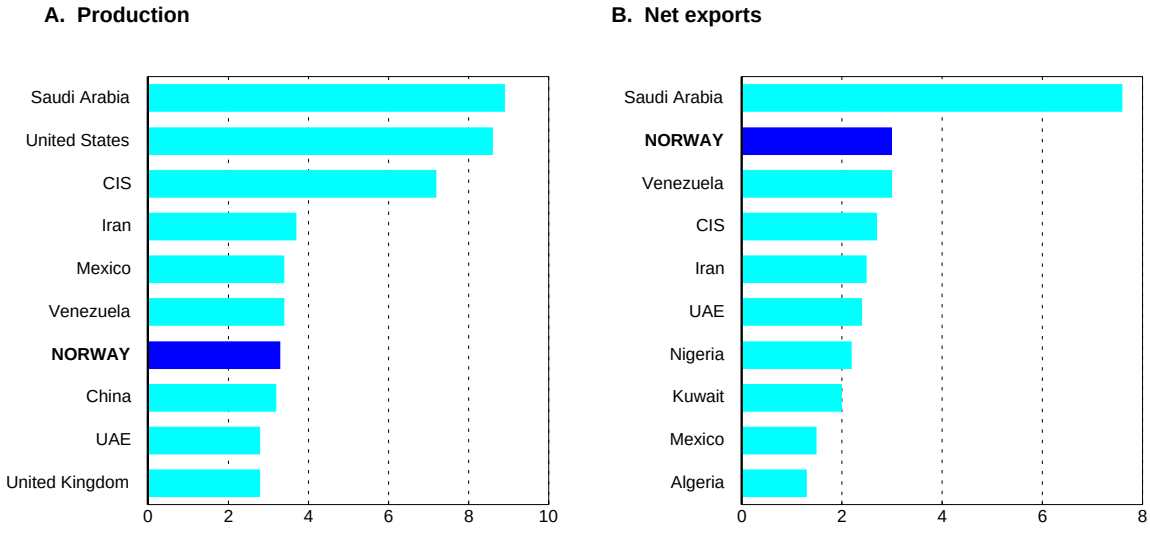
3. At current extraction rates and technology, oil reserves span 18 years and gas reserves 85 years, with oil production expected to peak in the early 2000s. Gas production will last for much longer than oil production (Figure A2)[6] and the delivery infrastructure for natural gas from the Norwegian continental shelf to the continent will be expanded accordingly.[7] The prospects for exports of Norwegian gas to Europe are favourable as the delivery is deemed to be secure, with potential new buyers in eastern Europe seeking to diversify their supply from reliance on Russian gas. Natural gas is, moreover, a relatively clean fuel and several countries substitute gas for coal and heavy oil use. Based on commitments in existing contracts, export volumes should double from current levels by 2005, with Italy becoming a major new customer. By then, Norway is expected to supply an estimated 17 per cent of western Europe's gas consumption.

Table A1. **World reserves of oil and gas**
1997

	Oil		Gas		Total	
	Billion scm oe	Per cent	Billion scm oe	Per cent	Billion scm oe	Per cent
Norway	**1.8**	**1.1**	**1.2**	**0.9**	**3.0**	**1.0**
Western Europe	2.9	1.8	4.7	3.4	7.6	2.5
Eastern Europe and CIS	9.4	5.8	56.7	40.5	66.1	21.9
Middle East	107.5	66.4	45.8	32.7	153.3	50.8
North America	4.3	2.7	6.6	4.7	10.9	3.6
Latin America	20.3	12.5	7.8	5.6	28.1	9.3
Africa	10.7	6.6	9.3	6.6	20.0	6.6
Asia and Oceania	6.7	4.1	7.1	5.1	13.8	4.6
OPEC	125.4	77.4	58.1	41.5	183.5	60.8
World	162.0	100.0	140.0	100.0	302.0	100.0

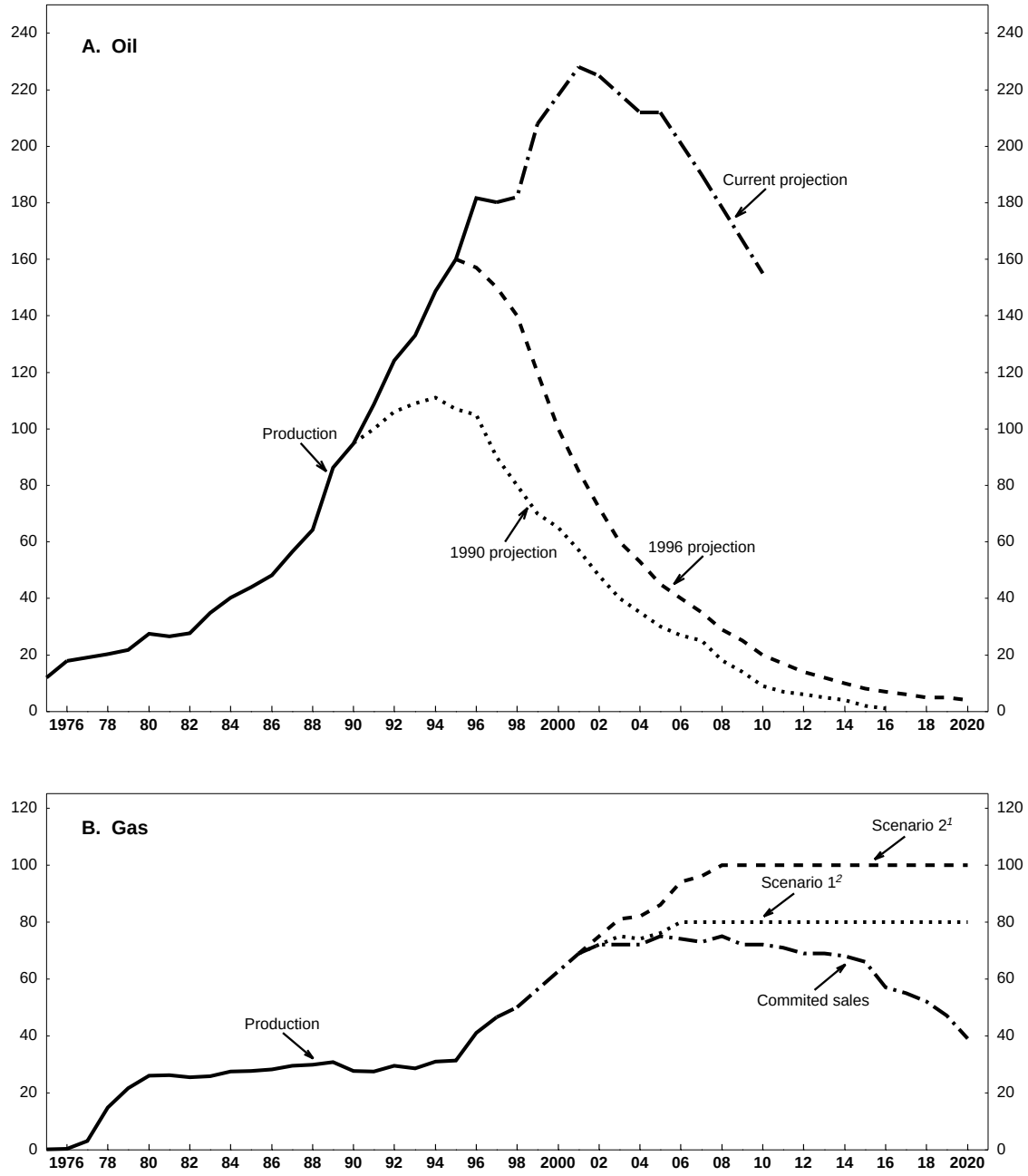
Source: Statistics Norway.

Figure A1. Production and net exports of crude oil
Million barrels per day, including NGLs,[1] 1997



1. Natural gas liquids; production level in 1997 was 10.8 million scm compared to 176.8 million scm of crude oil.
Source: Ministry of Petroleum and Energy.

Figure A2. Oil and gas production on the Norwegian continental shelf
Million scm oe



1. Depletion by 2065.
2. Depletion by 2075.
Source: Ministry of Petroleum and Energy and International Energy Agency.

Table A2. **Petroleum resources on the Norwegian continental shelf**
1997

	Total	Composition, per cent of total			
		Discovered			Undiscovered
	Billion scm oe	Produced	Reserves	Other[1]	
Oil and gas[2]	**12.8**	**18**	**25**	**29**	**28**
of which:					
North Sea	8.7	25	27	32	16
Norwegian Sea	2.9	2	24	29	45
Barents Sea	1.2	0	16	15	70
Oil[2]	**6.6**	**26**	**29**	**23**	**23**
of which:					
North Sea	5.0	33	27	24	16
Norwegian Sea	1.3	5	40	20	35
Barents Sea	0.3	0	6	10	84
Gas	**6.2**	**9**	**22**	**36**	**33**
of which:					
North Sea	3.6	15	27	42	16
Norwegian Sea	1.7	0	12	35	53
Barents Sea	0.9	0	19	16	65

1. Discovered resources outside fields in operation and expected enhanced recovery.
2. Including NGLs.
Source: Ministry of Petroleum and Energy.

The supply structure of oil and gas

4. Some 20 international oil companies are engaged in exploration and development activities on the Norwegian continental shelf. Norway's approach includes, however, the strong presence of government in the exploration and development of fields and majority ownership in two companies: Statoil (fully state owned) and Norsk Hydro (51 per cent state interest). The major official justification for the strong state involvement is that it provides the government with an adequate level of experience and know-how in setting oil and gas policy. Field participation by the Norwegian state takes place through the so-called State's Direct Financial Interest (SDFI), which is operated by Statoil on the state's behalf. Until the 14th licensing round, which took place in 1993, Statoil and SDFI were allocated a stake of at least 50 per cent on every consortium. As a result, Statoil and SDFI were by far the biggest producers on the continental shelf.

5. Direct regulation of oil extraction by the government is possible in theory but, once investments are made, it is very costly to interrupt production as oil and gas reserves may be lost forever. In rare cases, for instance, in 1987, production was capped following the price drop in 1986. However, the arrangement broke down in 1989 and was formally ended in 1990. Moreover, while the authorities do have the possibility to postpone the issuing of permits for investments on fields in operation, this instrument is used

only occasionally to regulate demand pressure on the mainland economy. The pipelines on the shelf are owned by licensees of which Statoil and SDFI have in most cases the majority share — as with extraction until the 15th Licensing round in 1995.

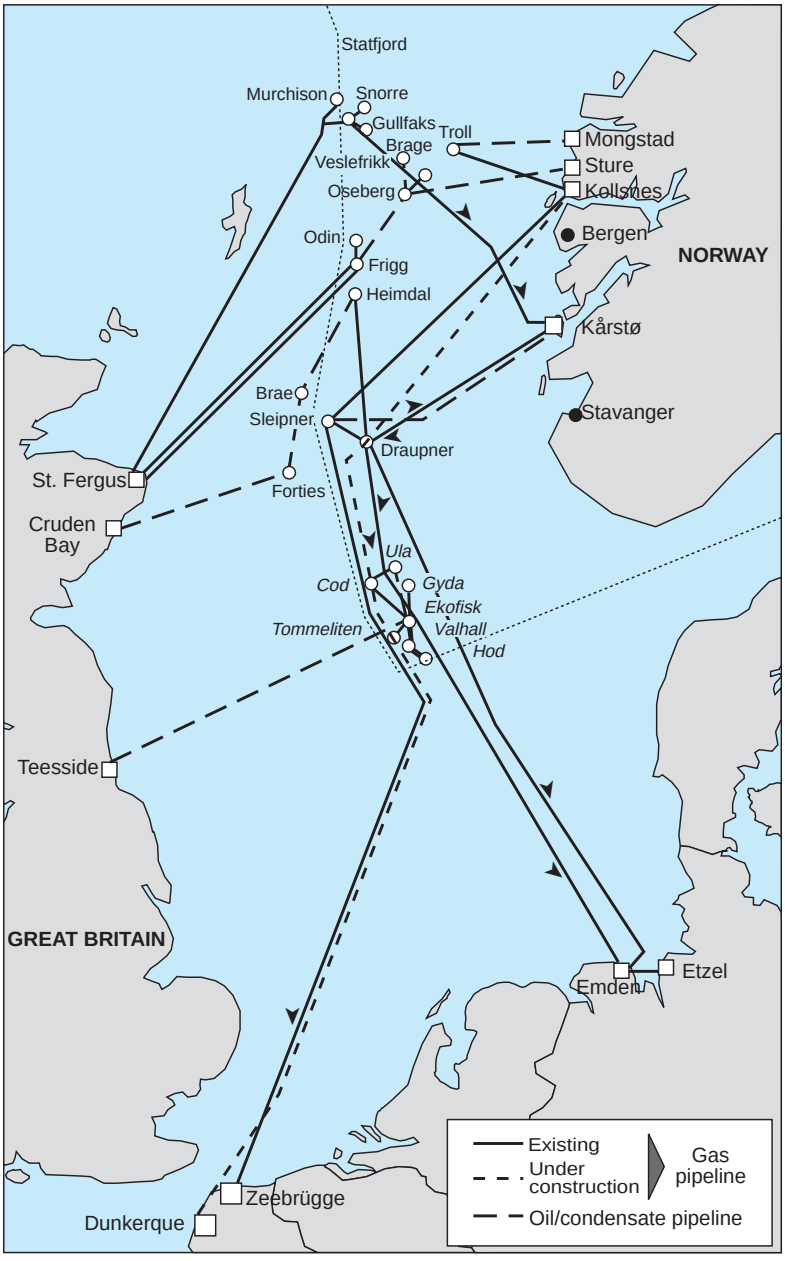
6. While the production and sale of oil is largely determined on the spot market, gas exports are marketed by the Gas Negotiation Committee (GFU), which since 1980 has acted as the sales agent for Norwegian gas.[8] GFU members are the Norwegian companies Statoil (chair), Norsk Hydro and Saga Petroleum, who hold licenses for three-quarters of Norway's total gas reserves. The GFU is responsible for preparing and conducting all negotiations, including price and volumes, for the sale of Norwegian gas. Prices are set as a weighted average of competing fuels in the destination market plus a mark-up provision for the cost of land transportation, storage, delivery and other services. The two largest customers are the Ruhrgas consortium in Germany (42 per cent of deliveries) and Gaz de France (24 per cent).[9] It is noteworthy that gas contracts are not earmarked for a specific field, which has facilitated the set-up of the integrated gas transportation grid on the shelf (Figure A3). The integrated network has generated important economies of scale and has reduced the need for gas flaring on oil fields, as unused gas can be delivered through the pipeline grid to other operators for enhanced oil recovery projects. It also created the possibility of mixing gas from various fields in order to ensure a uniform quality, both over time and across sales contracts. For this purpose, the Gas Supply Committee (GSC) was established in 1993. The GSC includes representatives from the twelve largest licensees on the shelf. Its task is to ensure that gas — which is produced in a variety of fields with different characteristics and requires a substantial amount of treatment, processing and transportation — can be delivered to the customers in Europe according to standardised quality specifications. The GSC formally acts as an advisor to the Ministry of Petroleum and Energy with the Ministry selecting delivery fields and transportation mechanisms for each contract.

7. Norway plays a valuable and increasingly important role as a secure provider of natural gas in Europe. However, Norway will be faced with new challenges, with the opening up of energy markets in the EU and the likelihood of significant change in the current structure of the EU gas market. While the current set-up of co-ordinated gas sales and field allocation has generated important economies of scale, and raised the energy efficiency of oil and gas extraction and transportation, Norway will need to take careful stock of its arrangements in this regard so as to reap the potential benefits of market liberalisation. In particular, the Norwegian authorities should assess the cost and benefits of alternative ways of managing the gas transportation grid and negotiating gas contracts.

The taxation of oil and gas

8. The significant revenues the government draws from the activities on the continental shelf come from the special tax regime applying to oil companies, including the fully state-owned company Statoil. The present tax regime includes a standard 28 per cent corporate tax charged on profits net of depreciation allowance, a special surtax of 50 per cent on those profits minus an uplift and a royalty of 8 to 16 per cent of gross sales on oil from fields cleared for development before 1986. In addition, an acreage charge is levied as a lump sum per square kilometre licensed and companies are also liable for the CO_2 tax.[10] Of less significance, in quantitative terms, is the annual dividend pay-out of Statoil, which usually amounts to 50 per cent of its after-tax operating profits. However, of increasing importance for public finances are the proceeds from the SDFI's stakes in licences on the shelf (Figure 2, Panel A). On 1 January 1985, the government created the State Direct Financial Interest which implied that a significant part of Statoil's profits henceforth accrued directly to the state. After this arrangement was implemented, all oil and gas extracted by Statoil had to be split into a part owned by the company and a part owned by the state, with Statoil formally acting as an operator on the state's behalf. The purpose of this measure was to channel a

Figure A3. **North sea oil and natural gas transportation systems**



Source: Norwegian Petroleum Directorate.

larger part of the petroleum revenues directly to the government as well as to reduce the company's ability to increase the capital base and become too independent from the state.

9. The effective tax burden on the continental shelf is not out of line with that observed in other gas and oil production areas in the world. It is high compared to the mainland, reflecting the fact that offshore value added is largely a resource rent. The degree to which the current tax system captures the whole rent has been subject to some debate. A majority in the *Green Tax Commission* (1996) commented on several weaknesses in the system which, over time, could induce operators on the continental shelf to avoid offshore taxes through the establishment of subsidiaries on the mainland. They, therefore, recommended to reassess the tax rules on the shelf regarding the valuation of financial assets and liabilities offshore and onshore. A minority in the Commission, however, noted that, in view of the complexity of the offshore tax regime, a major in-depth review of the regime would be required before any firm conclusions within the context of a green-tax proposal could be formulated. The minority, therefore, could not support the recommendations of the majority.

10. Due to price and volume volatility, the contribution of the state's oil and gas proceeds to the budget have varied substantially in the past two decades. Petroleum revenues were substantial in the first half of the 1980s, of the order of 15 per cent of GDP and 20 per cent of total general government revenues, as they were boosted by the high oil price in the wake of the second oil price shock. In the second half of the decade, the oil proceeds suffered considerably from the combined collapse of the oil price and the United States dollar. With the coming on stream of new production facilities, including through the SDFI, however, the government's petroleum revenues had recovered strongly in recent years. Indeed, the state's petroleum revenues soared from 3 per cent of GDP in 1994 to 8 per cent in 1997, before plummeting to an estimated 4 per cent of GDP in 1998 after the recent oil price collapse. The oil and gas proceeds are expected to pick up in the coming years, but should start a long-term decline from the middle of the next decade due to the fall in oil production.

NOTES

1. A standard cubic metre of oil equivalent (scm oe) has the same calorific value as 6.3 barrels of crude oil and 1 000 standard cubic metres of natural gas.

2. Discovered gas reserves are estimated at 2 805 billion cubic metres (bcm), over 40 per cent of the total estimated reserves in Europe. Undiscovered resources are estimated at 2 410 bcm.

3. There is almost no onshore use of natural gas in Norway, except for one methanol production facility and apart from a small local distribution network near the Karstø gas-landing terminal, a mainland transportation and distribution network has not been developed.

4. The Troll field, which is located in the north-western part of Norway's North Sea territory and roughly level with the coasts of Bergen and Stavanger, is the largest oil and gas field that has recently come on stream.

5. The average production costs in Norway are relatively high compared with other oil provinces in the world. The weighted average operating costs are US$4.2 per barrel of oil equivalent (including CO_2 tax), compared with US$4.2, US$3.9 and US$3.6 on the British, Dutch and Danish parts of the production region. Average costs in Norway have been on a declining trend since 1986/87, when major gas fields, in particular the Troll field, were brought on stream, but this trend may end in the coming decades. Moreover, while the reserves located in the main North Sea fields are generally of high quality — light crudes with low sulphur content and a low CO_2 content in the case of natural gas — some newer finds are of not so high quality.

6. White Paper St meld 46 (1997-98) *Olje- og gassvirksomheten.*

7. There are four main pipeline systems carrying gas to export markets: the Frigg pipeline to St. Fergus (Scotland), Statpipe/Norpipe from the North Sea *via* the Karstø terminal and the Ekofisk field to Emden, (Germany), Zeepipe from the Sleipner and Troll fields to Zeebrugge (Belgium) and Europipe to Emden (Germany). A new pipeline to Dunkirk in France became operational in 1998 to serve gas sales to Gaz de France. A third pipeline to Germany will be operational in 1999. An agreement reached in April 1997 with the United Kingdom, moreover, opened up the possibility of interconnecting existing pipelines for transportation of Norwegian gas to customers in third countries.

8. Only gas for own use, or if a better price can be obtained, can be sold outside the GFU, but there is no precedent to date.

9. Gas sale contracts usually provide for the gas to be delivered at the border of the buyer's country. Hence the sellers (licensees) also transport the gas. When a new field is developed this usually implies the construction of a new pipeline and a terminal, and normally a joint venture with the same ownership structure as the field is formed for this purpose in order to avoid conflicts of interest. Norway has no storage facilities for gas. Variations in demand are matched by variation in production, although there are storage arrangements with Germany and France concerning one field (Troll). Pipeline tariffs are set by the government.

10. The royalty, the acreage charge and the CO_2 tax are deductible from the corporate income tax and the special surtax. Investments are allowed to depreciate in six years, at a book value of 130 per cent of the actual value.

ECONOMICS DEPARTMENT
WORKING PAPERS

217. *Coping with Population Ageing in Australia*
(July 1999) David Carey

216. *Estimating Prudent Budgetary Margins for 11 EU Countries: A Simulated SVAR Model Approach*
(July 1999) Thomas Dalsgaard and Alain de Serres

215. *The Problems and Prospects Faced by Pay-As-You-Go Pension Systems: A Case Study of Greece*
(June 1999) Paul Mylonas and Christine de la Maisonneuve

214. *Greek Public Enterprises: Challenges for Reform*
(May 1999) Paul Mylonas and Isabelle Joumard

213. *The Levels and Cyclical Behaviour of Mark-Ups Across Countries and Market Structures*
(May 1999) Joaquim Oliveira Martins and Stefano Scarpetta

212. *Poverty Dynamics in Four OECD Countries*
(April 1999) Pablo Antolín, Thai-Thanh Dang and Howard Oxley
Assisted by Ross Finnie and Roger Sceviour

211. *The Recent Experience with Capital Flows to Emerging Market Economies*
(February 1999) Sveinbjörn Blöndal and Hans Christiansen

210. *Foreign Portfolio Investors Before and During a Crisis*
(February 1999) Woochan Kim and Shang-Jin Wei

209. *Towards More Efficient Government: Reforming Federal Fiscal Relations in Germany*
(February 1999) Eckhard Wurzel

208. *Stock Market Fluctuations and Consumption Behaviour: Some Recent Evidence*
(December 1998) Laurence Boone, Claude Giorno and Pete Richardson

207. *Microeconometric analysis of the retirement decision: The Netherlands*
(June 1998) Maarten Lindeboom

206. *Microeconometric analysis of the retirement decision: United Kingdom*
(June 1998) Raffaele Miniaci and Elena Stancanelli

205. *Microeconometric analysis of the retirement decision: Italy*
(June 1998) Raffaele Miniaci

204. *Microeconometric analysis of the retirement decision: Germany*
(June 1998) Pablo Antolin and Stefano Scarpetta

203. *Microeconometric analysis of the retirement decision: United States*
(June 1998) Joseph Quinn, Richard Burkhauser, Kevin Cahill and Robert Weathers

202. *The retirement decision in OECD countries*
(June 1998) Sveinbjörn Blöndal and Stefano Scarpetta

201. *The macroeconomic effects of pension reforms in the context of ageing populations: overlapping generations model simulations for seven OECD countries*
(June 1998) Ketil Hviding and Marcel Mérette

200. *The macroeconomics of ageing, pensions and savings: a survey*
(June 1998) Richard Kohl and Paul O'Brien

199. *Marginal Effective Tax Rates on Physical, Human and R&D Capital*
(May 1998) Kathryn Gordon and Harry Tchilinguirian

198. *The Norwegian Health Care System*
(May 1998) Paul van den Noord, Terje Hagen and Tor Iversen

197. *APEC Trade Liberalisation: Its Implications*
(May 1998) Seunghee Han and Inkyo Cheong

196. *The OECD Jobs Strategy : Progress Report on Implementation of Country Specific Recommendations*
(May 1998)

196. *La Strategie de l'OCDE pour l'emploi : rapport sur l'état d'avancement de la mise en oeuvre des recommandations par pays*
(May 1998)

195. *Trends in OECD Countries' International Competitiveness*
(April 1998) Martine Durand, Christophe Madashi and Flavia Terribile

194. *The European Union's Trade Policies and their Economic Effects*
(April 1998) Peter Hoeller, Nathalie Girouard and Alessandra Colecchia

193. *The Macroeconomic Implications of Ageing in a Global Context*
(March 1998) Dave Turner, Claude Giorno, Alain De Serres, Ann Vourc'h and Pete Richardson

192. *Efficiency and Distribution in Computable Models of Carbon Emission Abatement*
(March 1998) Joaquim Oliveira Martins and Peter Sturm

191. *Monetary Policy when Inflation is Low*
(March 1998) Charles Pigott and Hans Christiansen

190. *Submission by the OECD to the G8 Growth, Employability and Inclusion Conference*
(March 1998)

189. *Income Distribution and Poverty in Selected OECD Countries*
(March 1998) Jean-Marc Burniaux, Thai-Thanh Dang, Douglas Fore, Michael Förster, Marco Mira d'Ercole and Howard Oxley

188. *Asset Prices and Monetary Policy*
(February 1998) Mike Kennedy, Angel Palerm, Charles Pigott and Flavia Terribile

187. *NAIRU: Incomes Policy and Inflation*
(January 1998) Silvia Fabiani, Alberto Locarno, Gian Paolo Oneto and Paolo Sestito

186. *OECD Submission to the Irish National Minimum Wage Commission*
(December 1997)

185. *OECD Submission to the UK Low Pay Commission*
(December 1997)