Environmentally Harmful Subsidies

CHALLENGES FOR REFORM

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Foreword

Much of OECD work in the area of sustainable development has been driven by the belief that the Organisation can assist member countries in pursuing their priority goals through cost-efficient policies to help them advance along a more sustainable path of economic development.

In 1997, a High-Level Advisory Group convened by the Secretary-General called upon the OECD to "re-interpret the 1961 Convention of the OECD — which calls on the Organisation to pursue policies that promote sustainable economic growth and employment — in light of 21st century conditions and challenges so that sustainable economic growth takes on a new meaning." Following this recommendation, the 1998 Ministerial Council "agreed to interpret the term sustainable as including social and environmental, as well as economic considerations." Ministers recognised "the achievement of sustainable development as a key priority for OECD countries" and "encouraged the elaboration of the Organisation's strategy for wide-ranging efforts over the next three years in the areas of climate change, technology development, sustainability indicators, and the environmental impacts of subsidies."

Translating this key priority into practice is a difficult challenge. It requires the reform of old policies, the introduction of new ones, and better implementation of those that have proven to be effective. Priorities for action were identified in *Policies to Enhance Sustainable Development*, addressed to Ministers in 2001, and further elaborated in the OECD contribution to the World Summit on Sustainable Development in Johannesburg, South Africa in 2002. Obstacles, however, are retarding implementation in all these areas. At the domestic level, these obstacles often reflect fears from firms, individuals and communities that stand to lose from reforms. As amply documented in this volume, strategies are available to overcome these barriers. In many cases, more efficient policies in the environmental and social fields (*e.g.* consistent use of market-based instruments) would also reduce concerns about their "affordability".

There is a demand for the OECD to continue to do work on sustainable development and to raise the visibility of this work. Areas identified for further work include: obstacles to reducing environmentally harmful subsidies and further use of economic instruments; sustainable resource use, including material flow accounting, decoupling of environmental pressures from economic growth, and resource productivity; and emerging issues as appropriate.

The horizontal project on environmental harmful subsidies has been undertaken jointly by the Directorate of Food, Agriculture and Fisheries, the Environment Directorate, the Trade Directorate, the International Energy Agency, the Directorate for Science, Technology and Industry, and the European Conference of Ministers of Transport. The background papers from the OECD workshop on environmentally harmful subsidies held in Paris on 3-4 November 2003 are available at www.oecd.org/agr/env/

Table of contents

Executive Summary 7

Chapter 1. Synthesis Report on Environmentally Harmful Subsidies 13

Introduction 15

Definition and Measurement of Subsidies 16

Assessment of Enviromentally Harmful Subsidies 33

Overcoming Obstacles to the Reform of Environmentally Harmful Subsidies 59

Chapter 2. When Removing Subsidies Benefits the Environment: Developing a Checklist based on the Conditionality of Subsidies 67

Introduction 69

Subsidy-Environmental Linkages 71

Merging Theory with Evidence 76

Developing the Checklist 88

Appendix 2.1. Selected Case Studies 101

Appendix 2.2. The Role of Elasticities 106

Chapter 3. The Political Economy of Environmentally Harmful Subsidies 111

Introduction 113

The Political Economy Framework 114

The Political Economy of Policy Concessions: the Demand Side 115

Constraints on Rent Seeking: the Supply Side 119

Strategies for Reform 120

Annex. A Stocktaking of OECD Work on Subsidies 127

Executive Summary

Available data indicate that subsidies are pervasive throughout OECD countries and worldwide. Every year, OECD countries transfer at least USD 400 billion to different economic sectors. Much of this support is potentially environmentally harmful. Subsidies distort prices and resource allocation decisions, altering the pattern of production and consumption in an economy. As a result, subsidies can have negative effects on the environment that are unforeseen, undervalued or ignored in the policy process. For example, fuel tax rebates and low energy prices stimulate the use of fossil fuels and greenhouse gas emissions and subsidies for road transport increase congestion and pollution. Agricultural subsidies can lead to the overuse of pesticides and fertilizers, and in fisheries to the overexploitation of fish stocks.

Not all subsidies, however, are bad for the environment. Some are used to correct specific market failures, such as in the case of some transport modes. Some are used to generate environmental benefits, such as the payments to farmers to plant trees to reduce agricultural run-off or maintain ecosystems. Yet even apparently benign subsidies can have effects that are difficult to discern in the policy milieu. The policy challenge in addressing subsidy reform is to disentangle the myriad effects on the economy, society and the environment that are generated by the provision of subsidies. Subsidies are often inefficient, expensive, socially inequitable and environmentally harmful, imposing a burden on government budgets and taxpayers — all strong arguments for reforming the existing subsidy policies. Decoupling subsidies from input use, production and consumption would yield economic, environmental and social benefits.

Many OECD countries would like to reduce subsidies and protection that favour particular sectors or industries in their economies, particularly those that also harm the environment as well as imposing economic costs. In 2001, Ministers from the member countries of the OECD asked the Organisation to identify how obstacles to policy reform to achieve sustainable development could be overcome, in particular obstacles to reducing environmentally harmful subsidies. This report presents a synthesis of the work that has been undertaken as part of the horizontal project to address this request.

At this stage, there is no universally accepted definition of a subsidy,[1] although the WTO definition under the Agreement on Subsidies and Countervailing Measures provides a solid starting point. There is also a need to consider market price support in the form of border protection and government infrastructure provided for specific industries at less than full cost. The issue of uninternalised externalities is a grey area and is treated differently in different sectors. It is particularly important in the transport sector where the generally accepted definition of subsidy includes the support that is provided as a

1. It should be noted that several terms are often used to describe the monetary transfers that result from policies: subsidies, support, assistance, and aid. The terms "support" in the case of agriculture and "financial transfers" in the case of fisheries are used to describe those monetary transfers.

result of failing to fully charge for the marginal social cost of using particular modes of transport (mainly road and air transport). A key step in ensuring continued progress in the measurement of subsidies is the adoption of a common reporting framework to improve consistency and comparability across countries and to increase the transparency of subsidy data at national and international levels.

According to the data held by the OECD, the bulk of the support provided in OECD countries goes to the agriculture sector. In 2002, the total support estimate for agriculture amounted to USD 318 billion, which represents about 1.2% of GDP in OECD countries. Of that total, USD 235 billion goes to producers. Financial transfers to fisheries appear very small in comparison at around USD 6 billion a year, yet are equivalent to around 20% of the value of landings. Support for European road and rail transport amounted to about USD 40 billion in 1998. In the case of the energy sector, it is estimated that subsidies to energy producers in OECD countries are around USD 20-30 billion a year. Data on support to the manufacturing sector are very dated, with the last available figures being an estimate of USD 44 billion in 1993, although more recent data are available for the shipbuilding and steel sectors. However, it should be noted that methodological and data constraints severely limit comparisons across sectors. Although OECD work highlights agriculture as the sector with the largest support in absolute terms, it is likely that support for the other sectors is underestimated. In addition, the sectoral coverage is very patchy, with little or no subsidy data available for large parts of the energy and manufacturing sectors and for other environmentally significant sectors such as mining and forestry.

Determining the environmental impact of subsidies is a major challenge as the environment is affected by all production and consumption activities, which are accentuated or attenuated by policies. The OECD has developed a checklist that will assist governments and analysts in identifying those subsidies whose removal would benefit the environment. The checklist focuses on two interrelated issues: the effects of subsidy removal on the decisions of consumers and producers; and the linkages between those decisions and the environment. The checklist process is then used to assess the key policy filters that are in place to ameliorate the environmental effects of particular subsides, the conditionality of the subsidy and the extent of technology lock-in that might result from imposition of the subsidy. The checklist can be used as a first-order "quick scan" to determine if removal of a subsidy will result in environmental improvements and to provide a ranking of subsidies in terms of their environmental harmfulness. This will assist in identifying the subsidy programmes that should be subjected to further detailed analysis.

The checklist was applied to a number of sectors in order to assess its usefulness as a policy tool. The sectors were agriculture, fisheries, transport, energy and water. The key finding from the cross-sectoral analyses was that there is significant scope for reducing environmentally harmful subsidies in most of the sectors. The checklist provided a common organising framework that allowed a core set of questions to be applied in a systematic way across sectors. As a result, it provided the transparency associated with subsidy analysis in the various sectors and increased the possibilities of cross-fertilisation of ideas between sectors. At the same time, there are certainly sectoral characteristics that need to be taken into account when assessing the scope for reform of environmentally harmful subsidies. The checklist should certainly therefore be applied flexibly, but not so as to reduce its usefulness as a rigorous policy tool.

In the case of agriculture, analytical work on agricultural support measures identified market price support, payments based on output, and input subsidies as potentially more harmful than other types of support measures. Such transfers account for around 76% of the total support to the sector in OECD countries. On the other hand, payments based on area planted and animal numbers, and based on input constraints, were seen as potentially most environmentally effective.

For fisheries, the effects of subsidy reform depend critically on the management system in place and the effectiveness with which the management is enforced. Management regimes employing market-based incentives tend to be more effective in ensuring fishers have an incentive to conserve fish stocks, provided they are well-enforced. Transfers to the fishing sector which encourage capacity and effort expansion by reducing the costs of vessels and inputs tend to be the most potentially environmentally harmful.

The net effects of removing subsidies to public passenger transport and rail freight are likely to be negative for the environment. Their removal is likely to increase the use of more environmentally harmful modes of transport, while having social consequences that also need to be addressed. In contrast, removing or reducing the support provided to private passenger transport, road haulage and air transport has the potential to provide environmental benefits. This would involve charging users for the external costs that they incur, although there are technological, political, and institutional obstacles to be overcome in doing so.

Reform of subsidies to the energy sector should focus on support provided to the use of fossil fuels, particularly coal and oil. Support to the increased use of these fuels poses greater threats to the environment than, say, subsides that support the use of energy-saving devices or the development of renewable energy. At the same time, there are often significant social objectives that need to be considered when assessing energy policy, together with the general equilibrium effects of altered patterns of energy production and consumption that may be generated by subsidy reform.

The potential environmental effects of removing subsidies at the various stages of the water cycle are generally positive, particularly at the early stages of the water cycle. Removing subsidies for water abstraction will decrease water use but may reduce investment in infrastructure. Proper pricing of water to end-users will improve price signals and encourage increased efficiency in water use. However, as with energy and transport, there are social and public health considerations to be taken into account. Adverse environmental effects may result from removal of subsidies to waste water collection and treatment.

The project has also addressed the range of obstacles that stand in the way of reform of environmentally harmful subsidies across countries and sectors alike. While not unique to environmentally harmful subsidies, the key obstacles to reform include the following:

- *Strength of special* interests and rent-seeking behaviour. Lack of political will to undertake reform of environmentally harmful subsidies is often linked to the strength of special interests, and to their rent-seeking behaviour in gaining and retaining subsidies. Benefits of subsidies tend to be highly concentrated in the hands of specific groups, while their costs are spread widely across taxpayers (and sometimes consumers). This divergence in the concentration of benefits and costs increases the expected returns to specific groups, and the incentive to lobby to attain and retain subsidies. Empirical evidence suggests that older and

declining industries, which are more environmentally damaging, tend to secure most support and trade protection.

- *False perceptions and fear of change*. Special interests have successfully invoked "mythologies and mantras" in order to gain popular and political support for the subsidies they receive. For example, subsidies have sometimes been justified by the need to maintain ideals of pre-industrial fishing and farming families. However, even when such ideals may reflect legitimate aspirations, subsidies are not necessarily the most effective means of attaining them, particularly if they have adverse effects on the environment.
- *Competitiveness and distributional concerns*, particularly with respect to regional interests. Despite the demonstrable benefits from unilateral subsidy reform, policy makers are often reluctant to undertake such reforms unless forced to by either economic or environmental crisis, or in response to external pressures (such as might occur through new multilateral or regional trade agreements). Similarly, distributional concerns (including concerns over regional interests) can inhibit moves to reform subsidy programmes. In this regard, there is scope for learning from experiences with other policy reforms such as higher environmental taxes, privatisation of state-owned enterprises, or tariff reform.
- *Lack of transparency.* Transparency may refer to information on the size of subsidy programmes, their beneficiaries, and their economic, environmental and social effects. Asymmetries in the review process for environmental and economic measures can also reduce transparency. In most cases, new environmental measures are subject to a "regulatory impact assessment" while, in many countries, existing subsidy programmes are not subject to an "environmental impact assessment". Despite efforts to incorporate sustainable development into the policy agenda of several OECD countries, there is much scope for better integrating economic, social and environmental considerations into policy assessment and decision-making.
- *Legal, administrative and technological constraints*. Such constraints can result from structural rigidities that restrict the ability of society to adapt to subsidy reforms. For example, restrictions on the sale, amalgamation or sub-division of farming land in some countries may restrict the ability of farmers to alter their farming practices in response to changes in subsidy policy. Constraints can also result from technological factors, as in the case of transport where the introduction of electronic charges based on marginal costs for passenger cars is impeded by the huge cost and technological challenges involved.
- *Establishment of a culture of "entitlement" to subsidies*. Long-term provision of subsidies generates perceptions of "entitlement" that may be hard to break, as they become capitalised into the prices of factors of production (for example, in the value of land, fishing vessels and catch quotas). The expectation that subsidy programmes will continue can also become embedded in the expectations of producers and consumers, leading to resistance to change and incentives to lobby for the retention of subsidy programmes.

A multi-pronged strategy is required to overcome these factors. Challenging the misconceptions surrounding the provision of subsidies to particular sectors will contribute to changing the terms of the policy debate. Recognition that a range of options is available to meet societal objectives is also important, as it contributes to the recognition

that subsidies are generally inefficient tools for achieving policy goals. Other ingredients of successful reforms include the diffusion of innovative schemes; better targeting of existing subsidies to improve their cost effectiveness and reduce any environmental impact; and improved subsidy design, to improve the efficiency of subsidies granted to correct environmental problems — although they remain less efficient than pollution taxes or tradable permits, and may violate the polluter pays principle.

Political economy considerations are crucial for successful reform. Windows of opportunity which may enable governments to undertake reform should be seized when they materialise, rather than waiting for a crisis to strike a sector or a country. In some countries, reforms have been driven by the need to respond to a fiscal or environmental crisis (*e.g.* reforms of fisheries subsidies in Canada) while in others they have been part of wider economic reforms (*e.g.* reform of agricultural subsidies in New Zealand), and in yet others, enlightened self-interest and a confluence of political forces agreeing on the need for change were the major factors in driving policy reforms *(e.g.* Sweden).

In all cases, a major factor in the push for reform of environmentally harmful subsidies is increased transparency. Transparency can stimulate voter opposition to subsidies and make subsidy reform less politically damaging for governments. In this regard, identifying who benefits from subsidies, and highlighting their relative "bargaining power", can provide a powerful motivating force for change. A good example is agriculture, where analysis of who receives and who benefits from support, both in terms of income levels and location, has strengthened the determination of some countries to reform support programmes. Structural impediments and rigidities in the legal and administrative framework should also be addressed. This requires a holistic approach to policy, as such impediments may not always be apparent when designing reform packages, and assessment of the administrative and geographical level at which the subsidy is provided.

Transitional measures may be required when phasing out or reducing subsidies. Such measures involve not only payment or compensation to assist in structural change, but also the provision of information, advice and retraining to affected workers and businesses. The appropriate speed of adjustment will depend on the resilience of the community to change and external pressures, and on the availability of alternative sources of employment and income. However, care needs to be taken to ensure that transitional measures not become entrenched in the expectations of beneficiaries of the measures. Finally, subsidy reform should be considered within the overall context of the economy. For example, increased competition and the opening up of economies to international forces may reduce the lobbying power of special interest groups and create opportunities for reforming environmentally harmful subsidies.

Chapter 1

Synthesis Report on Environmentally Harmful Subsidies

Abstract

This synthesis report provides an extended summary of the findings of the horizontal project on environmentally harmful subsidies. It addresses the definition of subsidies and presents a checklist approach to identifying when the removal of subsidies is likely to have a beneficial effect on the environment. The report then presents the key findings from the case studies conducted as part of the project. The sectors examined were agriculture, fisheries, transport, energy and water. The range of issues involved in the reform of environmentally harmful subsidies is discussed in the last part of the report, focusing on the political economy of subsidy policy reform.

Introduction

Available data indicate that subsidies are pervasive throughout OECD countries and worldwide. Every year, OECD countries transfer at least USD 400 billion to different economic sectors. Subsidies and import protection are proffered for a range of reasons: to promote regional and rural development, employment and incomes; protect economic sectors from international competition; and facilitate adjustment to changing economic, social and environmental conditions.

Much support is potentially environmentally harmful. Subsidies distort price and resource allocation decisions, altering the amount of goods and services produced and consumed in an economy. As a result, they can have negative effects on the environment that are either unforeseen or ignored in the policy process. For example, fuel tax rebates and artificially low energy prices stimulate the use of fossil fuels and greenhouse gas emissions; subsidies for road transport increase congestion and pollution; agricultural support can lead to the overuse of pesticides and fertilizers; and support for commercial fishing can result in overexploitation of fish stocks.

However, not all subsidies are bad for the environment. A prime example is subsidies that correct specific market failures. For example, road transport and pollution would increase in the short-term if the public sector did not subsidise rail transport. And some subsidies are used to support the generation of environmental benefits. OECD countries are increasingly linking agricultural support payments to farmers' actions to improve the environmental performance of agriculture. Some countries support land-owners who plant trees to reduce agricultural runoff and removing marginal land from production in order to provide habitat for wildlife. OECD countries have substantial programmes to support the development and production of renewable energy sources. And some financial transfers in the fisheries sector are directed towards improving resource sustainability.

Yet even these apparently benign subsidies may be unnecessarily costly in so far as they are used to offset the environmental damage caused by other support policies that stimulate production, and many may not be well-targeted to achieve specific environmental outcomes. As other subsidies or measures are put into place to counteract the negative effects of the original subsidies, it is possible that the adverse economic and social (and even environmental, in the longer term) impacts of the original support programmes will be exacerbated.

Many OECD countries would like to reduce subsidies and protection that favour particular sectors or industries in their economies, but they have made only limited progress in this in recent years. Economists generally regard subsidies as inefficient, expensive, socially inequitable and environmentally harmful, imposing a burden on government budgets and taxpayers — all strong arguments for reforming existing subsidy and trade-related policies. In the short term the reduction of agricultural support may lead some producers to exploit environmentally sensitive land to recuperate income loss. However, in the long term, decoupling subsidies from input use, production and consumption would yield economic, environmental and social benefits.

At the meeting of the Council at Ministerial level in 2001, Ministers from the member countries of the OECD asked the Organisation to identify how to overcome obstacles to policy reform to achieve sustainable development, in particular to the reduction of environmentally harmful subsidies (OECD 2001). The need to phase out environmentally

harmful subsidies was also a recurrent theme in the OECD Environmental Strategy for the First Decade of the 21st Century. In 2002 OECD Ministers renewed their long-standing commitment to reduce trade distorting and environmentally harmful subsidies (OECD 2002a).

Environmentally harmful subsidies have also featured in other international forums. They were debated at the World Summit on Sustainable Development and the adopted Plan of Implementation includes several references to reducing environmentally harmful subsidies across a range of sectors (United Nations 2002). Subsidy reform was also addressed during the Fourth Ministerial Conference of the World Trade Organization (WTO) in Doha, Qatar, in November 2001 (WTO 2001).

This report is a synthesis of the analytical work conducted under the OECD Ministerial mandate on environmentally harmful subsidies. It presents the key highlights from two workshops on environmentally harmful subsidies, held in November 2002 and November 2003, as well as research undertaken within the Secretariat. A selection of the key papers presented at the first workshop has been published in Environmentally Harmful Subsidies: Policy Issues and Challenges (OECD 2003). The papers presented at the second workshop are available on the OECD website www1.oecd.org/agr/ehsw

The next section of this report discusses the issues surrounding the definition and measurement of subsidies and provides a stocktaking of OECD subsidy data. Clearly, an essential first step in reforming environmentally harmful subsidies is to identify all the subsidies provided by governments. The next step in the process is to assess which of these subsidies are environmentally harmful. The issue of assessment is addressed in Section 3 where the checklist approach is discussed. The lessons from the application of the checklist to a number of sectors are also reviewed. Section 4 identifies the key policy obstacles to reforming environmentally harmful subsidies and highlights a number of options for their reform.

Definition and Measurement of Subsidies

Defining Subsidies[1]

At this stage, there is no definition of a subsidy that is universally accepted by all who use the term — national account statisticians, trade negotiators, environmental economists and the general public. In general, a subsidy is a result of a government action that confers an advantage on consumers or producers, in order to supplement their income or lower their costs. This broad definition, or significant elements of it, can be found in the analysis of subsidies across sectors in this study. However, the more detailed definitions differ between sectors and, sometimes, between countries, organisations and analysts for given sectors. Agriculture is the sector which is the most advanced in using a widely accepted definition, with the total producer support estimate (PSE) providing a measure that is produced by one organisation (OECD) and is comparable across countries. Analysis of subsidies to coal production has also employed the PSE framework. Analysts working on subsidies to marine capture fisheries seem for the moment to have adopted the GFT (governmental financial transfers) as the default measure, even if difficulties remain in assessing their size. This relates in particular to the level of government that provides transfers (national, regional or local), that some transfers are not posted as expenditure (*i.e.* they are un-budgeted) or because the amounts involved are relatively small. For other products or industries, such as forestry and energy, no single dominant indicator or framework has emerged.

The WTO definition of a subsidy as given in the Agreement on Subsidies and Countervailing Measures (SCM Agreement), signed at the end of the GATT-sponsored Uruguay Round of multilateral trade negotiations, currently serves as the only internationally agreed legal definition of a subsidy (Box 1.1). It is reasonably comprehensive and includes direct transfers of funds, fiscal incentives and the provision of goods and services other than general infrastructure. It is also the starting point for many of the sectoral definitions used in practice. However, the SCM Agreement is an instrument of international trade law and, as such, may be unduly restrictive in terms of defining all subsidies which may be environmentally harmful. Three issues stand out as requiring further attention in this regard: market price support; government-provided general infrastructure; and the treatment of uninternalised externalities.

Box 1.1.Definition of a subsidy in the WTO Agreement on Subsidies and Countervailing Measures

1.1 For the purpose of this Agreement, a subsidy shall be deemed to exist if:

(a)(1) there is a financial contribution by a government or any public body within the territory of a Member (referred to in this Agreement as "government"), *i.e.* where:

(i) a government practice involves a direct transfer of funds (*e.g.* grants, loans, and equity infusion), potential direct transfers of funds or liabilities (*e.g.* loan guarantees);

(ii) government revenue that is otherwise due is foregone or not collected (*e.g.* fiscal incentives such as tax credits);[1]

(iii) a government provides goods or services other than general infrastructure, or purchases goods;

(iv) a government makes payments to a funding mechanism, or entrusts or directs a private body to carry out one or more of the type of functions illustrated in (i) to (iii) above which would normally be vested in the government and the practice, in no real sense, differs from practices normally followed by governments;

or

(a)(2) there is any form of income or price support in the sense of Article XVI of GATT 1994;

and

(b) a benefit is thereby conferred.

1. In accordance with the provisions of Article XVI of GATT 1994 (Note to Article XVI) and the provisions of Annexes I through III of this Agreement, the exemption of an exported product from duties or taxes borne by the like product when destined for domestic consumption, or the remission of such duties or taxes in amounts not in excess of those which have accrued, shall not be deemed to be a subsidy.

Source: World Trade Organization (1999).

Market price support (transfers to producers provided through border protection) is excluded form the WTO definition of subsidies, other than in the sense of Article XVI of the GATT 1994 (Section A of this article refers to subsidies, "including any form of income or price support" and section B to export subsidies). Market-price support, as the term is used by the OECD, is excluded, not because the GATT negotiators considered them unimportant, but because international trade law deals with tariffs and non-tariff barriers separately. The inclusion of market price support enables calculation of producer and consumer support estimates, which integrates budgetary transfers and market price support into a holistic measure of support. The OECD calculates producer and consumer support estimates for agriculture and coal production. The method has been tested for fish production but was considered unsatisfactory due to technical difficulties and non-

availability of data. Although not all institutionalised subsidy exercises include market price support (using either the effective rate of assistance or the producer support estimate framework), there is now agreement among many economists that the concept of subsidy — or at least "support" or "assistance" — includes the effects of border protection.

The second significant exclusion from the WTO definition is government-provided general infrastructure, which is not further defined in the SCM Agreement. The term refers to government investments in such items as government-provided road networks, but not necessarily to a road built, for example, to service a remote mine or factory. The issue of the treatment of government-provided infrastructure is complex. Generally, the infrastructure in question serves one industry or sector predominantly, but not exclusively. Examples are irrigation infrastructure, and harbour facilities in major fishing ports. To complicate matters, particular infrastructure projects may be self-financing overall, but involve significant cross-subsidies between groups of users (*e.g.* electricity rate-payers and irrigators served by the same combined hydroelectric/irrigation project). Perhaps because such a large proportion of government support to the sector is provided through infrastructure projects, analytical work in this area is farthest advanced in respect of irrigation and transport.

The third issue that arises is the treatment of uninternalised externalities. It is particularly evident in the area of transport where the concept of a subsidy or support measure is more complex. One broad definition compares total revenue of the sector with the total social cost of each transport mode. According to this definition, in most European countries, revenue from fuel taxes and specific road user charges roughly covers the cost of road infrastructure. However, for countries at the lower end of the spectrum, spending on infrastructure exceeds revenue, thus resulting in a subsidy. Another approach compares the price paid for using transport infrastructure and the marginal social cost associated with a specific transport mode. Recent estimates indicate that in urban areas the prices for using cars and trucks are generally much too low and that prices in these areas should increase to cover marginal social costs.

Measuring Subsidies[2]

The OECD's stocktaking of sectoral support identified five main approaches to subsidy measurement, some of which overlap. The strengths and limitations of these approaches are summarised in Table I.1:

- Programme aggregation: adding up the budgetary transfers of relevant government programmes; in most cases data are at the national rather than the sub-national level.
- Price-gap: measuring the difference between the world and domestic market prices of the product in question.
- Producer/consumer support estimate: measuring the budgetary transfers and price gaps under relevant government programmes affecting production and consumption alike.
- Resource rent: measuring the resource rent foregone for natural resources.
- Marginal social cost: measuring the difference between the price actually charged and the marginal social cost.

Table 1.1. Overview of subsidy measurement approaches

Approach/ Description	Strengths	Limitations
Programme-aggregation: Quantifies financial transfers associated with various government programmes. Aggregates programmes into overall level of support.	Captures transfers whether or not they affect end-market prices. Can capture intermediation value (which is higher than the direct cost) of government lending and insurance.	Does not address questions of ultimate incidence of pricing distortions. Sensitive to decisions regarding inclusion of programmes. Requires programme-level data.
Price-gap: Evaluates positive or negative "gaps" between the domestic price and the world price. Also known as Market Price Support.	Can be estimated with relatively little data. Useful for multi-country studies. Good indicator of pricing and trade distortions.	Sensitive to assumptions regarding "free market" and transport prices. Understates full value of support by ignoring transfers that do not affect end-market prices.
Resource rent: Estimates the difference between the full economic rent and the price paid for exploiting a natural resource.	Relevant for natural resource sectors such forest and water.	Data intensive. Sensitive to assumptions.
Marginal social cost: Estimates the difference between the marginal social cost (that internalises all externalities) and the price paid.	Most comprehensive approach. Used for transport.	Data intensive. Requires a significant amount of modelling. Sensitive to assumptions and has a wide range of uncertainty.
Producer/consumer support estimate: Systematic method to aggregate budgetary transfers and consumer transfers (through market price support calculation) to specific industries.	Integrates budgetary transfers with market price support into holistic measurement of support. Distinguishes between support to producers and consumers.	Data intensive. Currently calculated for agriculture and coal production, but not for other sectors.

Based on Koplow and Dernbach, 2001.

Two basic organising frameworks have been applied by institutions and analysts to measure subsidies: comprehensive accounting systems, as exemplified by the System of National Accounts and sectoral subsidy accounts, which relate to a specific product, industry or sector. For tracking government expenditure, national accounts can be very useful. However, for the purpose of analysing the effects of subsidies on economic performance, trade or the environment, the definition of a subsidy used for the purpose of national accounting is too narrow. Also, national accounts report gross data and are not adjusted to take into account possible cost recovery through user charges or another mechanism. Nonetheless, the conceptual framework provided by the SNA provides a useful model, in as much as it embraces the entire (measured) economy and is internally consistent.

The limitation of the national accounts for analytical purposes is a major reason behind the emergence of composite indicators of support, and of sectoral subsidy accounts. Indeed, the sectoral subsidy accounts are the major means by which subsidy

data are defined and measured. A key feature of the sectoral accounts is that the major subsidy measurement exercises — the ones that tend to inform policy debates — are prepared by different groups that, to varying degrees, cover different support measures and use different classification systems. Established approaches, such as the effective rate of assistance or PSE frameworks, have had an influence on subsequent exercises. In addition, there is a close correlation between the adoption of a formal framework (as signalled by the use of aggregate indicators such as the PSE) and the establishment of a series of records. Sectoral subsidy accounts have their own sets of limitations, a major one being that, by excluding non-specific subsidies, they leave out general subsidies that may affect the allocation of resources within an economy, in particular between different factors of production (land, capital and labour). A common example would be a non-targeted tax credit designed to encourage investment.

The significant differences between sectors and countries with respect to the depth and robustness of subsidy measurement raise a number of issues for the analysis of environmentally harmful subsidies. There remain important differences that may limit the degree to which economy-wide data on subsidies can be prepared from sectoral accounts. These disparities relate to coverage, systems of classification, and measurement methods. Determining where the significant differences exist is often hampered by inadequate documentation of assumptions, methods and data. Improvement of documentation would facilitate comparisons and peer review.

Another potential source of subsidy measurement is the WTO subsidy notifications. While the WTO provides the only internationally agreed definition of a subsidy, the level and quality of reporting on subsidy programmes is relatively poor. This emerged from a review by the OECD of WTO subsidy notifications for a number of sectors. Except for obviously politically sensitive sectors (such as agriculture), there is a high degree of variation in the level of detail provided in the notifications. While it is not possible, in the absence of a full set of subsidy programme information, to determine how comprehensive the notifications are, it is understood that the coverage is generally poor. The case of notifications on subsidies to fisheries is a case in point (Box 1.2). In this regard, the ongoing negotiations at the WTO on fisheries subsidies offer a unique opportunity to make notification rules more enforceable and to allow for a broader scrutiny of subsidy information provided by WTO members.

At one time it may have been acceptable to consider the effects of subsidies from a partial perspective, sector-by-sector. Ministries of energy may not have been measuring subsidies in the same way as ministries of agriculture, but it hardly mattered: each knew where the trade-offs in their domains lay. The ideal of sustainable development, however, argues for taking a more integrated perspective, one that recognises the inter-connectedness of policies and their effects. Yet the fact that subsidy data currently differ so much from one sector to another confounds attempts to consider them across whole economies and allows vested interests to legitimately challenge each subsidy estimate as inconsistent with the others.

While the subsidy debate may not yet be fully resolved, and further work is required on some key outstanding issues, there has been considerable progress in recent years and an emerging consensus on the core elements of the subsidy definition. A key step in ensuring continued progress is the adoption of a common reporting framework for subsidy data. Such a framework would improve consistency and comparability across sectors and across countries. It would also significantly increase the transparency of the way in which the subsidy data are compiled and reported. It is suggested that a

framework structured around the data requirements for an effective rate of assistance (ERA) could serve such a purpose, even if the available data do not currently permit the calculation of an ERA itself.

Box 1.2. Fisheries subsidy notifications to the WTO

The WTO has published a full list of notifications of subsidies provided to the fisheries sector received between 1 January 1995 and April 2001. The table below presents the number of notifications according to main recipient, *i.e.* harvesting sector, shipbuilding, processing sector and "other" covering research in particular. It will be observed from this table that not all fishing nations notify subsidies to the WTO despite the fact that the notification process is an international commitment.

Country	Harvesting sector	Shipbuilding	Processing	Other	Total
Canada	4				4
Japan	6			1	7
Korea	6	2	2	1	11
Norway	16	1	1	4	22
Philippines	1				1
Poland	3				3
Senegal	1				1
Slovakia	1				1
United States	5				5
EEC	75	9	9	34	127
Iceland	1		1	3	5
Tunisia				1	1
Singapore	1				1
Turkey	1				1
Thailand				1	1
TOTAL Notifications	**121**	**12**	**13**	45	**191**

Source: WTO (1998, 1999, 2001).

Taking Stock of OECD Subsidy Data

Every year OECD member countries transfer at least USD 400 billion to various economic sectors (Table 1.2). About three quarters of these subsidies go to agriculture. However, it should be noted that methodological and data constraints limit comparisons across sectors. Although OECD work highlights agriculture as the sector with the largest support in absolute terms, it is likely that support is underestimated for other sectors.

Table 1.2. Subsidies in OECD countries

	Billion USD			
	1990	**Most recent data [year]**	**Coverage**	**Comments**
Agriculture	351	318 [2002]	Total support estimate; includes market price support, budgetary payments and support for general services; covers all OECD countries.	Equivalent to 1.2% of GDP.
Transport (road and rail)		40 [1998]	Subsidies estimated as the difference between total revenues and total social costs; includes the European Union, Hungary and Switzerland.	Nash *et al.* (2002) estimated that revenues cover on average 36% of rail system costs.
Energy production	n.a.	20-30 [1999]	Aggregate estimate.	
of which *- Coal production*	11	5 [2000]	Includes market price support, budgetary payments and support for general services; includes France, Germany, Japan, Spain, Turkey and UK.	Equivalent to USD 68 per tonne of coal produced.
Manufacturing	44 [1993] *49 [1992]*	*22 [EU]*	Net government expenditures to industry. Figures in *italics* cover the EU only and include grants, interest subsidies, tax exemptions, equity participation, soft loans, tax deferrals and loan guarantees, converted into cash grant equivalents.	Figures in *italics* from the EU State Aid Survey.
Of which *- Shipbuilding*	.. *2.5 [1995]*	0.75 [2000] *1 [2000]*	Figures in italics cover the EU only and include grants, interest subsidies, tax exemptions, equity participation, soft loans, tax deferrals and loan guarantees, converted into cash grant equivalents	Figures in *italics* from the EU State Aid Survey.
- Steel	*2.2 [1995]*	*- [2000]*	Includes grants, interest subsidies, tax exemptions, equity participation, soft loans, tax deferrals and loan guarantees, converted into cash grant equivalents; EU only.	Figures from EU State Aid Survey.
Fisheries	n.a. [9 in 1996]	6 [1999]	Government financial transfers to the marine capture fisheries; includes direct payments, cost-reducing transfers and general services. The 1999 figure excludes Australia, Belgium, Mexico, the Netherlands, Poland and Turkey	Equivalent to 20% of landed value.
Water	..	10	Aggregate estimate.	
Forestry	..	6	Aggregate estimate; includes only Canada and the United States.	

Note: Data and calculation methods not comparable across sectors.
Sources: OECD (1998b; 2001b; 2001c; 2003a), EU (2002), IEA (2001), ECMT (2000b), Nash *et al.* (2002), Myers and Kent (1998, 2001).

The data coverage is also relatively patchy (Box 1.3). Agriculture has the most comprehensive estimates of support as a result of the extensive annual PSE exercise. Fisheries financial transfers are also collected annually, but there are gaps in the

information gathered (especially with reference to tax relief, regional and local subsidies and national data for a few countries), making in-depth analysis of the data difficult. Data for the energy sector is restricted to subsidies provided to coal production while subsidy data in the transport sector is largely confined to the European road and rail transport sectors. The coverage of other sectors, such as manufacturing, forestry, water, is quite poor, with the exception of the shipbuilding and steel sectors.

Box 1.3. Subsidy Definitions Used in OECD Sectoral Analysis

Agriculture: the most commonly used definitions and measures of subsidies are the producer support estimate (PSE), the consumer support estimate (CSE), the total support estimate (TSE), calculated annually by the OECD; and the aggregate measurement of support (AMS) used in the GATT Uruguay Round and WTO agricultural negotiations. OECD estimates cover market price support, financial transfers (including those to reduce the cost of fixed capital and/or variable inputs), general services (transfers covering the costs of research, marketing and structural/infrastructure services) and consumption subsidies. Data are available with respect to both production and consumption.

Fisheries: the OECD measures transfers to reduce the costs of fixed capital and/or variable inputs; direct payments; general services (transfers covering the costs of research, management, and enforcement and infrastructure); and, to some extent, price support through market measures.

Energy: the OECD measures grants or soft loans to producers or consumers of energy; market price support; differential tax rates on different fuels; and publicly funded research and development programmes. Data are available with respect to production in the case of coal subsidies.

Transport: subsidies are commonly measured on a purely financial basis as the gap between government expenditures on transport systems and the revenues collected from those systems. Measurement on an economic basis has also been attempted, on the basis of the deficit or surplus of revenues produced by current taxes and charges compared with those that would pertain in an optimum where all transport services are priced at their marginal social costs (including the external costs of congestion, scarcity, accidents, noise, air pollution, climate change and so on).

Manufacturing: measured subsidies include grants and interest rate subsidies, tax exemptions, soft loans, equity investments, tax deferrals and loan guarantees.

Irrigation water: subsidies are measured either as government expenditure covering all or some of the costs of installing and/or maintaining irrigation systems, or on the basis of the water's true value to the irrigator.

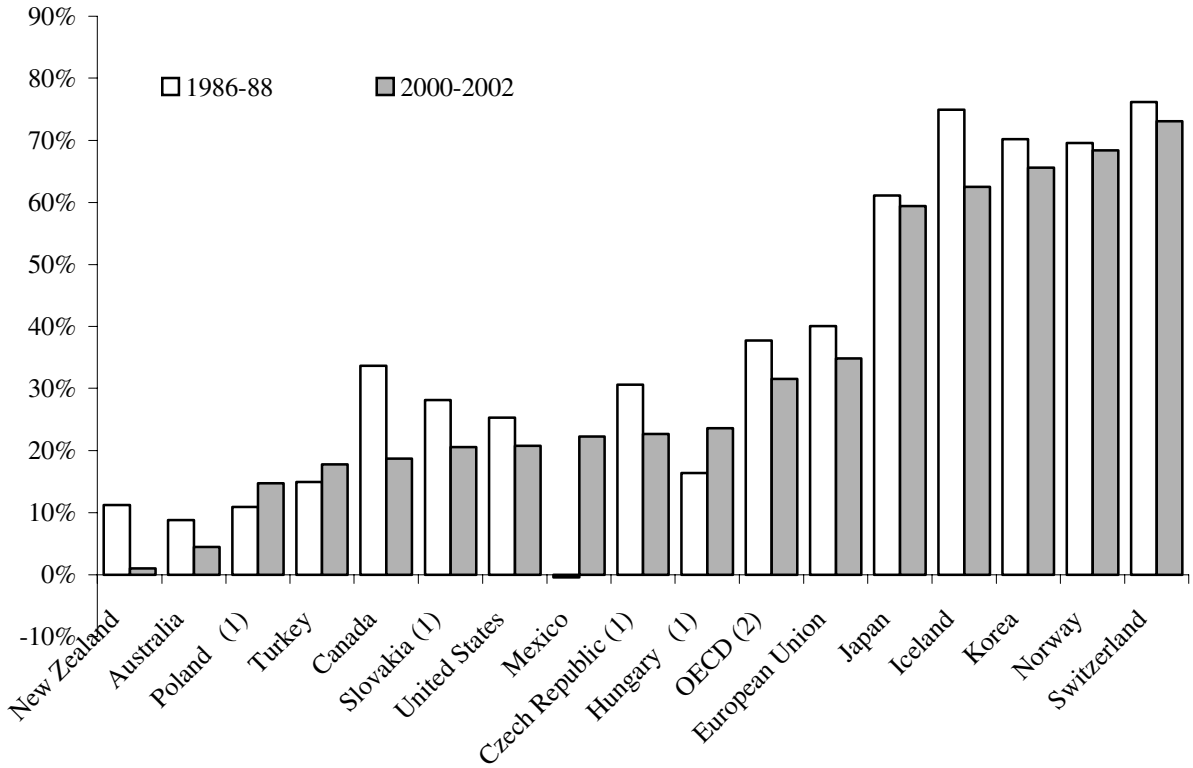
In 2002, the total support estimate (TSE) for agriculture amounted to USD 318 billion, which represents 1.2% of GDP in OECD countries. Of this total, USD 235 billion goes to producers, measured by the producer support estimate (PSE). The PSE measures the annual monetary value of gross transfers from consumers and taxpayers measured at the farm-gate level, arising from policy measures that support agriculture, regardless of their nature, objectives or impacts on farm production or income. The PSE estimates cover market price support budgetary payments and input subsidies (including those to reduce the cost of fixed capital or variable inputs). The TSE in addition includes general services (transfers covering the costs of research, marketing and structures and infrastructure services) and consumption subsidies.

During the 1990s many OECD countries began to take steps to reduce and restructure their support policies in an effort to reduce overproduction and trade distortions, and to encourage more environmentally sound use of land, soil, and water. The pace of these developments has been modest and support remains high in many OECD countries, causing production and trade distortions as well as adverse effects on the environment. In

2002, support to farmers (as measured by the Producer Support Estimate) still represented 31% of the value of farm receipts, though down several percentage points compared with the mid-1980s, when it as 38% (Figure 1.1).

Figure 1.1. Producer Support Estimates by country

(Percent of value of gross farm receipts)



Notes: Countries are ranked according to 2000-2002 levels.
1. For the Czech Republic, Hungary, Poland and the Slovak Republic 1986-88 is replaced by 1991-93.
2. For 1986-88, the Czech Republic, Hungary, Poland and the Slovak Republic are excluded.

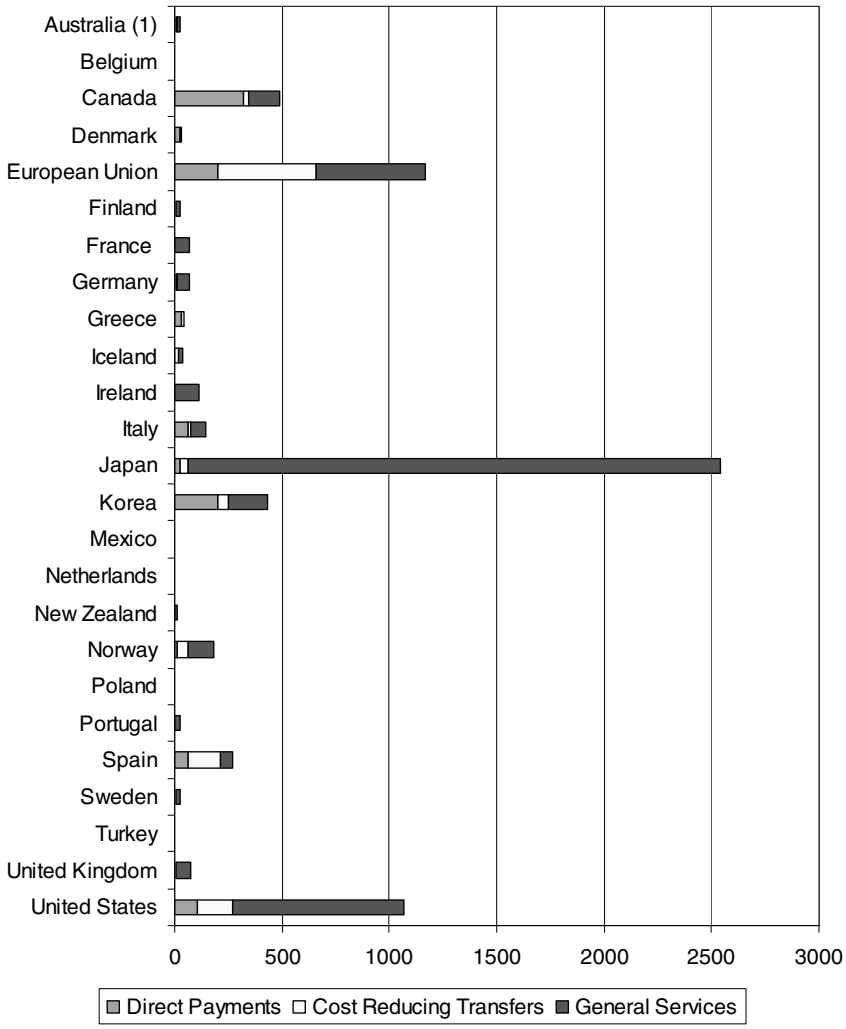
Source: OECD, PSE/CSE database, 2003.

The OECD countries have supported their fishing industries by significant amounts of money and over long periods of time. Government financial transfers in support of marine capture fisheries in OECD countries amounted to more than USD 5.8 billion in 2000, corresponding to 20% of the total value of landings (Figure 1.2). The data measure direct payments, cost-reducing transfers and general services, but not market-price support. Japan provides the largest fisheries subsidies in the OECD, followed by the European Union, United States, Canada, Korea and Norway.

Around a third of the government financial transfers to marine capture fisheries by OECD countries are devoted to research, management and enforcement, with another third being spent on fisheries infrastructure. Although a proportion of the transfers are aimed at ensuring the sustainable use of fish stocks and the aquatic ecosystem, some of them have contributed to over-capacity in fishing fleets and to over-fishing in a number of fisheries. The introduction of cost recovery programmes for some research,

management and enforcement expenditure in some countries implies that some of these activities directly benefit fishers, rather than society as a whole. Capacity-reducing transfers, including vessel buyback programmes, licence retirement schemes and payments to fishers to leave the industry, have been widely used in OECD countries in response to over-fishing and over-capacity.

Figure 1.2. Financial transfers to marine capture fisheries in OECD countries 2000

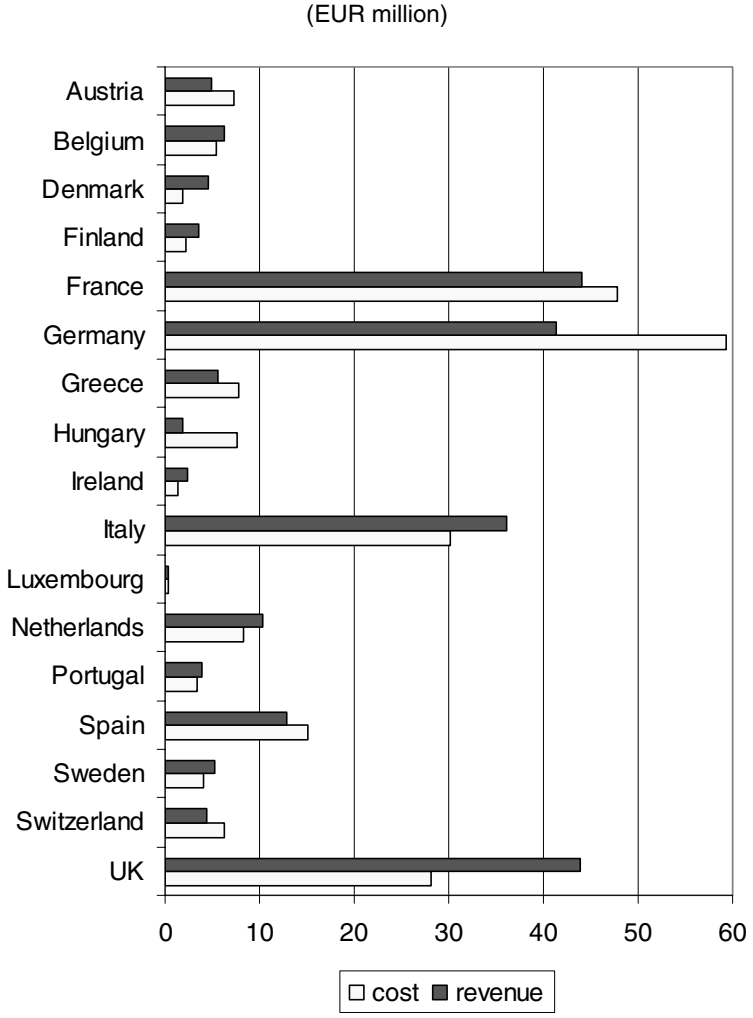


Source: OECD 2003.

Support for road and rail transport in the European Union, Hungary and Switzerland amounted to about USD 40 billion in 1998. This estimate is based on a broad definition of subsidies that compares total revenues with total social costs for each mode of transport (that is, that internalises externalities as discussed above). In nearly all countries, revenues from road transport cover the total social cost (Figure 1.3), whereas other modes of transport are heavily subsidised. Thus phasing out of transport subsidies would, in the short and medium term, divert traffic from other modes, especially rail, to road. Although there might be some reduction in the total amount of transport, any increase in road

transport would have negative effects on the environment. According to estimates prepared for this study, passenger and freight revenues cover, on average, 36% of rail system costs.

Figure 1.3. Road transport: total social cost and revenue, 1998



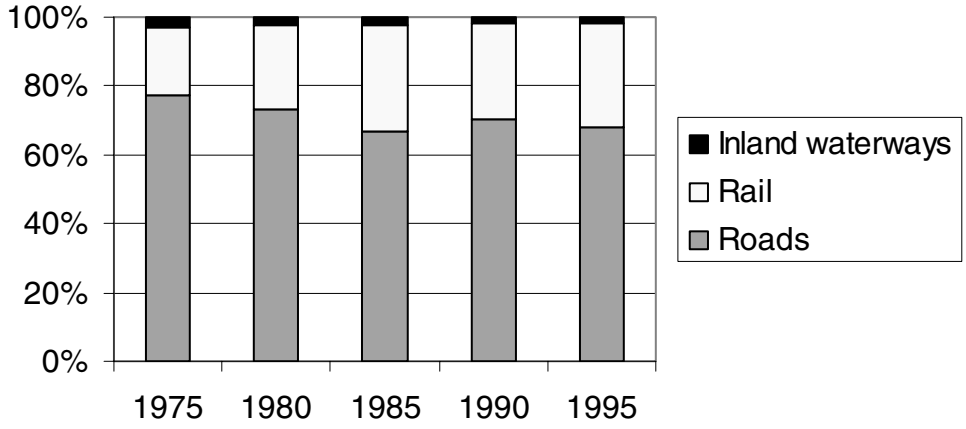
Source: Nash *et al.* (2002).

Investment in road infrastructure continues to dominate government infrastructure investment expenditures (Figure 1.4).[3] Although the figures do not show the magnitude of the subsidies in the transport sector, they do give an indication of the extent of government involvement in encouraging different modes of transport. According to European Conference of Ministers of Transport estimates, "positive transfers" amount to 23% of capital road infrastructure costs.

Estimates of support to energy consumption and production in the OECD area are either incomplete or very approximate. In 2001 the International Energy Agency estimated that subsidies to energy producers in OECD countries were running at around USD 20-30 billion a year. Other researchers (for example van Beers and de Moor 2001)

have suggested the actual number may be closer to USD 80 billion a year. Support to energy production usually takes the form of grants, loans and tax exemptions, which directly affect costs or prices, often in combination with indirect measures, such as those that flow from government interventions that skew the market in favour of a particular fuel or government-sponsored technology research and development.

Figure 1.4. Trends in investment share by transport mode in 18 OECD countries (1)

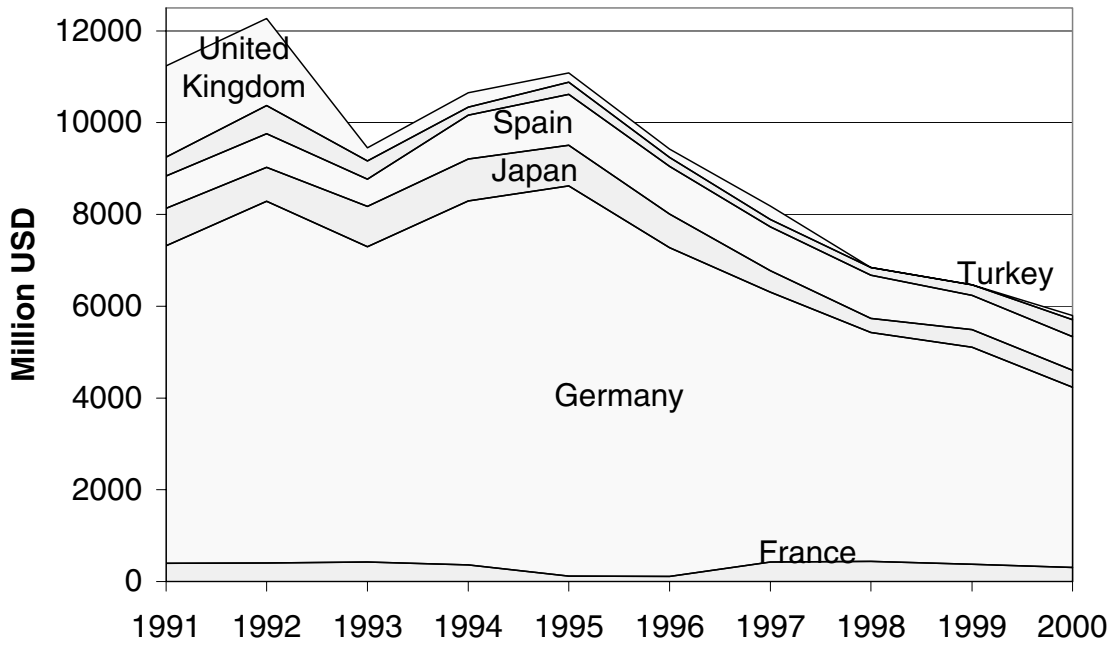


Notes: (1): The countries included are the 15 EU countries, Norway, Switzerland and Turkey.
Source: ECMT (2000b).

A third of these energy subsidies support coal production, although the support has declined from USD 11.4 billion in 1990 to USD 5.4 billion in 2000 (Figure 1.5). Coal production has also decreased dramatically in OECD countries so that there has been no major reduction in coal subsidies measured in USD per tonne of coal produced over the past ten years (Figure 1.6)[4]. Subsidised production is expected to decline further over the next few years, as coal production is expected to decrease further and several OECD countries plan to phase out their remaining subsidies.

Figure 1.5. Support to coal in selected OECD countries

(USD million)



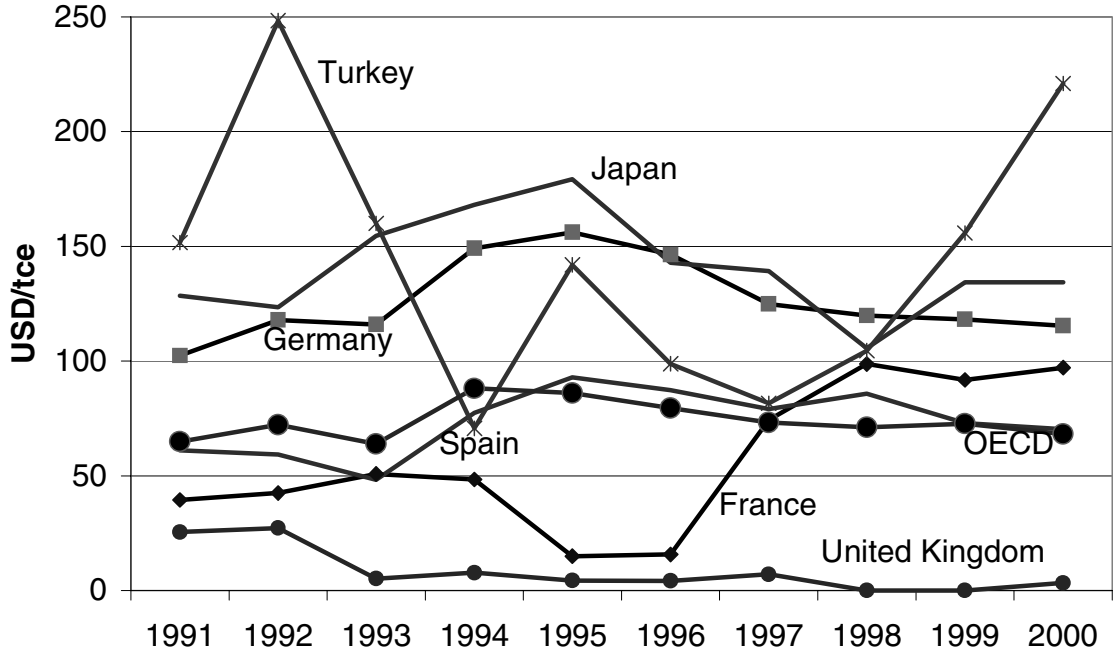
Source: IEA.

Data on subsidies to other forms of energy production, other than coal, relies on *ad hoc* studies such as those conducted by the IEA, the World Bank and independent researchers. The lack of a systematic collection of information on other energy subsidies at the international level represents a major gap in the information base. Reviews of member country energy policies undertaken by the IEA will only partially fill this gap.

The OECD Industry Committee has published several reports on support to industry in the early 1990s, with no updates published since that time. The reports presented public support in terms of Gross Government Budget Expenditure and Net Cost to Government (OECD, 1998a,b).[5] Support to manufacturing, measured in constant prices, declined in 1986-1989, reaching USD 37 billion in 1989 (OECD, 1998a). The support peaked at USD 46 billion in 1991 before declining to just under USD 44 billion in 1993. There was a 24% growth in support in nominal terms from 1989 to 1993, corresponding to a 4% decrease in constant terms during the period (OECD, 1998a). More recent data are available for the European Union which indicates that manufacturing subsidies have decreased over the past ten years (Figure 1.7). In the European Union, state aid to manufacturing amounted to about USD 22 billion in 2000.

Figure 1.6. Support per tonne of coal production in selected OECD countries

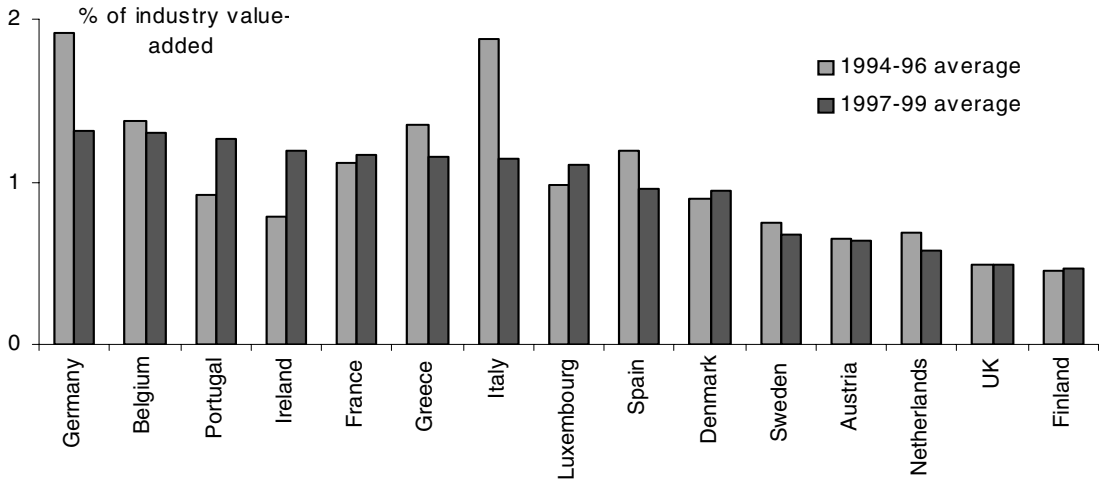
(USD/tce)



* tce = tonnes of coal equivalent.
Source: IEA.

Figure 1.7. State-aid to EU industry as a share of industry value-added

(percentage)

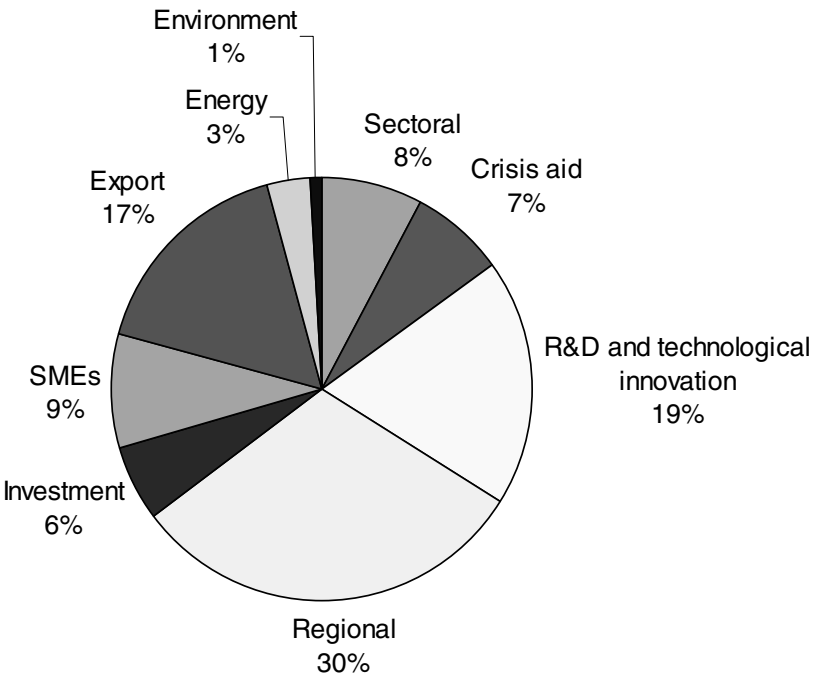


Note: Industry excludes the primary sector.
Source: Based on EC (1998, 2001*b*).

Industry support is increasingly being directed to horizontal objectives such as regional development, research and development (R&D) and small and medium-sized enterprises rather than to specific sectors such as steel and shipbuilding (Figure 1.8). Nowadays, support provided through tariffs and other border protection is generally very low in OECD countries for most manufactured products. Indirect means of support, such as public procurement, R&D contracts, and R&D intermediary institutions, channel far more financial resources to manufacturing industry than does direct support. As there is no agreed methodology for measuring the support element in indirect support, uncertainties remain as to its role as a policy instrument and, more specifically, as a tool of support to manufacturing industry.

Figure 1.8. Industrial support by policy objective, OECD

(as a % share of total support)

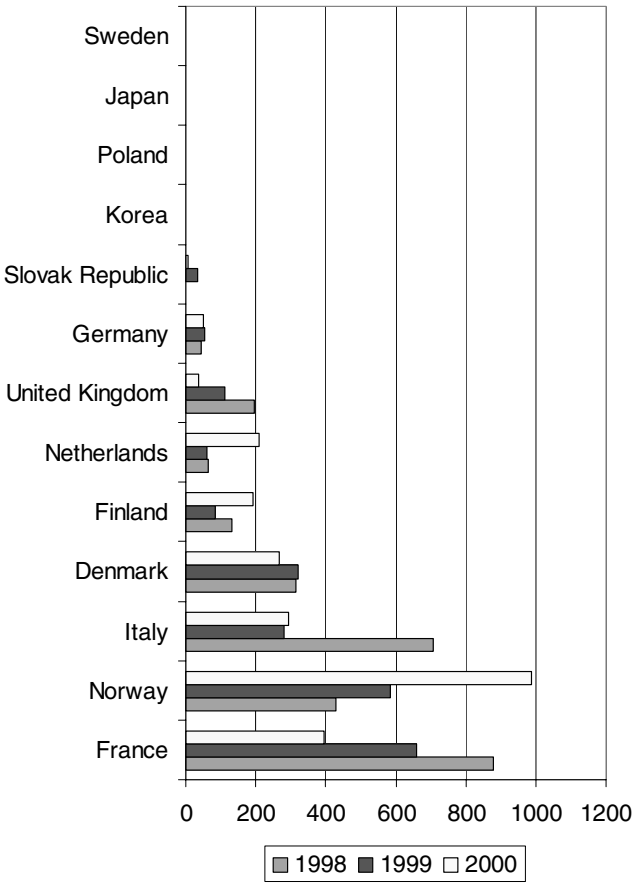


Source: OECD Industrial Support Database, OECD, 1998b.

Subsidies to the OECD shipbuilding and steel sectors have received particular attention in recent years due to heightened policy interest in the structural adjustment occurring in the sectors. The OECD collects information on government subsidies to shipbuilding by member and observer countries. Although it does not currently cover all member countries (as some have not provided the information), it covers most of the OECD area (and therefore global) shipbuilding production. In total, the responding countries provided grants and subsidies to the value of USD 2.7 billion for the years 1998 to 2000. This support was highest in 1998 when a total of almost USD 1.2 billion was provided, but clearly governments have begun to reduce their support as this amount declined in each of the two subsequent years. In order to get a more balanced picture of shipbuilding subsidies, it is useful to look at support per compensated gross tonne of output (Figure 1.9).

Figure 1.9. Support to shipbuilding in selected OECD countries

(USD per compensated gross tonne of output)



Source: OECD Secretariat.

OECD work on steel subsidies shows that subsidies have played a key role in creating and sustaining global over-capacity in steel. The assistance has been provided to meet a number of objectives. Grants, loans and related financial assistance, for example, have been used in developed and developing countries alike to promote the construction of facilities. Such support has been motivated by the strategic importance that governments often assign to the industry and the formidable costs associated with building facilities and providing needed infrastructure (such as port and transportation facilities and power utilities). The active promotion of investment in the industry continued in the OECD area up through the mid-1970s, at which time an economic recession and a less promising outlook suggested that over-expansion had occurred.

There is support among governments and private sector steel producers to reduce or, where possible, eliminate subsidies and related industry support in the context of trade negotiations. There have been a number of developments in this regard. For example, state aid to steel in the European Union has decreased dramatically over the past five years (Table 1.3).

Table 1.3. State aid for steel in the European Union

	USD million					
	1995	1996	1997	1998	1999	2000
Austria	4.6	4.6	4.0	4.0	3.7	2.3
Belgium	4.3	5.5	2.5	0.0	0.0	0.0
Denmark	0.0	0.0	0.0	0.0	0.0	0.0
Finland	0.0	0.0	0.0	0.0	0.0	0.0
France	0.0	10.3	0.0	0.0	0.0	0.0
Germany	104.3	6.2	2.5	0.0	0.0	0.0
Greece	0.0	0.0	25.6	0.0	0.0	0.0
Ireland	0.0	71.0	0.0	0.0	0.0	0.0
Italy	238.2	248.0	243.8	7.0	0.0	0.0
Luxembourg	2.6	0.0	0.0	0.0	0.0	0.0
Netherlands	0.0	0.0	0.0	0.0	0.0	0.0
Portugal	72.6	0.0	2.7	0.8	0.3	1.2
Spain	1729.1	209.1	85.8	34.6	32.1	0.0
Sweden	0.0	0.0	0.0	0.0	0.0	0.0
United Kingdom	0.0	0.0	0.0	0.0	0.0	0.0
Total	2155.7	554.6	366.8	46.4	36.1	3.5

Source: Ninth State Aid Survey, EU.

Many sectors other than those discussed above also benefit from subsidies and other forms of support, some of which may be environmentally harmful. However, the availability of subsidy data for these other sectors is very poor. For example, neither the OECD nor other international institutions have collected information on forestry subsidies and, consequently, there is no dataset on government transfers to the forest sector for OECD countries or for other groups of countries, although there are some anecdotal estimates on support to the forestry sector. Similarly, there are all too few data on water subsidies in almost all OECD countries. Some irrigation subsidies are included in the figures for agricultural support, although the information on these is often patchy and data gaps remain. Information on other sectors (such as tourism) is even sparser.

Where to Next on Subsidy Data?

The OECD has made significant progress in the measurement and analysis of subsidies for sectors such as agriculture, coal production and fisheries over the past twenty years. However, much remains to be done. Factors contributing to the relatively modest progress in measuring support for the other sectors range from complex methodological and data issues to a lack of political will to compile reliable and internationally comparable subsidy figures. Trade-offs are made both at national and international levels as data collection is often resource intensive and aggregate estimates of support are only as good as the underlying data. Although methodological and data constraints severely limit comparisons across sectors, work carried out by the OECD highlights agriculture as the sector with the largest support in absolute terms. While the

other sectors seem to pale in comparison, it is likely that support is underestimated for the other sectors due to incomplete coverage and methodological issues.

The review of subsidy data definitions and measurement undertaken for this project (Steenblik 2003) has highlighted a number of key areas for future work. Pursuit of these lines of research would significantly enhance the ability to identify the range of subsidies that may be potentially environmentally harmful and would make a valuable contribution to the transparent and systematic policy analysis of such subsidies. The key areas identified in the study are to:

- Continue work on subsidy data collection, improving methodologies and consistency across sectors and countries.
- Extend subsidy data collection efforts to cover those sectors where environmentally harmful subsidies are likely to be important (for example, energy, mining, forestry, aviation and manufacturing) and where current data are inadequate.
- Adopt a common reporting framework to help systematise data collection, reporting and transparency.
- Improve the publicly available documentation of subsidy programmes, data and methodologies.
- Undertake peer reviews of subsidy data and methodologies across disciplines, sectors and institutions.
- Encourage greater transparency and clarity of budget documents at national levels.

Assessment of Environmentally Harmful Subsidies

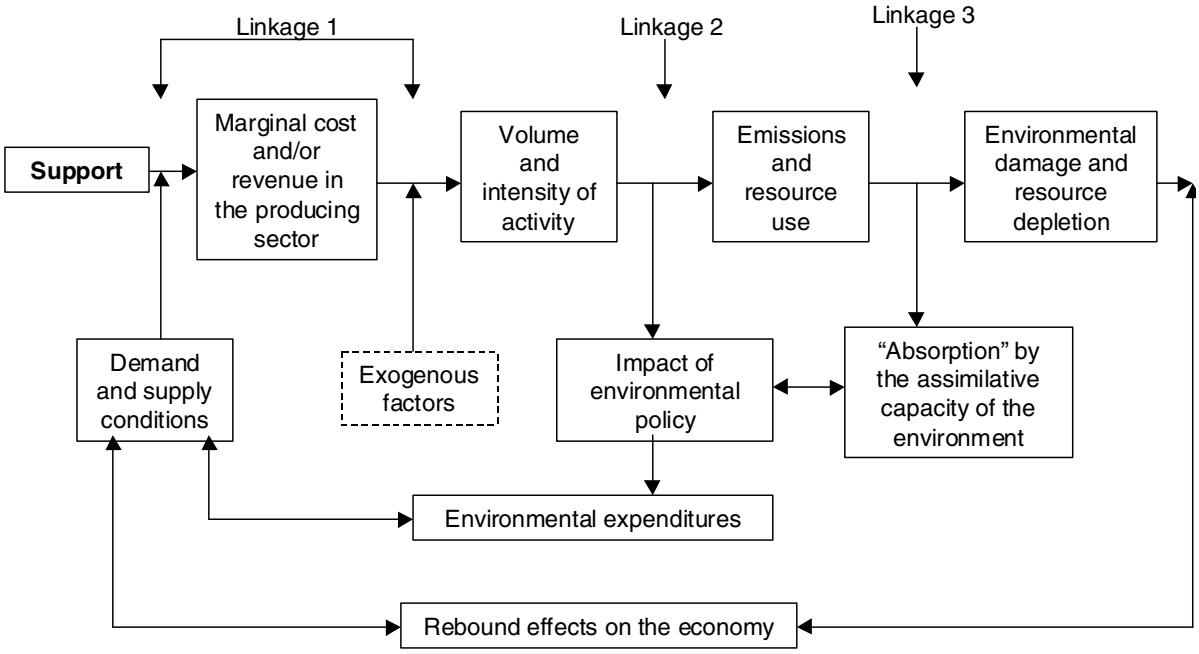
Shifting from identifying and measuring subsidies to determining their environmental impact is a major challenge. All production and consumption activities potentially have an impact on the environment. These impacts will be accentuated or attenuated by policies that governments put in place both in the economy and in specific sectors. In general, a subsidy is harmful to the environment if it leads to higher levels of waste and emissions, including those in the earlier stages of production and consumption, than what would be the case without the support measure. This includes higher levels of resource extraction than is socially optimal as well as impacts on biodiversity. Removing the subsidy would result in an improvement in environmental outcomes, as the benefits from removing the subsidy would be expected to exceed the cost of removing the subsidy. The main factors that determine the environmental effects of support measures are the:

- Level of protection from competition that support measures offer the recipient sector and the extent to which alternatives to the recipient sector are discouraged as a result;
- Environmental effects of the alternative products or technologies that are discouraged by the support measure, compared with those of the supported sector; and the
- Circumstances that determine how sensitive the environment is to the particular change in emission or waste levels brought about by the support measure.

The factors highlight the division between what governments can change, such as support policies and, to some extent, the emergence and use of cleaner technologies; and

what they cannot influence, including the dose-response relationship between particular emissions and environmental quality (OECD, 1998a). The environmental impact of support measures result from complex mechanisms that are far from being fully elucidated. Subsidies can have direct and indirect effects. There is no direct linkage between the volume and nature of the subsidy and the environmental impact. In Figure 1.10, the first linkage is the extent to which the support measure affects the composition of production in the economy. The second linkage measures the emissions that result from a volume of activity, excluding the impact of environmental policies.[6] This is a function of production and emission abatement techniques of the polluting sector and the type and effectiveness of the environmental policy in place (environmental policy "filter"). Environmental expenditure will then have a rebound effect on the economy (multiplier effect), and possibly on the support measures. The third linkage is the dose-response relationship describing the assimilative capacity of the environment, which shows the extent to which the increased emission levels or resource depletion lead to actual environmental damage. Environmental impacts will also produce rebound effects on the economy through health effects, depletion or deterioration of natural resources, higher production costs, and so on.

Figure 1.10. Linkages between support measures and environmental effects



Note: As with all analyses, results will be dependent on the chosen assumptions, methodologies and available data such that quantitative results will always be subject to some degree of uncertainty.

Source: OECD.

This analysis highlights the complexity of the linkages between support measures and environmental impacts. Existing studies on the environmental impacts of subsidies use different models, assumptions and data, and consequently the estimates are not directly comparable. However, they do give a good indication of the range of findings available from different studies on removing support in different countries, with different

assumptions and timescales. All studies show that removing support will have a positive effect on the environment, although sometimes the effect may be quite small.

In particular, decoupling subsidies from input use, production and consumption would bring economic, environmental and social benefits. Subsidies may have different initial points of impact, such as output, input or profits and income. Initial points of impact matter for two reasons. Subsidies to inputs affect other markets more than subsidies to outputs or profits and income. Generally speaking, subsidies that directly impact material flows have more direct effects on forward linkages than subsidies to output or profits and income. Such subsidies also leave fewer options for more benign modes of production to be employed than subsidies to output or income. Second, if input subsidies are conditional on the use of particular energy carriers or materials (including water), or particular types of capital equipment that require only certain types of energy carriers or materials, they will discourage materials and energy saving, on which the success of environmental policy is highly dependent.

Ideally, decision makers should have access to a thorough economic, social and environmental assessment of these linkages and the impacts of subsidies based on a complex set of general equilibrium analyses (to evaluate the dynamic effects of policy changes on the economy) and environmental impact evaluation techniques. In practice, the environmental impacts of subsidies are usually estimated with a partial or general equilibrium model, and the results are typically highly sensitive both to the model chosen and to the magnitude of the subsidies data used as model inputs. An exhaustive analytical approach, however, is not always possible due to technical and resource constraints and it is generally necessary to adopt a more pragmatic and simplified approach, such as the checklist approach discussed in the next section.

A Checklist Approach to Assessing Subsidies

As part of this study, a "checklist" framework was developed as a policy tool to assist in identifying those subsidies whose removal would benefit the environment. Since the environmental impacts of subsidies depend on numerous factors, the checklist cannot substitute for a thorough, empirical case-by-case analysis of the subsidies under consideration. It can, however, serve as an important "quick scan" of subsidies that are likely to yield environmental benefits when removed and identify the key factors that should be further examined in an in-depth analysis.

The checklist focuses on two interrelated issues: the effects of subsidy removal on the decisions of consumers and producers; and the linkages between those decisions and the environment. A schematic of the checklist is provided in Chart 1.1. The key stages in the checklist can be summarised as:

- *Policy filter*. What restrictions on production, pollution or resource depletion levels result from regulations, standards and similar policies and programmes? Importantly, do these constraints work as a cap on total pollution or resource damage, or are they only reduced by a proportionate amount?

- *Technology lock-in*. What technologies and products are likely to replace the previously subsidised products and modes of production, and how do the environmental profiles of these competing products and modes of production compare with those of the previously subsidised ones?

- *Conditionality of the subsidy*. What are the likely responses of the previously subsidised industries in terms of production volumes and rates of exploitation of natural resources? The answer to this question depends on the size and conditionality of the subsidy as well as the distribution of market power.

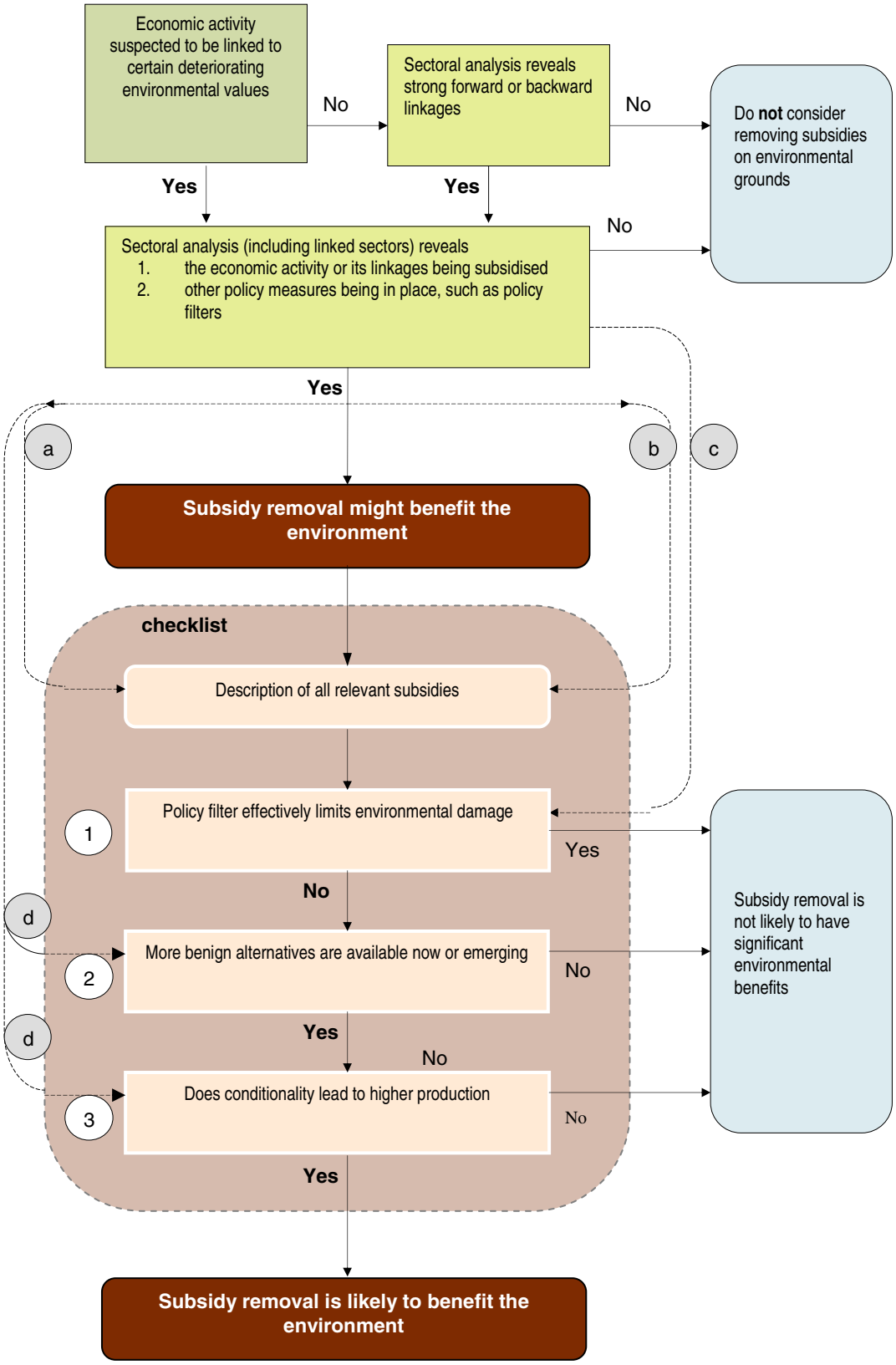
The checklist highlights the role of "policy filters" in terms of environmental management regimes in defining the environmental impacts of subsidies. If, for example, subsidies to fisheries are removed while the fish catch is limited by other measures, the effects of the subsidy removal may not be as significant as if there were no constraints on catch (as occurs in an open access fishery). Similarly, if fossil fuel subsidies for a particular transport mode are removed while infrastructure is a limiting factor in the ability of consumers or producers to switch to alternative modes of transport, the environmental effects of subsidy removal may not be significant.

At the same time, it is important to distinguish between those policy filters that are in place for the purposes of environmental management and those that have been imposed in response to environmental problems introduced as a result of the subsidy. The latter set of policy measures can be claimed to offset the environmental effects of the subsidy, but they would not be necessary if the subsidy programme had not been introduced. The mix of policies and the rationale for particular filters are therefore quite significant considerations in this stage of the checklist.

The checklist recognises the potentially important effect that subsidies have on the innovation and uptake of technologies that may be more environmentally beneficial than currently exist, particularly over the long term. The checklist is based on the assumption that, in the short-run, subsidies that reduce variable costs (such as energy and materials, including water) are more likely to impact on production (and thus emissions) than subsidies that lower fixed costs. The environmental harm of these subsidies is aggravated if they delay the development and dissemination of new technologies that increase resource productivity while cutting back on environmentally harmful effects. Other subsidies likely to have an environmentally harmful effect are those that lower the cost of access to natural resources, and capital subsidies that impede or thwart technological change, locking in potentially less efficient uses of energy and other materials.

The third key element of the checklist refers to the conditionality of the subsidy. Subsidies are always conditional on something. This could relate to the level of production, the use of particular inputs, and the introduction of a mandated technology, undertaking specific research and development or even to undertake an unspecified level of activity in a sector. Subsidies that are conditional on output have tended to attract the most policy attention, particularly in relation to market price support for agriculture, coal and manufacturing (steel and shipbuilding).

Chart 1.1. Flow chart of the checklist



Key Findings from the Sectoral Analyses

The checklist was applied to a number of sectors in order to assess its implementation as a policy tool and to identify areas for future work to refine and apply the methodology. The sectors were agriculture, fisheries, transport, energy, and water and the case studies are presented in the Annex to this report. The choice of sectors partly reflected the depth of existing analysis on subsides that was *available* and the policy priorities attached to subsidy reform in the sectors. Existing analytical and empirical work on the environmental impacts of subsidies, together with the OECD checklist for environmentally harmful subsidies, provided a good basis for initial identification of environmentally harmful subsidies. The following discussion summarises the key findings from the sectoral analyses.

Agriculture[7]

The quality of the environment appears to be especially sensitive to changes in agricultural production as agriculture is a major user of natural resources. Agricultural activities can generate environmental benefits including aesthetic value, water accumulation and supply, nutrient recycling and fixation, soil formation, wildlife protection and flood control, and carbon sequestration by trees and soil. However, major changes in farming practices have brought new pressures to bear on natural resources. Moreover, for many decades, agricultural policies in most OECD countries have encouraged the expansion of commodity production, including onto environmentally sensitive land.

The impacts of agricultural support measures on the environment depend on their effects on farm-level decision-making concerning the intensive (input use) or extensive (land use) degree of agricultural production. These impacts result from the relationships linking land quality, production practices, input use and environmental quality defined in terms of, for example, erosion, chemical run-off, leaching, landscape and biodiversity or wildlife habitats. In general, the more a policy measure provides an incentive to increase production of specific agricultural commodities, the greater is the incentive for monoculture, intensification (greater yields), or using marginal (environmentally sensitive) land, and the higher is the pressure on the environment. However, some restrictions or constraints on providing support (*e.g.* environmental cross-compliance[8] and regulations) may attenuate the environmental impacts of support measures. Moreover, the more a policy measure can be targeted to a specific environmental goal and situation, the greater is its potential effectiveness in achieving such a goal.

Analytical work on the agricultural support measures using the OECD's Policy Evaluation Model allows support measures to be ranked according to their relative impacts on the environment. All other things being equal, the main categories of PSE measures can be ranked according to their impact on the environment (Box 1.4). On this basis, market price support, output payments and input subsidies (such as fertilizer, pesticide and energy subsidies) are potentially more harmful for the environment than other types of support measures.

Box 1.4. Relative potential impacts of producer support measures in agriculture on the environment

All other things being equal, the main categories of PSE measures can be ranked according to their relative impacts on the environment as follows:

Market price support and *payments based on output* both increase the price received by producers for a specific commodity such that the more the commodity is produced, the higher will be the support. Thus, the higher these forms of support, the greater is the incentive for monoculture, for increasing the use of inputs (such as chemicals), and/or for using environmentally sensitive land, and the higher is the pressure on the environment**.** Moreover, these payments have the lowest effectiveness in achieving environmental goals, as they are sector-wide payments that cannot be targeted to any environmental goal or situation that are generally local.

Payments based on input use reduce the cost of inputs used by producers such that the more the input is used the higher will be the support. Thus, the higher these payments, the greater the incentive to use the input, and the greater the impact on production and the environment. The more the payment is specific to a variable input (*e.g.* fertilizer, pesticide) the greater the incentive for production intensification, and the pressure on the environment. For example, the environmental impact of a credit subsidy for purchasing fertilizers or pesticides is potentially higher than a credit subsidy for acquiring farm land or extending farm buildings. Therefore, these payments may have a higher, the same, or a lower effect on production and the environment than an output payment depending on the type of input on which the payment is based.

Payments based on area planted/animal numbers reduce the cost of land/livestock for current plantings/animal numbers. As producers have to plant a specific crop or own specific animals, these payments may be an incentive for keeping environmental sensitive land producing commodities non-environmentally-friendly in such land. Although these payments may be targeted to a specific environmental goal or situation, they provide an incentive to bring additional land or animals into specific production and encourage monoculture in the same way as the payments based on output. However, as producers are not encouraged to increase yields and to produce as intensively as they are with the forms of support outlined above, the environmental impact of these payments is potentially lower.

Payments based on historical entitlements (*i.e.* past support, area, animal numbers, production, or income) and *payments based on overall farming income* (paid on the condition that the overall farmers' income is below a pre-defined level) also have the potential for retaining environmentally sensitive areas under production. However, as to receive these payments producers are not obliged to plant, own animals, or produce any particular commodities, they allow for individual choices on environmentally friendly production techniques, and do not encourage production intensification and/or monoculture. Therefore, the impact of these payments on the environment is relatively benign or lower than the previous forms of support.

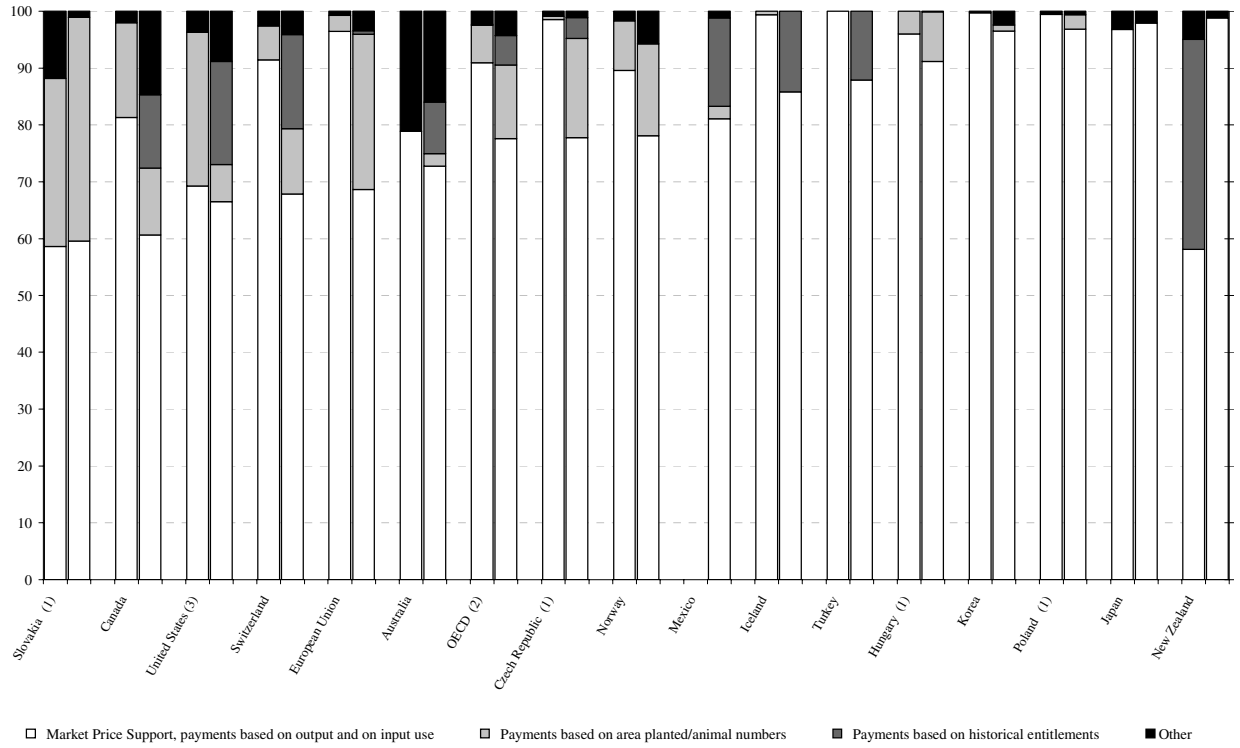
Payments based on input constraints are paid on the condition that farmers respect certain constraints (reduction, replacement or withdrawal) on the use of inputs often for environmental purposes. These payments may be targeted to specific environmental situations to address specific environmental issues associated with agriculture. They may contribute to offset the reduction on a positive environmental impact or the increase on a negative environmental impact of farming activities often benefiting from one or more of the previous forms of support. Mainly through input constraints that reduce production intensity, they encourage production diversification, or put environmentally sensitive land aside from production relative to what would otherwise occur. The environmental impacts of these payments depend on the type of constraint, but they have the potential for reducing environmental pressure and for being the most environmentally effective PSE measures.

Source: OECD (2002b).

Market price support, output payments and input subsidies, potentially the most harmful for the environment, accounted for 76% of OECD producer support in 2000-2002, which amounted on average to about USD 235 billion per year. While their share has decreased since the mid-80s, the shift to more transparent and less environmentally harmful forms of support has been slow. This share varies across countries, and is highest in the countries with the highest levels of support (Figure 1.11). While the share remains persistently high in Korea and Japan, it has decreased in Iceland, Norway and Switzerland due to a shift to less distorting support.

Figure 1.11. Composition of agricultural support by country, 1986-88 and 2000-02

(Percentage share in PSE)



Notes: Countries are ranked according to 2000-2002 levels of market price support and payments based on output.
1. For the Czech Republic, Hungary, Poland and the Slovak Republic 1986-88 is replaced by 1991-93.
2. For 1986-88, the Czech Republic, Hungary, Poland and the Slovak Republic are excluded.
3. Payments based on area planted for the 2000-2002 average provisionally include "Counter cyclical payments" granted in 2002.

Source: OECD, PSE/CSE database, 2003.

In general, the checklist provides a good starting point for the analysis of the environmental effects of subsidy removal in agriculture – to the extent that subsidies encourage an increased intensity in farming practices and farming on environmentally sensitive land, their removal could be expected to be beneficial to the environment, all other things being equal. By working through the step-by-step process of the checklist, it is evident that a number of other factors are also instrumental in shaping environmental outcomes when agricultural subsidies are removed, including the effectiveness of policy

filters in addressing environmental problems and likely emerging patterns of production with the removal of subsidies. The case study identified some of the main challenges in assessing the likely impacts of all these factors.

First, agricultural support measures can encourage agricultural production activities that impact on the environment in a variety of ways. Each of these effects can raise different policy issues; in some cases subsidies may even generate both positive and negative environmental effects over different dimensions of the environment. For example, the environmental impacts of the phasing out of a given support measure will differ across and within countries depending on the production response and the specific environmental conditions pertaining. Thus the net environmental impact cannot be determined a priori, but through empirical study. Accommodating these impacts effectively increases the dimensions in which the checklist is applied. On this basis it may therefore be necessary to identify key environmental priorities in relation to the application of the checklist for a given subsidy.

Second, agriculture is characterised by the heterogeneity of the natural resource base and production systems used by farmers. Therefore, environmental issues associated with farming are often site-specific, with the assimilative capacity of ecosystems together with production patterns and structures differing from place to place. This means that any links between farmers' production decisions and their environmental impacts can vary considerably across different locations. On this basis, the value of the application of the checklist in agriculture may crucially hinge on the quality of data held by policy makers with respect to local/regional conditions and production patterns.

Third, assessments of the environmental impacts of subsidies are complicated by the many environmental effects of other factors. Environmental effects are determined by a multitude of influences – including market developments, policies and other (exogenous) factors such as climatic events. Disentangling the influence these various factors have on environmental outcomes raises well-documented problems of identification and measurement, including the predominance of dispersed, non-point source pollution in agriculture and often lengthy delays in the manifestation of environmental outcomes. These issues present challenges in terms of deriving systemic conclusions from applying the checklist — for example, in assessing the effectiveness of policy filters.

The fourth challenge concerns the extent to which support provided by a given subsidy "leaks" away to upstream or downstream industries, the full environmental impacts of the removal of subsidies become difficult to predict, and depend on a range of factors including, amongst other things, on the characteristics of input and output markets.

Finally, the checklist only enumerates economic characteristics of subsidies that may serve as predictors for first order effects on those industries that are directly affected by the removal of a certain subsidy. The reasoning behind the checklist ignores wider macro-economic implications, such as the effects of subsidy removal on governments' budgets and consumers' incomes and their effects on the economy when recycled. However, such effects can be very significant in agriculture, given the magnitude of agricultural support and the growing significance of agri-environmental policy filters in OECD countries.

Fisheries[9]

The effects on fish stocks of removing subsidies to the fisheries sector depend critically on the management regime in place for particular fisheries and the effectiveness with which the regime is enforced. This key finding from the application of the checklist to the fisheries sector highlights the central role played by the policy filter in the analysis of fisheries subsidy reform. While the other aspects of the checklist are important, and may be particularly significant in some cases, the management parameters will largely determine the potential responsiveness of fishers to changes in subsidy policies. The actual response of fishers to changes in subsidies will depend on the bioeconomic situation of the fishery and the effectiveness of enforcement.

In the study, subsidies are defined broadly to cover all direct and potential transfers from the government to the fisheries sector, including "off-budget" items such as tax exemptions and loan guarantees. Note that this definition is broader than the WTO definition of subsidies drawn from the Agreement on Subsidies and Countervailing Measures as it includes expenditure on management, research and enforcement, and access agreements with other countries. Transfers are broadly classified into:

- Management, research and enforcement expenditure
  - Management (administration, international obligations)
  - Research (stock and economic assessment, productivity improvements, etc.)
  - Enforcement
- Infrastructure expenditure
  - Community infrastructure (lighthouses, navigation facilities, search and rescue services)
  - Fishery sector specific infrastructure (landing quays, auction halls, fishing ports)
- Payments for access to third country waters (comprising government-to-government payments not recouped from the fishing fleet)
- Subsidies for vessel decommissioning and licence retirement
  - Permanent capacity retirement (vessel scrapping, licence withdrawal)
  - Permanent capacity transfer (including joint ventures)
- Subsidies for labour retirement and retraining
- Subsidies to capital costs
  - Construction and modernisation
- Subsidies to variable costs (including direct payments, loan guarantees, fuel tax exemptions)
- Income support and unemployment insurance
  - Community income support (regional aid, small-scale fisheries aid, development aid)
  - Individual income support (direct payments to boat owners and employees)
  - Unemployment insurance
  - Temporary capacity retirement (laying up payments)
- Direct price support subsidies
  - Market stabilisation schemes, price guarantee schemes (other than border measures)
  - Marketing and promotion schemes.

Management regimes can be broadly classified according to four key aspects: whether there are any controls on fishers (that is, open access); the extent of catch controls; extent of effort controls; and the existence of property rights structures. Under open access, there is no control of the fishery in terms of either the amount of fish caught, fishing effort or property rights, so that fishers compete for available fish stocks. In general, the expected effects of subsidies are observed over the longer term — overexploitation of stocks, longer-term decline in catches, higher intra-marginal profits, increased capital and labour attracted to the industry, and resource rents reduced to zero. Depending on the starting point (whether the fishery is above or below the maximum sustainable yield), catches may rise in the short term as transfers increase the profitability of the industry before falling in the longer term as the stock is exploited beyond the maximum sustainable yield.

In a management regime where there is catch control, subsidies will not have an effect on fish stocks or catches of fish (by definition), although there may be problems of discarding and highgrading in some cases.[10] If there is no control on fishing effort (through restrictions on the number of boats or how they are used), then the intra-marginal profits will increase, attracting additional labour and capital to the sector with the result that resource rents are reduced to zero. The resulting potential for overcapitalisation of the fishing fleet could result in capacity spilling over into other fisheries or could increase pressure on fisheries management authorities to raise the allowable catch.

Effort controls primarily take the form of restrictions on the number, capacity and power of vessels that are allowed to operate in a fishery, the amount of time they are allowed to fish, and restrictions on the fishing gear and techniques that may be used. This method is useful for certain species or when insufficient scientific data for stock assessment are available. Despite the best efforts of regulators, it is difficult to identify and control all the variables that determine the effort that fishers can bring to bear on fish stocks and effective effort can expand their effort along uncontrolled dimensions (a process known as effort creep). This problem in turn makes it difficult for fisheries managers to set the appropriate level of effort controls as the effect of a given level of effort on catches and fish stocks necessarily remains uncertain. Moreover, the effect is unlikely to remain constant over time as the industry adapts and reacts to new restrictions, thereby resulting in a race between the development and application of new regulations on the one hand and the introduction of effort-increasing measures by fishers on the other.

The addition of regimes based on property rights to the use of catch and effort controls adds a further dimension to the available menu of management regimes. Property rights can be used in conjunction with either catch controls or effort controls, with the most common form of property right being individual quota rights (which may or may not be tradable). Rights-based regimes significantly alter the incentive structure facing fishers. They no longer have the incentive to race for fish as they can concentrate their efforts on catching their allowable catch in order to maximise profits. Nor do they have an incentive to increase the fishing power of their boats beyond that which is needed to catch their allocation at minimum cost. Individual rights can also be defined for fishing effort, although this is less common in practice. The use of territorial use rights or community management schemes may also result in appropriate incentives for fishermen to limit their fishing effort to agreed levels.

Application of the checklist to the range of subsidies listed above demonstrates that, in general, the environmental effects of removing subsidies fall between two extremes. At one end of the management spectrum, removing subsidies that reduce the capital and operating costs of fishers or increase their incomes will reduce pressure on fish stocks in those fisheries characterised by open access. However, the removal of such subsidies may not be sufficient to restore stocks in the absence of the appropriate management being introduced to restrain catch or effort. There is still an incentive for intra-marginal vessels to increase their catch and effort. In contrast, at the other end of the management spectrum, the removal of subsidies in fisheries characterised by fully enforced property rights and catch controls will not, in principle, have any effect on fish stocks.

Between these two ends of the spectrum, the effects of subsidy removal are difficult to gauge precisely and will depend on the specifics of the subsidy programme, the management regime and the effectiveness of enforcement. Particular concerns may arise in the case of effort controls where removing subsidies to inputs will alter the price signals to fishers and may better reflect true prices, but may not address the problem of effort creep.

The results from this broad application of the checklist assume that the management regimes are perfectly and effectively monitored and enforced. Relaxation of this assumption may assist in better explaining real world behaviour, but will also increase the complexity of the analysis and alter some of the conclusions. For example, weak enforcement of property rights or catch limits in a fishery could mean that the effects of a subsidy on the environment are closer to those associated with open access. Determining the effectiveness of the policy setting and monitoring and enforcement can only be done on a case-by-case basis and raises a myriad of issues relating to governance, institutional arrangements and political economy (lobbying, rent-seeking, and so on), some of which are discussed below.

Subsidies provided in the form of government provision of management, research and enforcement services (collectively called fisheries services) and fisheries-related infrastructure pose an additional issue relating to the public good nature of fisheries management. Clearly, fisheries services are essential for the sustainable use of fisheries resources. Similarly, the provision of infrastructure is required for the proper functioning of management and the sector. There are grounds for considering that some of the fisheries services and infrastructure have public goods aspects and, in this regard, free provision by the government is an essential part of the management role of governments. Removal of the transfer by not undertaking the service or providing the infrastructure would have adverse effects on the environment.

There are, however, some components of both fisheries services and infrastructure that do not have public good characteristics and for which removal of the support element through cost recovery would result in either no or positive environmental effects. This is reflected in the increasing use of cost recovery and user charging schemes in OECD countries where the beneficiaries of fisheries services and fisheries infrastructure can be identified and charged accordingly.

The analysis also assumes that the subsidies are applied to the fishery in the absence of other policy interventions. The concurrent application of subsidy and other policies may either magnify or offset the environmental effects of the subsidy. For example, the

provision of subsidies to both capital and variable costs will reinforce the environmental effects by lowering the costs of fishing more than would have otherwise have been the case with just one of the subsidies. Alternatively, offsetting subsidies arises where countries provide subsidies for both vessel decommissioning and vessel construction, a situation which has been observed in a number of OECD countries.

The analysis has focused on the effects of subsidies on fish stocks: no account is taken of the broader range of environmental variables that may be of analytical and policy interest. These include, for example, the effects of subsidies on by-catch, the marine benthos, marine pollution and the fuel used in fishing operations. Subsidies to particular types of gear use or to fuel use will have environmental effects beyond the target fish stock and need to be taken into account in the checklist. However, it should be underlined that the key policy concern to date has been the effects on fish stocks.

Finally, the results may be more complex for multi-species fisheries, as opposed to the single species fisheries that have been assumed in the study. In multi-species fisheries, operators harvest a range of fish species using a variety of gears and often in different geographical locations. There is also often a variety of management instruments applied to the different species within a particular fishery. Fishers are likely to have greater scope for shifting operations, costs and revenues between species to maximise profits. As a result, it is harder to trace and isolate the effects of subsidies on fish stocks.

Many fisheries in OECD countries are managed with a combination of these broad types of management measures. For example, many countries use catch control regimes in conjunction with limited entry systems for fishing vessels or licensing for fishers. Only a few countries employ full property rights regimes in conjunction with catch control (such as individual transferable quotas). However, the effectiveness of Member countries enforcement capabilities is debatable and subsidy programmes may, therefore, have a negative effect on fish resources.

Transport[11]

The range of subsidies addressed in the analysis of the transport sector includes both explicit and implicit subsidies. Explicit subsidies such as direct payments, low interest loans, favourable tax treatment and under pricing of access to infrastructure, are used to secure the provision of public transport and to encourage the use of rail transport for freight. Implicit subsidies arise from failing to fully charge for the external costs of private cars, road freight transport and air transport. In general, there tends to be a concentration of explicit subsidies on more environmentally friendly modes of transport, such as public passenger transport and rail freight, while implicit subsidies tend to be provided on modes that are potentially more environmentally harmful, such as private cars, road haulage and air transport.

The justification for subsidies to public passenger transport is usually a combination of the desire to promote access to facilities to reduce social exclusion for those without private transport, and the wish to promote more environmentally friendly modes of transport for those with private cars. Both of these reasons may in principle be valid, although the latter is a second best argument (it is only valid if other modes are not appropriately charged for the externalities they cause). That there are good reasons in principle for subsidies does not mean that they are always effective in practice. In particular, when they are awarded to existing public or private monopolies, rather than by

competitive tender, they may serve to reduce efficiency and increase wages rather than to lead to the provision of more services and lower fares.

The net environmental effect of removing subsidies to public passenger transport is not as clear-cut as might be imagined, but is probably negative. The net effect depends on load factors achieved on public transport and the exact technology used, as well as on the degree to which additional public transport trips are diverted from more environmentally damaging modes. To the extent that public transport subsidies promote additional trips, longer trips, or the substitution of public transport for walking or cycling, such subsidies are environmentally damaging. On the other hand, by reducing trips made by private car, and provided that reasonable load factors are achieved on public transport, such subsidies may be environmentally beneficial.

The removal of subsidies to rail freight is unlikely to result in benefits to the environment. The main justification given for such subsidies is to encourage traffic to use rail rather than the more environmentally damaging mode of road haulage. While it would be better to deal with the problem by levying appropriate charges on road haulage, a case would remain for subsidies to allow rail freight access to the rail infrastructure at marginal rather than full cost, in the light of economies of scale in the provision of infrastructure.

Subsidies for rail freight may be large and long standing, tied to fixed assets and are generally conditional upon use of a particular mode of transport. Thus the potential for technology lock-in is large. Moreover, because the use of rail freight may lead firms to investments that tie them to particular locations, sources of supply and distribution systems, lock-in is a particularly important issue in this case.

Throughout the world, the private car is taxed, but its use imposes costs on the provider of the infrastructure, on other road users in the form of congestion and accidents, and on the community in general in the form of environmental costs. The relationship between these taxes and external costs varies between countries, between locations within a country, and by time of day. However, in urban areas cars are not usually charged fully for the external costs they impose, thus providing an implicit subsidy to motoring.

The subsidy to private motoring through the failure to charge its external costs emerges as a subsidy, the removal of which is clearly likely to bestow significant environmental benefits. While there are policy filters ameliorating the effects of the subsidy (in the forms of emissions standards, environmentally relevant taxes and physical constraints through traffic management schemes and controls on parking), these by no means fully offset the damage caused by the subsidies. There are also more benign alternatives available in the form of public transport and walking and cycling, although these are more competitive for some kinds of trip than others. Use of private motoring tends to lock users into location and trip-making patterns that are too decentralised and diverse to be readily served by other modes, so there is an acute lock-in effect. The failure to charge private cars appropriately for external costs fails to give due encouragement to alternative-fuelled or other less polluting vehicles, which may be a more benign alternative.

There are many barriers, however, to the removal of the subsidy, grouped into:

- Technological, concerning the cost and reliability of equipment that can accurately reflect the variability of such costs;
- Institutional, where the layers of government most concerned may lack the powers to do anything about addressing the subsidy; and
- Political, as road pricing is often regarded as unacceptable on grounds of equity or due to potential long-term effects, for instance on land use.

The case of road haulage is similar to that of the private car in that the divergence between price and marginal social cost varies greatly in time and space. However, there is an important difference in that part of the issue with goods vehicles is the wear and tear to the roads by vehicles with high axle weights. This varies with the strength of the road, so the damage tends to be greater on more minor roads. The result is a case for a kilometre-related charge which varies with the characteristics of the vehicle and of the road on which it is travelling, quite apart from the issue of congestion and environmental effects. Whilst some countries have, or are proposing, kilometre-based charges for goods vehicles, none yet has a differentiated system that would be implied by the structure of marginal social cost.

The removal of the explicit subsidy to road haulage would be likely to have significant environmental benefits, although perhaps not as great as in the case of the private car because the magnitude of subsidies as a proportion of costs and their effect on traffic levels is less. Barriers to appropriate charging for road haulage may again be grouped into technological, institutional and political barriers. The existence of kilometre-based charges in Switzerland and New Zealand, and their proposed introduction in Germany and Great Britain, suggests that technological barriers are no longer significant: the appropriate fitting of heavy goods vehicles is not as mammoth a task as fitting the complete stock of cars for congestion charging. However, there are institutional and political concerns, particularly where charges affect vehicles registered or operating in one country rather than another. Within Europe, there is a need for a common approach, as in other closely related markets. Acceptability issues are largely related to the effect of appropriate charges on competitiveness, especially in more peripheral countries and regions.

As well as receiving some explicit subsidies from governments to cover losses, and for the research and development of new aircraft, air transport is a major recipient of implicit subsidies. It is generally free from VAT and fuel tax, which means that it is favourably treated relative to other products and pays nothing for the externalities it causes (some countries do have a departure tax which at least partly offsets this). Airport landing charges also frequently fail to reflect the full external costs of use of the airport, including the opportunity cost of scarce capacity.

Overall, air transport appears to be a case where the removal of both explicit and implicit subsidies would be likely to offer significant environmental benefits. Noise and emissions standards, and restrictions on the times of flights (at least for noisier aircraft) act as a policy filter which reduces without eliminating the external cost of additional flights. For shorter distance flights, rail may offer an alternative which is less environmentally damaging. For longer flights, the only real alternative is to travel less, substituting telecommunications for business travel and other leisure activities for leisure

travel. The size of the explicit and implicit subsidies vary a lot from case to case but can be large, especially relative to some of the fares charged by low cost airlines.

In summary, in the transport sector, subsidies are defined according to the relationship between price and marginal social cost, rather than a narrow accounting definition of subsidies, for their removal within the transport sector to be environmentally beneficial. Moreover, circumstances in the transport sector mean that a clear answer will usually only follow from detailed modelling of specific cases. It is necessary to not only model carefully the interactions between the different transport modes, but to also consider location and land use decisions which are often relevant. The full effects of reforming transport pricing will only be felt in the long run. Because of these interactions between modes, it is important to consider packages of measures affecting all the modes together rather than individual modes in isolation.

Energy[12]

There is no consensus definition of energy subsidies. The study for this project uses a fairly narrow definition, with subsidies being defined as any government action that concerns primarily the energy sector that lowers the cost of energy production, raises the price received by energy producers or lowers the price paid by energy consumers. In contrast to the transport sector, environmental externalities are not considered subsidies under this definition.

The environmental effects of energy subsidy reform depend on various interdependent factors, including:

- targeted energy sources
- the size of subsidies
- types of subsidies
- energy system circumstances
- policy circumstances, and
- general equilibrium effects.

All else being equal, a subsidy's targeted fuel or energy source is the principal indication of whether reforming the subsidy would be environmentally beneficial. The production, transport and use of all types of energy entail negative environmental externalities so, at first glance, any subsidy that results in greater energy use harms the environment. But there are vast differences in the potential environmental harm associated with different fuels and energy sources. In many cases, the relevant question is not whether a subsidy causes harm, but whether the energy source it supports causes more or less harm than an alternative energy source.

In general, subsidies supporting fossil fuels — particularly coal and oil — represent greater threats to the environment than those that aid renewable energy sources. With respect to support to nuclear power, on the one hand some countries consider that it can be environmentally beneficial, as long as appropriate measures are taken to ensure safety, because the use of nuclear power contributes to the reduction of greenhouse gases. On the other hand, since some other countries do not consider that nuclear power is an environmentally beneficial form of energy, support to nuclear power does not contribute

to sustainable development. Subsidies to renewable energy are generally considered, on balance, environmentally beneficial, although the full range of environmental effects of renewable energy (including those beyond the energy sector) also needs to be taken into account.

Because of these general environmental profiles, and because of the pervasiveness of the aid involved, oil and coal subsidies have received the greatest policy attention in moves to reform subsidies. Nuclear power subsidies, which are mostly in the form of publicly-funded R&D, receive somewhat less attention. This is probably because funding has being declining in recent years and also because the link between the subsidies and any increases in nuclear power production or changes in nuclear prices is more tenuous.

The impact of subsidy reform also depends on the types of subsidies involved, as different types of subsidies influence energy markets in different ways (Table 1.4). Some subsidies target current production (*e.g.* production grants); others address future production (*e.g.* R&D); others address future obligations (*e.g.* government assistance to environmental trust funds).[13] Some use direct payments; others use indirect arrangements involving market rules. Some are directed at price; others at costs (operating costs and capital investment costs). In addition, they often target specific activities and entail obligations for the recipient, for example, producing energy by a particular method (*e.g.* producing oil by enhanced recovery methods) or requiring that certain facilities to be modernised or shutdown. In OECD countries, subsidies aimed at reducing the costs of producing and using energy predominate. Subsidies targeted directly at energy prices are declining in importance.

Untangling the market and environmental impacts of these myriad interventions is difficult. However, a few generalisations might be made. Reforming policies aimed directly at prices probably have the most immediate and predictable effects on the market. The effects of reforming aid that reduces production costs will depend on the recipients' ability and willingness to compensate for their lost aid. In some cases, the recipients' behaviour will not change at all; that is, there are free riders. Other recipients may be able to cut costs and remain competitive. Still others may have no options to remain competitive and be forced to halt production.

Subsidies to infrastructure (which target both current and future production) lead to a certain degree of technology/fuel lock-in and affect markets long after the aid ceases. Aid to future production in the form of R&D is less clear in its effects than other forms. Some R&D spending will result in commercially viable technologies and others will not. For R&D that results in commercial technology, the market potency (impacts per amount of money spent) could be very high.

Table 1.4. Environmental effects of various types of energy subsidy

Government intervention	Example	How the subsidy usually works			
		Lowers cost of energy production	Lowers energy prices	Lowers cost of energy consumption	Raises energy prices
Direct financial transfers and preferential lending	Grants to producers	●	?		
	Grants to consumers			●	
	Low-interest or preferential loans to producers	●	?		
Preferential income tax treatment	Rebates or exemptions on royalties, duties, producer levies and tariffs	●	?		
	Tax credit	●	?	●	
	Accelerated depreciation allowances on energy supply equipment	●	?		
Differentiated energy sales taxes	Below-standard value added taxes (VATs)		●		
	Excise taxes				●
Trade restrictions	Quotas, technical restrictions and trade embargoes				●
Energy-related services provided directly by government at less than full cost	Direct investment in energy infrastructure	●	?		
	Public research and development	●	?		
	Preferential tariffs provided by state-owned energy companies		●		
Regulation of the energy sector	Demand guarantees and mandated deployment rates	●	?		●
	Price controls		●		
	Market-access restrictions				●

● direct effect
? indirect effect, varying in terms of degree and timing.

Source: Adapted from UNEP and IEA (2002)

Policies aimed at lowering the cost of energy production are the most common type of energy subsidy used in OECD countries. These subsidies can take many forms, including grants, loans with special terms, preferential tax treatment, direct investment in energy infrastructure, R&D, and market regulations. Assuming that most energy producers are price-takers in competitive markets, reforming production-cost subsidies would not be likely to alter prices much in the short term. In the face of import competition, there would be limited opportunities to raise prices to cover lost subsidy benefits. An exception would be in monopoly situations, such as some electricity markets, where prices are

regulated and tied to cost. A more significant short-term response would be the decreased competitiveness and decreased production of the fuel concerned, and increases in imports and closely competitive alternative fuels. In the longer-term, reforming production-cost subsidies may lead to significant shifts in fuel competition as new cost regimes and technological change are factored into energy investment decisions.

OECD countries have relatively few subsidies aimed directly at lowering energy prices. Those that are used include: below-standard rates for duties and value added taxes (VAT), cross-subsidised tariffs for rural and remote electricity consumers, preferential contracts between state-owned electricity suppliers and energy-intensive industries (*e.g.* aluminium smelters), and emergency price controls. The more common method of lowering energy prices is through the indirect long-term effects of the production-cost subsidies described previously. Reform of these subsidies would lead to lower prices and shifts in fuel use once energy producers have adapted their processes to the new cost regimes and technological change.

Other aid seeks to lower energy costs by reducing the costs of energy-saving measures. Examples include: funding insulation for low income homes, giving tax preferences to purchases of high-efficiency equipment and efficiency-improving products, and supporting energy audits. These types of subsidies are usually tied to economic, environmental or other social (*e.g.* fuel poverty) goals. Reducing them would lead to decreased energy efficiency, and thus increased energy consumption and harm to the environment. However, careful examination is required of the public policy grounds for providing such subsidies to ensure that a subsidy is the most appropriate mechanism for achieving energy conservation objectives (for example, targeted taxes may be an alternative).

The most common government interventions that raise energy prices in OECD countries are energy taxes, market access restrictions, demand guarantees and mandated deployment rates. Many excise taxes can be considered subsidy offsets or negative subsidies, because they take money away from the energy sector. Those excise taxes that are tied to trust funds for taking care of future environmental and health obligations are not subsidy offsets, however. They are essentially obligatory prepayments toward future liabilities. Market access restrictions can also raise energy prices, by limiting competition that might drive production costs and prices down;

An energy system can react in various ways to subsidy reform. There can be a decline in consumption, a decline in production, a shift to imports, or a shift to alternate fuels. Mostly likely all of these changes would occur to some extent, and would differ in the short and long terms. The relative size of each change would depend on the *particular* circumstances and constraints of the energy system involved. Among the relevant factors that need to be considered in the context of the checklist are:

- To what extent would the subsidy recipients be competitive without the aid? How much free riding is there?
- Is the transportation system (ports, pipelines, inland transportation systems, etc.) equipped to handle additional imports? If not, how quickly could it be?
- Are cost-competitive alternative fuels available? Is their production capacity and the transportation infrastructure adequate to handle the extra demand? If not, how quickly could they be?

- How elastic is demand?
- What is the status of long-term contracts? How prevalent are they in the market concerned? Are major contracts due for renegotiation soon? How flexible are the contracts in the face of government-induced market shifts, such as subsidy reform?
- Are the major consumers (*e.g.* particularly electricity producers) equipped to handle alternative fuels? If not, is a major period of capital investment — either to meet expected growth or to renew aging facilities — foreseen? What are the growth segments of the energy system? Could plant construction or rehabilitation facilitate a transition to alternative fuels?

Subsidy reform does not occur in a policy vacuum. It is likely to be accompanied by a variety of related policy changes that reflect the energy policy priorities of the time. There might be replacement policies to address some of the reformed subsidy's original goals, rule changes to attain further market liberalisation or new policies to tackle climate change and other environmental goals. In this regard, a number of important factors must be considered.

First, subsidy reform needs to include a thorough examination of the public-interest purposes (as opposed to the purely political goals) of the subsidies (for example, promoting domestic supplies in the name of energy security or employment, enhancing regional economic development, increasing energy diversity or mitigating energy's environmental impacts). Second, there could be a variety of concurrent policy reforms accompanying subsidy removal. For example, the reform of coal subsidies in the UK in the early 1990s occurred when the electricity supply industry was undergoing radical reforms. Many components of the electricity production and distribution system were unbundled and privatised. Lastly, there are issues as to what would be done with public budget savings resulting from subsidy reform. They could conceivably be used to fund a wide variety of programmes, including general tax cuts, government debt reduction, alternative energy programmes to environmental cleanup activities.

The energy sector shifts and public budget changes described in the preceding sections will have ramifications throughout the economy. Prices will change and certain sectors will expand and others will decline. The full consequences of these changes can only be assessed with multi-sector general equilibrium models, or sometimes partial equilibrium models. Current models, however, are not yet capable of measuring the trade or environmental effects of individual government interventions. They have had to use "price gaps" (essentially, the difference between domestic and world prices) as a proxy for the cumulative effects of all energy sector interventions.

The analysis of environmentally harmful subsidies in the energy sector for the project moved from the general to the specific by examining the cases of Germany and the United States. In the case of Germany, subsidies are primarily provided to coal and renewable energy production and to nuclear fusion R&D.[14] The United States subsidises all energy sources to some degree.

Based on the externalities of German power generation, it appears that the coal subsidies are environmentally harmful, while those for renewables are less so. However, reforming German coal subsidies would probably not yield environmental benefit in the short term. In this timeframe, the coal shortfall would probably be met through increased coal imports, which would entail increased ocean transport. In the medium and longer terms, as the markets react to the ensuing higher coal prices, there would probably be

increased use of gas and renewables (both entailing lower externalities than coal) in Germany and elsewhere. The mix would be influenced by, among other things, the adequacy of the gas infrastructure and the rate of cost improvements of renewable sources. In addition, the various mechanisms and programmes adopted to meet Kyoto Protocol requirements would probably favour the use of renewables and gas. Overall, the reform of German coal subsidies would lead to declines in CO_2, SO_2 and particulates emissions, and an increase in NO_X emissions.

In the United States, the target profile of aid (including direct payments, tax expenditures and R&D expenditures) in terms of fuel type is: gas (27%), renewables (19%), electricity (10%), nuclear (10%), oil (9%), end use (9%), coal (8%), conservation (4%), and oil, gas and coal combined (3%). Most of the subsidies support newer technologies for extracting fuels from difficult geological formations, transforming energy resources with less environmental harm and using energy more efficiently.

Over 40% of U.S. subsidies go to tax exemptions that lower the cost of energy production. Some benefit conventional production — being artefacts of the historical preferences given to natural resource enterprises. Reform of these subsidies would lead to production decreases. Other tax exemptions seek to promote particular non-conventional resources and efficiency activities. Reforming these subsidies could lead to cutbacks in the various activities, and may result in reduction in benefits flowing to the environment. Once again, however, there is a need to ensure that subsidies are the most appropriate mechanism for achieving particular conservation and efficiency objectives.

About a third of U.S. energy subsidies are for R&D. Most of this is targeted at nuclear energy waste/fuel/safety issues, end use efficiency, clean coal technologies and renewable energy. Reforming these subsidies could lead to reduced opportunities for less environmentally harmful technologies in the future. The final quarter of the subsidies are paid to consumers to decrease their costs of energy consumption. Reforming the two programmes in this category may or may not lead to environmental benefits, but would probably lead to decreased comfort and hardship among the poor.

Water[15]

Subsidies to the water sector, in this analysis, encompass not only subsidies for water services (water supply and sewerage), but all types of subsidies that contribute directly or indirectly to the quality of water resources available for use or to the quantity of water resources actually used. They are provided at various stages along the water cycle: water abstraction; water storage, supply and distribution; water use; waste water collection; and waste water treatment. The subsidies are provided both directly and indirectly. Direct subsidies take the form of direct payments, low interest loans/grants and debt reductions. Indirect subsidies occur if the system of water prices in place does not adequately reflect all of the true costs involved in producing that service and is primarily reflected in the under-pricing of water and water services and the cross-subsidisation between water users. As was noted earlier in this report, however, the amount of subsidies provided to the water sector and the relative magnitude of subsidies to the various stages of the water cycle are unknown.

The potential environmental effects of removing subsidies to water at the various stages of the water cycle are generally positive for the environment, particularly at the early stage of the water cycle. However, there are cases where the removal of subsidies may result in adverse environmental effects. The potential effects of subsidy removal are summarised in Table 1.5. It should be noted that the results are of a general nature and

that site-specific characteristics may vary significantly both between and within countries, and need to be incorporated into the analysis. However, some broad observations can be made about the application of the checklist and the key issues that arise.

Table 1.5. Possible effects of subsidy removal in the water sector

Category	Description of the Subsidy	Possible Effects of Subsidy Removal
Water Abstraction	- Underpricing; - Substandard rates of return; - Financial assistance for irrigation water abstraction; - Indirect subsidy via tax exemption (*e.g.* groundwater abstraction tax); - Compensation payments for environmentally friendly farming practices.	- Decreased cultivation of water intensive crops; - Deterioration of abstraction infrastructure with adverse effects on the environment; - Elimination of technological lock-in effects.
Water Storage, Supply and Distribution	*Network* - Low interest loans or debt relief for investment in infrastructure; - Substandard rate of return; - Underpricing; - Tax exemptions (*e.g.* Value Added Tax); - Financial support to operation and maintenance; - Subsidies for building new and upgrading existing water plants; *Agriculture* - Irrigation water provision below costs; - Financial supporting schemes for investments or maintenance and operation of irrigation systems; *Industry* - Underpricing; *Households* - Prices below cost recovery; - Low interest loans for constructing infrastructure for water supply to households; - Financial support for investments in water works supplying households; - Retrofitting of water-using installations (flush toilets or showers).	- Elimination of subsidy induced technological lock-in effects; - Environmentally more benign techniques may lose out against environmentally less friendly but lower priced options; - Reduced investment in irrigation infrastructure; - Signalling function of prices both for water itself as for water-intensive products is restored; - Decreased cultivation of water intensive crops.
Water Use	*Agriculture* - Underpricing; - Cross-subsidisation; - Tax exemptions. *Industry* - Exempted from certain taxation schemes; - Underpricing. *Households* - Cross-subsidisation; - Underpricing; - Financial assistance for installing certain equipment, such as water saving appliances.	- Adjustment of water use to change in prices; - Removal of compensation payments for environmentally friendly farming practices may have negative environmental effects; - Reduced installation of household water-saving appliances.
Waste Water Collection	- Underpricing; - Financial assistance for investments.	- Elimination of subsidy induced technological lock-in effects; - Decreased investment in waste water collection infrastructure; - Deterioration of equipment, inefficient collection or increased leakage of waste water; - Increased nutrient percolation into groundwater.
Waste Water Treatment	- Underpricing; - Financial assistance for investments; - Exemptions for certain user groups from taxes earmarked for financing waste water treatment; - Financial support provided for the operation and maintenance of waste water treatment plants.	- Reduced investment in waste water treatment infrastructure with potentially lower levels of treatment; - Higher levels of eutrophication.

Most of the subsidies provided to water abstraction lead to an increase of the volume of water withdrawn as they effectively lower the costs of withdrawal. This effect is of particular significance in the case of subsidies that support irrigation water abstraction.[16] Removing this subsidy for irrigation will result in increased irrigation costs for farmers, and thereby reduce the cultivation of certain water-intensive crops and reduce the acceleration of the depletion of non-renewable water resource stocks. In contrast, the removal of low-interest loans for infrastructure will influence investment decisions and may lead to a deterioration of the abstraction infrastructure, with potential adverse effects on the environment. In addition, in those cases where the granting of financial assistance for investments in infrastructure is coupled to environmental performance assessments and favour environmentally benign techniques, the environmental effect of subsidy removal may be negative, as these techniques may be unprofitable without subsidisation and be replaced by less favourable techniques.

Most of the subsidies to the network infrastructure increase the capacity or efficiency of water storage, supply and distribution, but often also lead to higher levels of water withdrawal as the availability of water increases. The overall effect of removing subsidy programmes targeted at network infrastructure is thus indeterminate. Subsidy removal may reduce technological lock-in with a potentially positive impact on the aquatic environment as less favourable techniques may be replaced in the longer run. However, depending on the exact specification of the subsidy scheme, environmentally more benign techniques may also lose out against options that are environmentally less friendly but lower priced. Second, investments in infrastructure may decrease in response to the elimination of subsidies and a deterioration of equipment may result with unfavourable environmental effects. The overall long-run environmental effect of the removal of infrastructural network subsidies is thus indeterminate.

In terms of water use, in those cases where water supply tariffs are kept below the economic costs involved (due to cross-subsidies and tax exemptions), while the availability of water is threatened, an adjustment of the water price to a (full) cost-recovery level constitutes a clear win-win situation. The signalling function of water prices for the different categories of water users would be restored and, depending on the magnitude of the price change as well as on the elasticity of water demand, water use would be adjusted to reflect the change in prices.

However, in the case of household water supply, the provision of water services fulfils important public functions and in consequence requires a careful assessment of each case in question to decide if and under what conditions a significant rise in water prices can be justified. In effect, this means that the principle of full cost-recovery has to be weighed against social and economic considerations, public health interests and social policy objectives in particular. In order to soften the potential social consequences of a move to (increased or full) cost-recovery, it may be necessary to establish programmes that set incentives for higher water use efficiency (such as incentives for installing water saving appliances).

Subsidising waste water collection infrastructure and lower prices for waste water collection increase the volume of waste water collected. In contrast to other subsides in the sector, the higher waste water collection levels that are likely to result from subsidies will generally benefit the environment. However, eliminating subsidies for the construction of waste water collection infrastructure may still have indeterminate effects

on the aquatic environment. On the one hand, subsidy-induced lock-in effects are removed, which may pave the way for the introduction of more environmentally friendly techniques in the long run, including a move toward more integrated methods and away from end-of-pipe solutions. More importantly, however, the investment in waste water collection infrastructure may decrease. As a consequence, equipment may deteriorate and potentially inefficient collection or increased leakage of waste water may result, which will trigger increased nutrient percolation into the groundwater.

Similar arguments apply to removal of subsidies for the treatment of waste water or the required infrastructure *(e.g.* the construction of waste water treatment plants). In general, these subsidies will increase the volume (or quality) of treated wastewater, and the environmental benefits from waste water treatment are positively correlated with volume. Removing investment subsidies in the form of interest-free loans or grants may lead to reduced investment in waste water treatment infrastructure and thus to lower levels of treatment. This development would clearly be detrimental to the aquatic environment. The same rationale applies to charges below cost recovery and tax exemptions: Eliminating these arrangements will increase the prices users have to pay for the treatment of their waste water, which may lead to reduced treatment with unfavourable environmental consequences like higher levels of eutrophication.

The main conclusion from the application of the checklist to the water sector, even at this general level, is that it provides a practical decision-making tool for systematically approaching the issue of subsidy reform in the sector. The different steps of the checklist ensure a co-ordinated approach and enhance the consistency and comparability of decisions. The analysis also raises a number of important issues. First, it is clear that any approach to subsidy analysis and reform should be sensitive to the multi-dimensional nature of the water resource. Water is always part of the environment, has an impact on public health, always comprises the redistribution of benefits (necessitating social considerations), and is a production factor. Accordingly, taking a decision between alternative options for reform always means that the multi-dimensionality and interdependence of decisions have to be taken into account.

Second, analysis of potential environmental outcomes of subsidy reform in the water sector is complicated by the fact that the social, economic and political circumstances into which subsidies are embedded differ for each individual case. In particular, removing subsidies may have strong redistributive effects, which should be considered in the decision-making process in order to obtain a politically viable outcome. In addition, the contribution of water services to public health generally has significant public good aspects, in which case there is a justified case for the operation of subsidisation schemes if affordability and universal access cannot be otherwise ensured.

Finally, the long life-span of capital assets and investment goods in the water sector (*e.g.* water treatment plants, dams, etc.) creates technological lock-in effects for future investments. As it is prohibitively costly to duplicate existing systems of, for example, sewerage collection and treatment, water service infrastructure has historically been regarded as a natural monopoly. Furthermore, in the short to medium term it is always less costly to replace defective units than to replace the entire system. Accordingly, investment decisions tend to carve infrastructure systems into stone for a long period of time and delay adjustments to more environmentally friendly technologies. Therefore, it is vital to take a long-term perspective on investment decisions in the water sector. This

specificity has to be considered in the analysis of subsidy schemes as well as in their reform, as effects will only become visible in the medium to long term, and as environmentally harmful effects will have long-term repercussions and consequences.

Summary

The major conclusion from the study is that there is significant scope for reforming environmentally harmful subsidies in OECD countries. The checklist is a useful tool for analysing environmentally harmful subsidies. Its main appeal is the establishment of a common organising framework that can be applied to different sectors. The checklist provides a core set of questions that are common to all sectors which can be applied in a systematic way to existing and proposed subsidy programmes. It is a policy tool that government agencies and other groups can easily apply in a relatively cost-effective manner.

In particular, by avoiding many of the evaluation problems that constrain cost-benefit analysis, it has the potential to be more widely applied by those less well-versed in subsidy analysis, yet with legitimate interest in the reform of subsidies. As such, the checklist will help to highlight those areas in which further detailed empirical analysis is required in assessing the economic, social and environmental effects of subsidy removal. The case studies also highlight the need for some further clarification of terminology and concepts in the checklist.

The variety of sectoral characteristics across countries may mean that different aspects of the checklist will be more important for some sectors and countries than for others. For example, the case study on the fisheries sector highlighted the particularly important role played by the policy filter in analysing subsidies to the sector. In this case, the policy filter refers primarily to the fisheries management setting in place, which will determine the responsiveness of the industry to subsidy removal in terms of impacts on fish stocks. In the case of agriculture, which is heavily supported, the checklist highlights the fact that some policy filters are already in place to offset the environmental harm generated by production-linked agricultural policies, and that some of them would not be needed if the agricultural policies were reformed. It is also clear that the environmental profiles of industries will differ between and across countries according to the industrial structure and biophysical endowments of countries. However, the checklist provides sufficient flexibility to allow sectoral and national differences to be accommodated within the core set of questions, augmented by country-specific information. However, the temptation should be resisted to make the checklist so flexible and all-encompassing that it ceases being a useful tool for rigorous analysis.

Continual refinement of the checklist methodology is necessary good practice to ensure the rigour of policy analysis using the methodology. This is best achieved by integrating the experiences gained from its further empirical application at the sectoral, national and programme level. The methodology will evolve naturally as a result of empirical application — "learning by doing" is regarded as the most appropriate way ahead in further refining the checklist. The policy analytical tools that have tended to be the most enduring and useful are characterised by international review mechanisms, peer reviews, which are transparent, continuous, and constantly evolving. Empirical applications could be done at the OECD sectoral committee level as well as in OECD countries themselves.

Improved transparency on both subsidy data and the effects of subsidies is one of the main advantages of the checklist. The value of empirical application would be increased by having the results reviewed internationally and, ideally, subject to some form of monitoring and assessment. The role of transparency in highlighting the environmental effects, as well as the costs and benefits of subsidy programmes is significant in attempting to phase-out environmentally harmful subsidies.

Application of the checklist to sectors, countries and specific subsidy programmes helps to identify data problems, which Workshop participants highlighted as an ongoing source of concern. Data gaps are significant in most sectors, the exceptions being agriculture and, to a lesser extent, fisheries and coal (although comparisons in this regard largely depend on the definition of subsidies in the various sectors). As noted earlier in this report, continued efforts are needed to gather, refine and improve data on subsidies and this process could be assisted (but not solved) by application of the checklist. The role of the OECD as an internationally recognised repository of subsidy data and analysis is important in this regard.

In terms of future case studies and empirical analysis, it was emphasised that there is a need to ensure that a more holistic approach to the analysis — covering the economic (including trade), social and environmental aspects of subsidy provision and reform — be undertaken as a follow-up to the application of the checklist. Focusing purely on the environmental aspects of subsidies runs the risk of missing the economic and social aspects of subsidy programmes which, depending on the circumstances, may be particularly important.

Where to Next on Assessment of Environmentally Harmful Subsidies?

The work carried out in this project represents only the first step towards identifying and assessing environmentally harmful subsidies. The sectoral analyses provided a top-down overview of how the checklist could be applied to a number of sectors. Three key steps were identified for the future work in this area to continue to contribute to the policy debate:

- Undertake additional case studies at a national, sectoral and individual programme level to obtain further experience in applying the checklist and to highlight the value of the approach in identifying environmentally harmful subsidies. In this regard, subsidies that are provided by supranational entities (such as the EU) or at sub-federal level (such as occurs in Canada, the United States or Australia) should also be included.
- Improve transparency by increasing the opportunities for experience sharing and learning by doing. This could be done by improving the documentation available on subsidy analysis and by convening more workshops to share information, data, analysis and experiences. The common organising framework provided by the checklist would facilitate this.
- Ensure that empirical assessment of environmental impacts is conducted in conjunction with assessment of the economic (including trade) and social impacts of subsidy removal.

Overcoming Obstacles to the Reform of Environmentally Harmful Subsidies

What Inhibits Reform of Environmentally Harmful Subsidies?

Reform of environmentally harmful subsidies offers the prospect of a "win-win" outcome for both the economy and the environment. Not only are many subsidies economically wasteful and environmentally damaging, but they may also be counterproductive and fail to meet their stated objectives. For example, subsidies to agriculture induce higher production, which in turn lowers commodity prices, leading to demands for increased support for the sector in more countries. Yet many governments around the world have been reluctant to dismantle harmful subsidies, despite growing environmental awareness and pressures on government budgets.

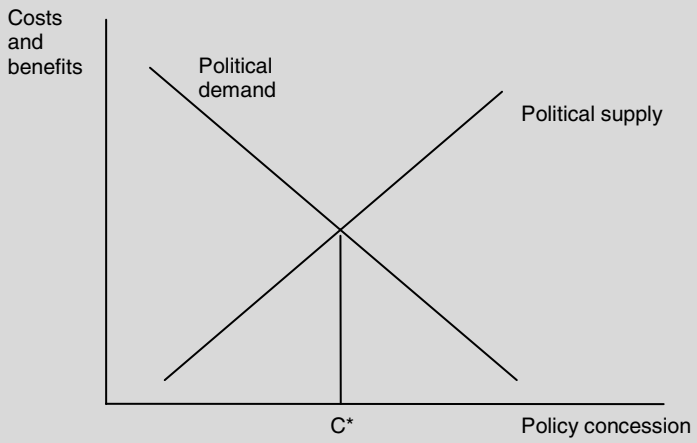
Since government policies are ultimately a consequence of political choices, it is necessary to examine the political incentives and motives of policy makers in order to better understand the obstacles to the reform of environmentally harmful subsidies and how to overcome them. Box 1.5 outlines a general framework that captures the key tensions that are likely to influence subsidy policy making in a democratic system.

Box 1.5. Political economy of subsidy reform

The political economy literature provides a general framework that captures the key tensions and conflicts that are likely to influence subsidy policy making in a democratic system. The political economy literature begins with the presumption that individuals act in their own self interest. This assumption precludes neither altruistic motives, nor enlightened leadership by policy makers. It is recognised that individuals (voters) often do care about the well being of their fellow citizens and the environment. Similarly, politicians derive satisfaction from pursuing socially beneficial policies. The self interest assumption captures the notion that behaviour is governed by attempts to maximise certain well defined objectives – which may include both altruistic and egotistical motives.

Governments are likely to be motivated by a number of factors such as ideological objectives, social welfare and above all, the desire to retain office, and government policy decisions will reflect these complex objectives. On the other hand, citizens who are affected by government decisions may attempt to influence policies by signalling their preferences through various channels. For instance, policy preferences can be "voiced" by lobbying the government for policy favours, or through political campaigns, or through voting choices. The manner in which policies are determined is therefore analogous to an implicit political market, where citizens signal their policy demands (or preferences) and the government responds with policy supply schedules.

The figure below portrays a hypothetical political market for a policy concession such as an environmentally damaging subsidy in (say) the agricultural sector. Since the policy confers benefits mainly to farmers, they may be willing to expend both effort and resources to signal their preferences to the government. The empirical evidence indicates that interest groups communicate their demands to politicians in three ways: providing information to legislators; lobbying to gain access to key politicians and decision makers; and political contributions paid to either political parties or individual legislators. Clearly, the greater are the costs involved in signalling sectoral preferences to policy makers, the lower will be the level of effective demand for the policy. Hence, the demand curve for policy concessions will have the usual downward slope. Conversely, the government's willingness to supply policy favours will increase with political and other benefits that accrue to it from implementing the policy. Hence the government's policy supply curve slopes upwards. The equilibrium level of subsidies to the agricultural sector is determined by the intersection of these demand and supply curves at C*.



Political, legal and economic institutions determine the limits and effectiveness of each group in achieving its desired objectives. Well organised and cohesive political pressure groups are usually more successful in translating their policy preferences into political demands than (say) unorganised individuals. Similarly, in democracies voter resistance may act as a constraint on the ability of a government to deliver narrow sectoral concessions. These and other factors determine the success of various groups in achieving their desired policy objectives. This very simple framework can go a long way to explaining the prevalence of subsidies in some sectors of the economy and the political impediments to subsidy removal.

The second workshop organised as part of the project addressed this issue and identified a range of common and sector-specific obstacles to the reform of environmentally harmful subsidies, both across countries and across sectors. It is recognised that these obstacles are not necessarily unique to the issue of environmentally harmful subsidies but can be identified as factors inhibiting many policy reform processes. However, there are significant lessons to be learnt from examining the range of obstacles and the experiences across sectors (and, indeed, across areas of policy reform). The key obstacles identified were:

- strength of special interests and rent-seeking behaviour;
- mythologies and fear of change
- policy convergence stifling debate between political parties;
- competitiveness and distributional concerns, particularly with respect to regional interests;
- lack of transparency;
- legal, administrative and technological constraints; and
- growth of a culture of "entitlement" to subsidies.

Lack of political will to undertake reform of environmentally harmful subsidies is linked to the strength of special interests and the role of rent-seeking in gaining and retaining subsidies. The benefits of subsidies tend to be highly concentrated in the hands of specific groups rendering lobbying highly profitable for these groups. However, the financial burden of supplying these benefits and the environmental damage caused are widely diffused across society at large. Hence, there is little countervailing lobbying pressure, or electoral pressure,

for the elimination of these harmful subsidies. Political resistance to these subsidies is made even more difficult since the environmental consequences are usually less visible, emerge with a time lag, and hence are harder to attribute to a specific policy concession.

Thus, demonstrating the economic and environmental costs of subsidies is difficult, whereas beneficiaries can more easily provide concrete anecdotes of the direct social benefits (for example, employment, regional growth), while ignoring most of the indirect effects and costs. This divergence between the concentration of benefits and costs increases the expected returns available to specific groups and increases the incentive to undertake lobbying to attract and retain subsidies.

Subsidies and protection thus create incentives for firms to remain inefficient and under-invest in new and more efficient technologies. Such policies therefore create an economically and environmentally damaging culture of subsidy dependence. Under these circumstances policy concessions once introduced will be difficult to eliminate. When an industry commits (locks in) to a subsidy dependent mode of production, support for the status quo becomes politically attractive for governments. Hence subsidies persist, even when it is clear that they have failed to satisfy their intended objectives and may even be counterproductive.

The political system has also been observed to generate a degree of policy convergence in relation to support policies. In this process, politicians seek to gain the middle ground on policies in order to insulate themselves from voter preferences and to minimise and sharpen the differences between political parties on certain policy issues. Sometimes, policies may converge around the maintenance of subsidy programmes, while, in other cases, they may converge around a consensus for subsidy reform. The latter was the case in Sweden where there was a general groundswell of support for agricultural policy reform, including the reduction of agricultural subsidies.

Concerns over industry competitiveness and income distribution are often cited by policy makers as being major obstacles to subsidy reform. Despite there being demonstrable benefits from unilateral subsidy reform, there is a reluctance to undertake such a process unless forced to by either economic or environmental crisis, or in response to external pressures (such as might occur through new multilateral or regional trade agreements). Similarly, distributional concerns (including concerns over regional interests) can inhibit moves to reform subsidy programmes as, inevitably, the removal of a subsidy will generate some losers from the policy change. In this regard, there is scope for learning the lessons from experiences with other policy reforms (such as increases in environmental taxes, privatisation of state-owned enterprises, tariff reform).

A lack of transparency often contributes to the difficulty of generating pressure for subsidy reform. Transparency in this case refers to information on the size of subsidy programmes, the beneficiaries of the subsidies, and the economic, environmental and social effects of subsidies. There is often an asymmetry between the review process for environmental measures and economic measures. Most environmental measures are subject to a regulatory impact assessment while, in many countries, the introduction of economic policies (such as subsidy programmes) is not subject to an environmental impact assessment process. The shift towards incorporating sustainable development paradigm into the policy agenda has taken OECD countries some way down that path but, despite some progress, there is much yet to be gained by better integrating economic, social and environmental considerations into policy assessment and decision-making.

There may also be legal, administrative or technological constraints to policy reform. Such constraints can result from structural rigidities which restrict the ability of society to adapt to changes in subsidy policy. For example, restrictions on the sale, amalgamation or sub-division of farming land in some countries may restrict the ability of farmers to efficiently alter their farming practices (some of which may be environmentally harmful) in response to changes in subsidy policy. In relation to transport, the huge cost and technological challenges involved in introducing fully electronic charging on a marginal cost pricing basis for the passenger vehicle fleet is an example.

Finally, it was observed that the long-term provision of subsidies generates a perception of "entitlement" that may be hard to break. It is well recognised that subsidies become capitalised into the prices of factors of production (for example, in the value of land, fishing vessels, quotas). The expectation that subsidy programmes will continue also tend to become embedded in the expectations of producers and consumers. This leads to resistance to change and strong incentives to lobby for the retention of subsidy programmes.

Opportunities for Reform

Existing studies tend to be stronger at highlighting the obstacles to subsidy policy reform, rather than specifying the mechanisms that can be used to deliver reform. The relationship between subsidy reform and political pressures is complex and depends greatly upon the specific economic and political climate in each country. The effect of subsidy reforms will also vary greatly across any given sector. As a result, there is unlikely to be a single set of strategies that would work across all sectors, in all countries. Rather, the appropriate set of reforms will be specific to each country and industry. Nevertheless, it is appropriate to evaluate the political prospects of some of the more promising reform strategies that have been suggested.

The obvious implication from analysis of the obstacles to subsidy reform is that policies which curtail the political (lobbying) power of sectoral interest groups will be most successful in achieving policy reform. However, these are the very policies that will be most strongly resisted by powerful interest groups. Moreover, since political incentives are shaped by institutional and legal factors, which cannot be easily altered in the short run, there is probably not much that can be done in a specific policy context to directly curb the level of rent seeking by special interest groups. Strategies for subsidy reform must therefore take rent-seeking behaviour as a fixture. The problem is therefore one of designing reforms that are politically feasible and do not ignite strong political opposition.

Having said that, though, there is a strong need to challenge the mantras surrounding the provision of subsidies to particular sectors or groups in society and changing the terms of the debate surrounding subsidies. This will involve clearer identification of the policy options that are available to meet society's objectives, and recognition that there is a range of policy options available to meet objectives: subsidies are generally recognised as being a relatively inefficient policy mechanism for achieving policy goals. The use of innovative policy instruments should be encouraged. A good example of this is the "Bush Tender" scheme being piloted in Australia which uses an auction scheme to compensate landholders who enter into agreements to provide management services that improve the quality or extent of native vegetation on their land (over and above those management services required by current obligations and legislation).

Better targeting of existing subsidy programmes should help to improve the effectiveness of the programmes and reduce any environmental impact of the subsidies. Improved subsidy design may help improve the efficiency of subsidies in correcting environmental problems (although they will remain less efficient than other policy instruments such as pollution taxes or tradable permits, and may violate the polluter pays principle).

There is a need to exploit windows of policy opportunity which may enable governments to undertake reform, rather than waiting for crisis to strike a sector or a country. There are conflicting experiences from among the country examples cited at the Workshop. Some countries' reform programmes were driven by the need to respond to a fiscal or environmental crisis (for example, the case of New Zealand agriculture subsidy reform as part of wider economic reforms). In other cases, such as Sweden, enlightened self-interest and a confluence of political forces agreeing on the need for change were the major factors in driving agricultural policy reforms. With regard to the fisheries sector, the ongoing negotiations at the WTO on fisheries subsidies provide a singular window of opportunity for subsidy reform.

A major factor in the push for reform of environmentally harmful subsidies is increased transparency. Improved transparency is required in relation to information about the beneficiaries of subsidies, the economic costs of subsidies, the environmental effects of subsidies and the assessment of the range of policy alternatives to subsidies. Transparency can stimulate voter opposition to subsidies and make subsidy reform less politically damaging for governments. In this regard, identifying who benefits from subsidies and highlighting their relative "bargaining power" can provide a particularly powerful motivating force for change. A good example is agriculture where there has been significant work done on who receives and who benefits from subsidies, both in terms of income levels, farm structures and geographically, and the cost of subsidies to consumers and taxpayers. This has helped to influence decision makers in some countries to reassess and reform subsidy programmes.

It is necessary to remove structural impediments and rigidities in the legal and administrative framework which may inhibit adjustment. This will require a holistic approach to policy reform as such impediments may not always be immediately apparent when designing policy reform packages. It may also involve assessing the administrative and geographical level at which the subsidy is provided.

Finally, it is also important to implement transitional measures when phasing out or reducing subsidies. Such measures involve not only payment or compensation to assist in structural change, but also the provision of information, advice, retraining and so on. Financial assistance to mitigate the social effects inherent in subsidy reform should also be considered. The appropriate speed of adjustment is also a factor and will depend on the resilience of the community to change and external pressures, and the availability of alternative sources of employment and income.

Endnotes

1. This section is based on Steenblik (2003).

2. This section is largely based on Steenblik (2003).

3. Note that this consists of government outlays and cannot be interpreted as subsidies.

4. Calculated using producer subsidy equivalents.

5. Gross Government Budget Expenditure measures the total amount of funds transferred to beneficiary companies and the total amount of uncollected tax liabilities from them per year of programme. Net Cost to Government measures the difference between the cost of funding a programme and the revenue generated for the public budget by the same programme in any given year

6. Governments can choose to keep the support measure and increase environmental policy enforcement costs or environmental damage, or reduce support and reap savings in environmental policy enforcement costs or clean-up costs (OECD, 1998a).

7. This section is based on Tyler (2003).

8. Support conditional upon farmers undertaking practices deemed to be beneficial to the environment.

9. This section is based on Cox (2003).

10. Discarding refers to the practice of dumping unwanted catch rather than landing it. Highgrading refers to the practice of discarding low value (usually smaller) fish under quota so as to maximise the value of a fisher's quota.

11. This section is based on Nash (2003).

12. This section is based on Newman (2003).

13. Aid targeting past production (*e.g.* environmental cleanup funds) is usually not considered a subsidy, unless it is used for meeting unfulfilled obligations of the private sector.

14. Financial aid for hard coal mining totalled EUR 3 520 million in 2002 while financial aid to rational energy use and renewable energies amounted to EUR 2 349.4 million in the same year (including EUR 2 212 million in feed-in compensations under the Renewable Energy Sources Act).

15. This section is based on Kraemer (2003).

16. Subsidisation programmes targeted at supporting environmentally friendly farming practices constitute an exception to this rule, by setting incentives for more efficient resource use. However, it is necessary to ensure that such schemes provide a net benefit to society.

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Chapter 2

When Removing Subsidies Benefits the Environment: Developing a Checklist Based on the Conditionality of Subsidies

Abstract

The objective of this chapter is to develop a checklist that could help identify subsidies whose removal would benefit the environment most. The checklist focuses on two interrelated issues: the effects of subsidy removal on producers' and consumers' decisions; and the directness of the link between those decisions and the environment. The effects of subsidy removal on producers' and consumers' decisions depend on the overall policy setting of the subsidy (including environmental policy measures), on its conditionality, the availability of alternatives, and the nature of competition on factor and product markets. Since the environmental impact of subsidies depends on numerous factors, the checklist cannot substitute for a thorough analysis of the subsidies under consideration for removal. It can, however, serve as a first "quick scan" of subsidies that are likely to yield environmental benefits when removed and identify important elements that should go into an in-depth analysis.

Introduction

Context

Ever since the early 1990s, the reform or removal[1] of subsidies in order to improve the environment have been high on the international political agenda. Since then, many studies on the environmental effects of subsidies have been published. For an overview, see Gareth Porter (2002). In this vein, during the years 1992-1997, the OECD embarked on a comprehensive project on the environmental implications of energy and transport subsidies, resulting in numerous case studies and a final summarising report: *Reforming Energy and Transport Subsidies: Environmental and Economic Implications* (OECD, 1997). These studies, which applied various elaborate definitions of subsidies, revealed a complex picture and led to the conclusion that previous studies may have overestimated the environmental benefits of their removal. Environmental effects of subsidies appeared to be rather sensitive to circumstances as well as to the assumptions on which the quantitative analyses were based.

In 1995, G7 Ministers requested the OECD to carry out a study on the costs and benefits of eliminating or reforming subsidies and tax disincentives to sound environmental practices in various sectors. This project resulted in a major report, *Improving the Environment through Reducing Subsidies* (OECD, 1998, 1999). This project resulted in, among other things, a rudimentary and not-so-easy-to-apply "quick scan"(OECD, 1998) that would allow for selecting those subsidies that were more likely than others to have adverse environmental effects, while having little effect on their stated objectives (notably, employment and income). This "quick scan" more or less automatically emerged when trying to systemise the then available evidence and looking for common factors that have a decisive impact on the environmental effects of subsidy removal. The present study can be seen as an elaboration of this "quick scan", while being confined to environmental effects only.

Why Develop a Checklist?

Developing a checklist may serve two purposes. It could help to focus attention on those conditions under which subsidy removal could indeed have significant beneficial environmental effects. Identifying those conditions is the prime purpose of this exercise. When eventually developed successfully, governments could apply the checklist to any set of subsidies that they are considering for removal (on whatever grounds)[2] and (provisionally) rank them according to their likely environmental effects (when removed). Since subsidies are in general difficult to remove, focusing on the removal of subsidies that have a significant impact on the environment seems important.

It should be noted that, given this envisaged use of the checklist, this paper and its underlying reasoning does not give additional guidance on how to define subsidies. Governments already have a list of subsidies according to whatever definition(s) they consider to be appropriate. Moreover, the checklist will not contain items referring to the dose response relations that determine the nature and magnitude of the environmental effects of rates of exploitation and pollution, or items concerning the emissions and resource requirements ("environmental profiles") of industries. It is assumed that governments already have that information. The checklist merely lists important

questions that must be answered in deciding whether subsidy removal is likely to remedy adverse environmental effects, without creating other negative environmental impacts.

A checklist that is applicable to many different types of subsidies to many different industries operating under vastly differing circumstances must focus on the commonality in the mechanisms that determine the environmental effects of removing a subsidy. As a consequence, it will inevitably miss several factors that may be decisive, or conversely, will contain items that are not relevant to a particular subsidy. Therefore a checklist cannot substitute for a more thorough analysis that would reveal elements missed in the checklist and give a much more reliable picture of the effects of removing that subsidy.

In summary, if properly developed, the checklist: can serve as a "quick scan", allowing governments to concentrate on those subsidies for which removal would most *likely* result in environmental gains; can help in identifying important elements that should go into a more thorough analysis; and can help governments to claim justifiable environmental benefits, and avoid unjustifiable ones. The checklist should make it possible to identify reinforcing and mitigating factors that together determine the final outcomes of subsidy removal right from the start.

Limitations of the Checklist and its Underlying Reasoning

The checklist is not a tool to establish the environmental harmfulness of the subsidised economic activity. Such harm can only be evaluated using environmental impact analysis. The checklist addresses instead the important question of whether the environmental harm would diminish if the subsidy were to be removed.

Ideally, the effects of subsidy removal should be estimated using general or at least partial equilibrium models, taking the responses of other sectors into account. The checklist, by contrast, only enumerates economic characteristics of subsidies that may serve as predictors for first order effects on those industries that are directly affected by the removal of a certain subsidy. The reasoning behind the checklist ignores wider macro-economic implications, such as the effects of subsidy removal on governments' budgets and consumers' incomes and their effects on the economy when recycled.

Subsidies have effects on international trade and therefore on the geographical distribution of economic activities. Removing subsidies in one country will therefore have a knock-on effect on other countries. Any analysis of the full effects of subsidy removal should include these effects. This implies a considerable extension of the analysis, compared to a purely national one. On the other hand, the effects of subsidy removal on these extensions would basically entail the same elements as a national analysis, except that they would apply to more markets and more (and different) economic and environmental circumstances. Therefore the checklist is developed with only a national analysis in mind. This means, however, that possible effects of the international trade regime on trade flows once a subsidy is removed have been ignored.

The development of a checklist should ideally be based on a thorough meta analysis of ex-ante and preferably ex-post evaluations of subsidy removal, eliminating all the effects of differences in data and methodologies applied in those case studies. This, being a gigantic task, is beyond the scope of this paper. Instead the reasoning in this paper and the checklist is mainly based on previous OECD work (notably OECD, 1997a-d; OECD, 1998, 1999a,b; OECD 2002, and the literature cited in these studies) and basic micro-economic theory. No doubt the attained results are provisional and leave ample room for improvement and refinement.

As a result, the checklist follows a *probabilistic* approach as opposed to a deterministic approach, applying general equilibrium modelling. Applying the checklist only sheds light on the *probability* of beneficial environmental effects due to subsidy removal.

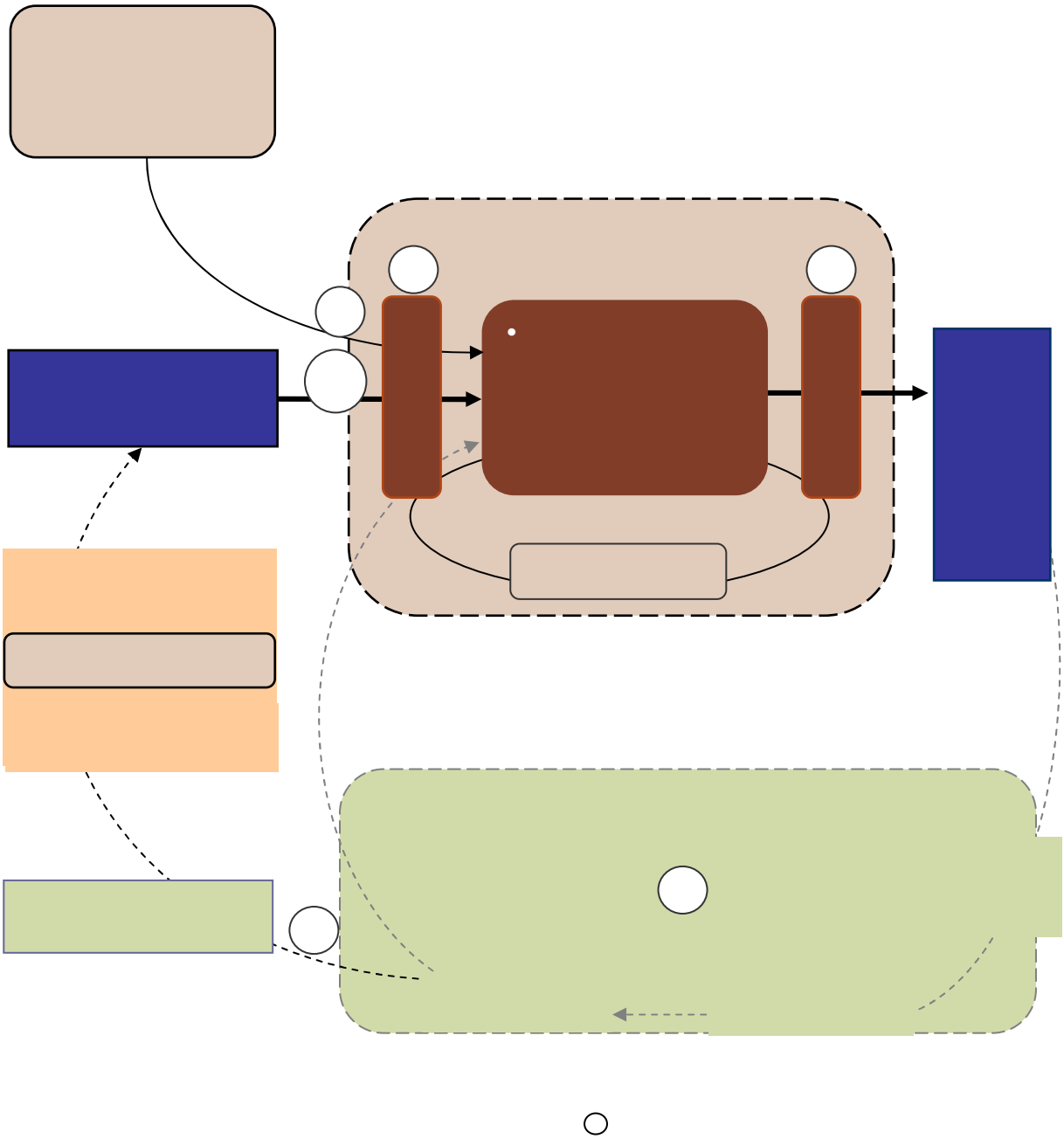
Subsidy – Environment Linkages

The links between subsidies and their environmental effects are very complex. These links vary from being very direct, *e.g.* if the subsidy is conditional on the production or use of a particular substance that causes environmental harm, while cleaner alternatives are available, to very indirect, if the subsidy is decoupled from production levels. The whole exercise boils down to identifying the factors that determine the directness of the links between removing a subsidy and its environmental consequences. For a more precise description of the reasoning behind the to-be-developed checklist, consider the diagrammatic presentation of the subsidy-environment linkages in Figure 2.1. Starting from the box "subsidy removal", Figure 2.1 contains several steps. The checklist is limited to analytical steps 1-3.

1. *A subsidy changes the relative volumes of economic activities and, potentially, emissions and rates of exploitation.* A subsidy increases revenues or reduces costs of the recipient sector, or may even have been decisive for starting the economic activity in the first place. As a result, at least the composition of (domestic) production and consumption will change. Generally speaking, the subsidised economic activity will expand and others will contract (unless the subsidy was granted to a monopoly). The degree in which this happens depends on the final incidence of the subsidy, which in turn depends on numerous elasticities of demand and supply on both factor and product markets. Such a shift in the composition of production and consumption may have significant environmental consequences (even if the total production does not change), due to the vast differences in resource needs and pollution between industries.

2. *The competitiveness of the subsidised sector may also be influenced by technical change.* In the long run, autonomous technical change as well as changes in market conditions may also affect the relative competitiveness of the subsidised and non-subsidised industries. Maintaining the competitiveness of an industry through subsidisation may very well be an uphill struggle, defending the industry against ever more efficient competitors. Note that this also applies to subsidies that were previously installed to favour environmentally benign modes of production. As a result, removing a long-standing subsidy may free the way to applying innovative technologies, whose introduction was blocked by the subsidy. This (only) yields benefits for the environment if the new technologies are more environmentally benign, which, in turn, will be influenced by the effectiveness of environmental policy.

Figure 2.1. Subsidy removal and environment linkages



Source: Adapted from OECD (1998).

3. *The effects of subsidy removal on emissions or rates of depletion depend also on the prevailing "policy filter".* Subsidisation takes place within a prevailing environmental policy context. This context may consist of a set of environmental measures such as the requirement to adhere to a set of best available technologies (BAT) or other measures that prescribe certain modes of production, like sustainable forestry, or maximum rates of exploitation or production. For example, if BAT requirements prescribe flue-gas desulphurisation, the removal of a subsidy that would lead to an increase of the use of sulphur-rich fuels would have a much smaller effect on tonnes of SO_2-emissions than if those requirements were absent. Likewise, removing a subsidy to fishery may have no effect on fish stocks if there is a management regime in place that already effectively prevents over-fishing. Other elements of the policy filter would include all other quantity restrictions such as the maximum capacity of infrastructure (in a given period), or planning and zoning requirements.
4. *The resulting changes in emissions and rates of exploitation due to subsidy removal may improve the (use) values of the environment.* The remaining changes in emissions and exploitation rates due to subsidy removal affect the environment, if the subsidy had environmental effects to begin with (that is, if its detrimental environmental effects had not already been eliminated by policy decisions, or other constraints). This depends on the site-specific assimilative capacity or resilience of the environment (dose response relations). Next, changes in the environment will influence the use values of the environment, which feeds back into the economic structure.
5. *Effects of existing subsidies on the (use) values of the environment may constitute a political argument to remove that subsidy.* The state of the environment may lead governments to explore whether removing subsidies would improve the environment. Typically this would entail drafting a list of existing subsidies that are likely to cause environmental harm. The next step would be to identify those subsidies that should be removed on environmental grounds. In the majority of cases the decision to remove a subsidy needs firm argumentation. The environmental case must be stronger in cases where there are fewer other arguments in favour of removing subsidies, like the ineffectiveness of subsidies to achieve other policy objectives such as increased income or employment or both.

Notice that in fact the policy analysis only starts in steps 4 and 5. They yield a long list of subsidies that *might* have adverse effects on the environment, because they accrue to economic activities that adversely impact the environment (revealed by environmental impact analysis). The checklist only serves to arrive at a list of subsidies whose removal is *likely* to yield environmental benefits.

The Basic Line of Reasoning

If it is established that a certain economic activity causes environmental harm (for example by applying environmental impact analysis), the next question is whether that economic activity is subsidised in what form and to what extent. The final question is whether removal of that subsidy would change that economic activity in such a way that less environmental harm is done. The checklist should be a tool to answer this last question.

The basic line of argument is that removing subsidies has the largest environmental impact if they directly affect the production and use of natural resources or emissions. The directness of the link between the environment (exploitation rates of resources or emissions, or both) and the subsidised activity depends on the following:

- Whether the subsidy to-be-removed is conditional on input or output levels. If not, its removal would affect relative incomes, but not have significant environmental impacts (only those that are affected by changes in relative incomes).
- The input/environment ratio within the subsidised economic activity, which in turn depends on the availability of alternative modes of production. If this ratio is invariable (*e.g.* [Carbon content of the energy used]/[CO_2-emissions]) removing subsidies to carbon-containing fuels would be in order. If the ratio is variable, removing the subsidy or intensifying environmental policy should be considered.
- The output/environment ratio of the subsidised industry, which also depends on the availability of alternative modes of production. If this ratio is variable only within close limits (*e.g.* in the case of a capital-intensive industry), removing the subsidy to output would have significant effects on pollution or resource exploitation. Otherwise other measures of environmental policy would be the preferred option.
- The availability of close substitutes for the products of the subsidised industry.

The way subsidies influence technical change is of great importance, especially in the long run, as the directness of the link between the subsidy and the environment depends strongly on the availability of alternatives. In this respect a distinction is made between removing subsidies that influence day-to-day decisions (their removal leading to a continuous new incentive to technical change — resource productivity) and removing subsidies that influence one-off decisions (their removal eliminating the opportunity to install environmentally benign technologies that are available at the time subsidisation starts, but also avoiding technologies that are not so good after all being locked-in for a considerable period of time). This distinction coincides with subsidies to environmentally relevant variable costs (energy, materials, water) exercising a continuous disincentive to increasing resource productivity on the one hand, and subsidies to capital equipment that can only use a particular input (which make them subsidies to that particular input in disguise), but with a discontinuous disincentive to technical change, and other input subsidies, on the other.

Lessons Learnt from Previous Work

Previous OECD work as well as (many) other case studies yield valuable insights on factors that are particularly important for developing a checklist. The primary lesson is that "details matter". All subsidies are unique! On the other hand, they share a number of common properties. As a result, stripping case studies from their specific circumstances may provide lessons that are applicable (in various degrees) to other cases and are useful in pointing out items that should be included in the checklist.

Factors that tend to make subsidies "unique", and that should be incorporated in the checklist include:

The political environment in which the subsidy is applied, such as

- How embedded it is in a wider array of sectoral or environmental policies that may contain institutional arrangements, planning and zoning requirements, training, limits imposed on production (*i.e.* maximum allowable catches, or other production quota) or imposed on the use of inputs (*i.e.* the capacity of -transport- infrastructure), or other elements of the "policy filter", mentioned in the previous section.

- The prevailing tax structure. The same subsidy will have different effects on marginal costs and revenues if applied under differing taxation regimes (OECD 1999; OECD 1999)

The "techno-economic" environment in which the subsidy is applied, such as

- The market structure. If, for example, a subsidy is granted to an industry with little bargaining power *vis à vis* its customers, this subsidy is likely to end up in the pockets of these customers (but nevertheless possibly stimulating output and consequently increasing environmental damage — depending on elasticities of demand and supply). These circumstances are especially relevant when removing subsidies, since they influence the need for flanking measures to avoid social hardships.

- The supply elasticities of factors of production. Subsidies tend to be capitalised in the price of the least elastic factor of production (land for example in the case of agriculture). So the ultimate price structure that emerges from a subsidy (and therefore the ultimate levels of production and environmental damage) depends on the relative elasticities of the relevant factors of production. A second corollary of this observation is that replacing one subsidy to a particular sector by another, may have similar environmental effects (see for example Rainelli, 1998).

- The "alternative".[3] Once subsidies are removed, a differing pattern of production and consumption will emerge. If, for example, agricultural subsidies were to be removed, comparative advantages may lead to a different geographical distribution of production. This may lead to a *different pattern* of specialisation and intensification of agriculture, but not to their reduction (for a study on the effects of trade liberalisation on Dutch agriculture see Massink and Meester, 2002). The new pattern of specialisation and intensification is not necessarily more environmentally beneficial than the one that emerged when agricultural subsidies were applied.

Common factors that should be incorporated in the checklist include the following:

- *Points of impact*. All subsidies impact production and consumption decisions at a certain point (point of impact), such as outputs, inputs and profit and income. These points of impact have differing effects on the economic and environmental consequences of the subsidy. These effects *merge* with the circumstances that make subsidies "unique", producing the final results. In assessing the environmental impacts of subsidies, however, the following common factors must be included in the checklist

- Degrees of freedom. Subsidies that stimulate output, but leave the producer free to choose his modes of production, give him more degrees of freedom to choose environmentally benign modes of production. By contrast, a *subsidy* that (explicitly or

implicitly) is conditional on the deployment of a certain mode of production, discourages him from looking for more environmentally benign processes and products.

- Lock-in effects. Subsidies tend to cast technologies in stone, especially if they are meant to shelter industries that are not economically *viable*. They may have especially long-lasting effects if applied to capital-intensive industries. Not using capacity that has been installed because of the subsidy may lead to high sunk costs, which serves as a barrier to removing them (for example, Naughten *et al.*, 1997, in OECD, 1997b).

Merging Theory with Evidence

Subsidies are always conditional on something, be it output, inputs, profits and income, or factors that influence demand (Table 2.2). The various types of conditionality lead to different points of impact of the subsidy. Different points of impact in turn, lead to different responses of the subsidised firms. And generally, the effects of subsidy removal depend strongly on the overall policy setting, as well as circumstances (the policy filter in Figure 2.1). This is described in greater detail in sections 2.4 – 2.7.

Before dealing with the conditionality of a number of subsidy types, two general observations should be made. Subsidies may have lock-in effects, meaning that they can cast technologies in stone by protecting them against competing technologies. Since the success of environmental policy greatly depends on the development and deployment of new, more environmentally benign technologies, this is a good illustration of the way that certain types of subsidies harm the environment (section 2.2.). Economic theory suggests that a firm's responses to changes in variable (marginal) costs differ from those in fixed costs. In section 2.3 the implications of this distinction are explored.

The Lock-In Effect

Reducing the environmental impacts of economic activities depends on reducing volumes of production and reducing emissions or input requirements per unit of production.[4] The latter is often called "decoupling". Basically, decoupling can be achieved by: increasing resource efficiency ("making more with less"), deploying abatement (end-of-pipe technologies), or both. These strategies are described in more detail in Table 2.1 (taken from OECD, 1998).

All of the strategies delineated in the table mentioned above have strong and weak points. Which strategy will be the best solution in any given situation will depend largely on the particular circumstances of the environmental problem it is required to address. Sometimes the choice of available strategies will be limited. Preventing pollution and waste from being generated (through process-integrated solutions) is often cheaper than trying to reduce their toxicity and dispose of them after their generation. In general, it would seem that increasing resource productivity is more cost effective than end-of-pipe technologies (but there are exceptions). Where there is dissipative use of materials (*e.g.* detergents, fertilizer, pesticides), pollution prevention may even be the only way to reduce pollution levels.

The bottom line is that success in environmental policy is largely dependent on changes in substance flows through the economy. Consequently, subsidies that stifle technical change are likely to harm the environment in the longer run, provided that environmental policy ensures that new technologies compare favourably with the older ones in their environmental effects. The more a subsidy fixates on a particular

technology, the more suspect it is.[5] These subsidies include subsidies to a particular input and subsidies to a particular type of capital good. Note that often there is a rather close link between a particular type of machinery and the inputs that are suitable for that machinery (*e.g.* type of machinery and the fuel it runs on). Subsidies that favour certain technologies over others add to the "lock-in effect".[6] The longer a subsidy is in place, the stronger it will add to the lock-in effect.

Table 2.1. A typology of the main technological strategies of environmental policy

Category	Main Strategies of Environmental Policy	Examples
	Reducing the toxicity of pollution and waste Transforming pollution and waste into emissions and waste streams that are less hazardous, or managing them in a more environmentally-benign manner	Waste water treatment, flue-gas desulphurisation, remediation activities, sequestration and disposal of waste in "safe" disposal sites
Increasing Resource Productivity (Pollution Prevention)	**Dematerialisation** More efficient use of a given material for a given function	Energy saving measures, less fertilizer and/or pesticide use per unit of agricultural output, increased vehicle fuel efficiency (including the reduction of vehicles weight), micro-miniaturisation in the electronics industry
	Materials Substitution Substitution of a given material by another, less hazardous (including less energy -intensive) one	Substitution of glass or aluminium fibre for copper wire, replacement of CFCs by other materials, use of less malign pesticides, use of aluminium or other lightweight materials in vehicle construction
	Recycling Repair, re-use, remanufacturing and recycling of products	Recovery of metals from discarded products, recycling of paper and glass, energy recovery by incineration of discarded products
	Waste Mining Recovery of materials from production waste	Recovery of elemental sulphur from flue-gas desulphurisation, recovery of limestone from scrubber waste, recovery of fertilizer by applying closed production systems in agriculture

Source: OECD (1998), adapted from Ayres and Ayres (1996).

It is difficult to assess lock-in effects quantitatively, since it would require comparing a "with-situation" to a counterfactual "without-situation" (what technologies would have gained market access in absence of the subsidy?). But subsidies that are maintained over a long period are much more likely to have strong lock-in effects, especially when they also directly influence the choice of materials and energy.

The Importance of Distinguishing between Variable and Marginal Costs

Standard economic theory tells us that *output* is determined by the equalisation of marginal costs and marginal revenues — the price of the product; *profitability* is determined by the difference between average costs and average revenues — the price of the product. The equality of minimum average costs and marginal costs determines the *optimal scale of the firm and the optimal offer price* by the same token. Hence, subsidies to fixed costs have different effects on total quantities used or produced by the entire industry compared to subsidies to variable costs. Over the long run, however, all costs are variable and these differences will disappear.

There are, however, four reasons for distinguishing between subsidies to variable costs on the one hand, and to fixed costs on the other.

- *Short and long term versus long-term effects only:* Removing subsidies to variable costs increases *marginal costs*. This immediately affects day-to-day production decisions, since only operations whose revenues exceed marginal costs increase profits or reduce losses. Removing subsidies to fixed costs (*i.e.* subsidies that lower the cost of capital, such as. low interest loans, the costs of buildings, capital equipment, land), by contrast, generally affects only *new investments* in the industry, since past acquisitions of assets cannot be undone. As a result, their effect will kick in only gradually.[7] Their full effects may take even decades to materialise.

- *Continuous versus discontinuous change:* Removing subsidies to materials and energy can work only in one direction: encouraging resource efficiency.[8] The effect will be *continuous*, spurring the emergence of ever more resource-efficient modes of production. This is likely to have large environmental impacts since the industries engaged in the early phases of production (extraction, energy and materials production) are among the highest polluting industries. By contrast, removing subsidies to capital equipment affects "one-off" investment decisions and fixates technical change over the lifetimes of the subsidised capital goods.

- *Always right, or sometimes right:* Whereas the removal of subsidies to environmentally relevant variable costs always work in the right direction, removing subsidies to fixed costs, in particular capital equipment, may temporarily damage the environment (if they favour environmentally more benign modes of production), or conversely improve the environment (if they favour relatively "dirty" modes of production). Note that the positive effect is likely to be temporary, because autonomous technical change may eventually render modes of production that were once environmentally benign into ones that are relatively "dirty".

- *Closeness of the link between the subsidy and the environment:* The link between energy and use of materials on the one hand (categories of variable costs), and pollution and exploitation of natural resources on the other, is more direct than the link between fixed costs and environmental impacts, unless the subsidy is conditional on the deployment of a narrowly defined type of capital equipment that uses only one specific type of material or fuel. Arguably it is then an indirect subsidy to that input. An example would be a subsidy to a coal-fired power plant. Such plants are very capital intensive, but coal is a cheap fuel compared to gas.

Subsidising the coal-fired plant therefore can be seen as an indirect subsidy to coal to the detriment of the cleaner fuel, gas. Subsidies to types of fixed costs that do not implicitly lock-in modes of production, such as subsidies to land, buildings and the cost of capital, leave the firm choices for environmentally more benign modes of production while being subsidised. Removing such subsidies is likely to have comparatively limited beneficial effects.

As a rule of the thumb, removing subsidies to environmentally relevant variable costs (materials, energy, water) has a greater immediate impact on the environment than subsidies to fixed costs. This also applies to subsidies to types of fixed costs that implicitly lock in the use of certain materials and energy carriers.

Conditionality: the Main Points of Impact

As already stated, subsidies are always conditional on something. The various types of conditionality or *points of impact* (Table 2.2) of the subsidies may lead to different responses from producers and consumers with respect to their modes of production, production and consumption levels and as a consequence to differences in the changes in levels of pollution and rates of exploitation. The purpose of this section is to explore the differences in likely responses of firms due to removing subsidies that have different points of impact.

Usually the following broad categories of points of impact are distinguished: output, input, and profits and income.[9] Such a characterisation always has arbitrary elements, because details of the subsidies at hand are not easily captured in such broad categories. Moreover, at the end of the day, all subsidies translate into either revenue increases or cost reductions. The usual break-down of subsidies, however, highlights some important differences in subsidies: revenue increases conditional on the volume of production (output); revenue increases irrespective of volumes produced (profit and income); and production cost reductions (input use).

We have introduced another criterion, namely points of impact that lie "within the firm" (affecting the individual firm's own cost and revenue structure directly) and "outside the firm" (affecting demand and thereby indirectly its revenues). In the first case, the firm avails itself of the subsidy by making certain choices of its own, whereas in the second case the subsidies benefit the industry collectively, giving the firm less influence on the volume of the subsidised product to be produced. In terms of economic analysis, in the first case the changes are along the demand curve, whereas in the latter case the demand curves themselves shift.

Table 2.2. Main points of impact/support conditionality

Categories	Main initial points of impact	Effects on sales, costs and rents
Within the firm[1] (affecting costs and revenues of the firm that avails itself of the subsidy)		
Output	▪ Market price support o Border protection o Market access restrictions o Government brokered contracts ▪ Deficiency payments and sales premiums	Create revenues proportional to actual production volumes (increase production levels)
	▪ Production quota	Off-sets production increase; creates rents (market value of quota)
Input use	▪ Materials, energy ▪ Short-lived equipment	Reduce variable costs
	▪ Particular types of fixed capital ▪ Access to natural resources below opportunity costs	Reduce fixed costs
	▪ Low interest loans ▪ Research and development	Reduce variable or fixed costs, or both
Profit and income	▪ Historical entitlements ▪ Preferential low rates of income taxes ▪ Preferential low rates of capital taxes ▪ Debt write-off ▪ Allowing insufficient provision for future environmental liabilities ▪ Exemptions from (environmental) standards ▪ Start of an operation	Create revenues, irrespective of actual production volumes (increase profits)[2]
	▪ Low rate of return requirements	Reduce fixed costs and revenues
Outside the firm[1] (increasing demand, thereby affecting revenues of the industry collectively)		
Demand	▪ Low rates of VAT ▪ Marketing and promotion by government ▪ Provision of government produced infrastructure below costs	Stimulate demand

1. By "firm" we mean an organisation that produces a certain product. In case of vertical integration a firm in the judicial sense may contain several "firms" referred to in this table

2. Such subsidies include "existence subsidies", whose purpose it is to maintain the subsidised activities without them producing anything for the market (but for producing non-marketable values).

Source: Adapted from OECD (1998).

Removing a Subsidy Conditional to Quantity of Output

Market price support, which represents a very important part of subsidies granted (agriculture, fisheries, coal), is either given to ensure certain output levels of domestic production that exceed volumes or to ensure a certain price level above the level without the market price support, or both. Removing such subsidies will reduce output of the previously subsidised product. If no change in technology occurs, this reduction equals the decrease in pollution or resource exploitation associated with the previously subsidised economic activity. At the same time, a proportionate reduction is to be expected in the supplying industries, leading to smaller environmental impacts. Removing market price support will lead to shifts in the geographical distribution of production locations with the associated changes in local environmental quality.

All volume effects are dependent on both price elasticity of demand and price elasticity of supply of the subsidised product. The largest effects occur if both demand and supply elasticities are large. Medium effects would result if one elasticity is large and the other is small (OECD, 1998). Of course the net effect on the environment depends also on what products will replace the previously subsidised ones. For example, what alternative crops will be grown, what alternative species will be caught, and would the previously subsidised coal be replaced by imported coal or by an entirely different fuel?

Removing output subsidies leads to a loss of producers' surplus and a decrease of production volumes (unless the latter continue to be limited by quotas or other environmental management regimes). In agriculture this is likely to lower the prices of farmland that (if sufficiently large, and translated into rents) may in turn stimulate farmers to produce less intensively. In other sectors the prices of other factors that have an inelastic supply will decrease. Usually, however, such second-order effects are relatively small.

Subsidies (not only market price support) are not applied in a vacuum. In a number of cases they are accompanied by various production limitations such as: exploitation or production quotas (*e.g.* in agriculture, fisheries, forestry); limitations of the available infrastructure (*e.g.* in energy and transport); planning and zoning requirements (*e.g.* in industry, agriculture, energy, transport); pollution limits (all sectors). These all are elements that have been labelled the "policy filter" in Figure 2.1. If those limitations are maintained, it may be *them* that determine the overall effect of subsidy removal. This will be the case if, for example, production limits have been set to avoid over-production even at the higher prices that result from market price support (such as milk or fish quota). By contrast, removing the subsidy *together with the production limit* will result in an increase in production volumes, if the production limit was below production limits that correspond with market equilibrium after subsidy and production limit removal.[10]

Deficiency payments and sales premiums, also being mechanisms to bridge the gap between a politically determined price and the market price, have similar effects on production volumes as market price support.

Removing a Subsidy to Input Use

Materials (including water), energy. Removing these subsidies is likely to have substantial environmental benefits. Their removal increases variable costs, whose effects are felt immediately and continuously; remove the lock-in effects that block developments towards more resource productivity, which, in turn, reduces the

environmental impacts of the extracting, energy producing and materials producing industries.

Short-lived equipment. Removing these subsidies likewise increases variable costs. Whether they have the wider effects on resource efficiency that characterise the removal of subsidies to energy and materials will depend on the degree to which they are linked to specific materials or energy uses.

Capital equipment. Removing these subsidies will slow down new investments which could have a *negative* impact on the environment if those new investments would have been more environmentally benign. Such a subsidy removal generally applies to new investments only, therefore the full effects will be felt only in the long run, if a significant portion of the old investments have been replaced by new (non-subsidised and therefore more expensive) equipment. Whether the environment will benefit from higher costs of equipment in the long run depends on two other factors as well: its effect on total production levels and substitution of factors of production towards more labour or more materials inputs, or both. Removing such subsidies may also have environmentally beneficial effects if the previously subsidised capital equipment has become relatively environmentally harmful. The more the previous subsidy has been conditional on narrowly defined types of equipment and the longer it has been in place, the more it is likely to have locked-in what are now "dirty" technologies. Removal of such subsidies can be expected to have stronger beneficial effects than the removal of subsidies that applied to broadly defined categories of equipment.

Access to natural resources below opportunity costs (*e.g.* exploitation concessions below opportunity costs — forestry, mining, water extraction etc., government purchased access to foreign-owned fishing grounds). Removing such subsidies decreases the rates of exploitation of the natural resources concerned. They may have an immediate effect (*e.g.* in the case of governments no longer paying for access to foreign fishing grounds) or a long-term effect (*e.g.* if governments sell new concessions at higher prices). Removing such subsidies will often have a decisive effect on the start or the continuation of the economic activity concerned.

Low interest loans. Low interest loans are a subsidy to capital. They will usually reduce the (sunk) cost of fixed assets and they may lower the internal rate of discount. They also make funds available for other acquisitions. Whether their removal results in an increase of fixed or variable costs is difficult to determine. Since these subsidies (if not conditional on specific types of equipment) leave the firm free to choose more environmentally benign modes of production, they may not have been as environmentally damaging as their effects on production volumes might suggest. As a consequence, it is more difficult to assess beforehand whether their removal would benefit the environment. More detailed analysis would be necessary.

Research and development. Assessing the effects of removing these subsidies also requires more detailed analyses. On the environmentally beneficial side, subsidies to research and development can be directed towards environmentally more benign production modes. On the other hand, they may postpone a change to fundamentally different technologies that are even more benign. Even worse, if these subsidies are large enough to work like a subsidy to operating costs, while conditional on the prevailing line of operations, they are likely to have serious lock-in effects. The effects of removing these subsidies on fixed or variable costs are difficult to determine (during the research and development stage, as well as when the results of the research and development efforts are put into practice).

Removing a Subsidy to Profits and Income

Historical entitlements. These subsidies are independent of actual production volumes. However, they get capitalised in the prices of factors of production in inelastic supply such as land, in which case removing them may have a downward effect on these factors of production and might change modes of production and production levels. Assessing the environmental effects of removing these subsidies requires a fairly detailed analysis that takes into account the details of production functions of individual firms.

Preferential low rates of income or capital taxation and debt write-offs. Such subsidies improve the profitability of the firms concerned (assuming that they are not also conditional on particular technologies and input uses) and will prolong the life-span of firms that would not be economically viable in the absence of these subsidies. Consequently, removing them will make the least efficient firms (possibly also the most polluting ones) leave the sector, possibly reducing the total output of the sector with favourable environmental consequences (if the reduction in supply is not replaced with supply from other even more polluting or resource inefficient firms). Firms that use environmentally more benign processes may enter the industry, thus removing the lock-in effects of subsidies to profits and income. Again, we are faced with a mixed bag of potential outcomes and detailed research is needed to establish the environmental effects of removing these subsidies.

Allowing insufficient provision for future liabilities and exemptions from (environmental) standards. Removing these subsidies is likely to have strong beneficial effects on the environment. They contain examples of measures to shore up the profitability of economic activities that would not otherwise have been economically viable, deliberately at the expense of the environment. Removing exemptions from environmental standards may increase marginal costs.

Start of an operation. In order to lure an investor into starting an operation, apart from other subsidies, a lump sum subsidy may be granted. No longer giving them would reduce investments in that particular jurisdiction. Of course the (local) environmental effects depend on the nature and scale of that operation. The effects of removing such subsidies, therefore, are hard to predict.

Low rate of return requirements. These subsidies are applied to government-owned utilities forcing producers to reduce their offer prices, most often in conjunction with low interest loans. They serve as a means to pass on preferentially the low interest rates to consumers. In fact they lower the internal discount rate for the entire operations (or reduce the break-even price). Removing them will result in a shift to (less capital intensive, and therefore more flexible) technologies with higher rates of return. Depending on the environmental characteristics of the alternative production processes, removing low rate of return requirements can have beneficial or adverse effects on the environment. It should be noted, however, that investments with shorter economic life-spans open the way to more frequent adaptations to new technological options, and possibly to their development.

Removing a Subsidy that Increases Demand

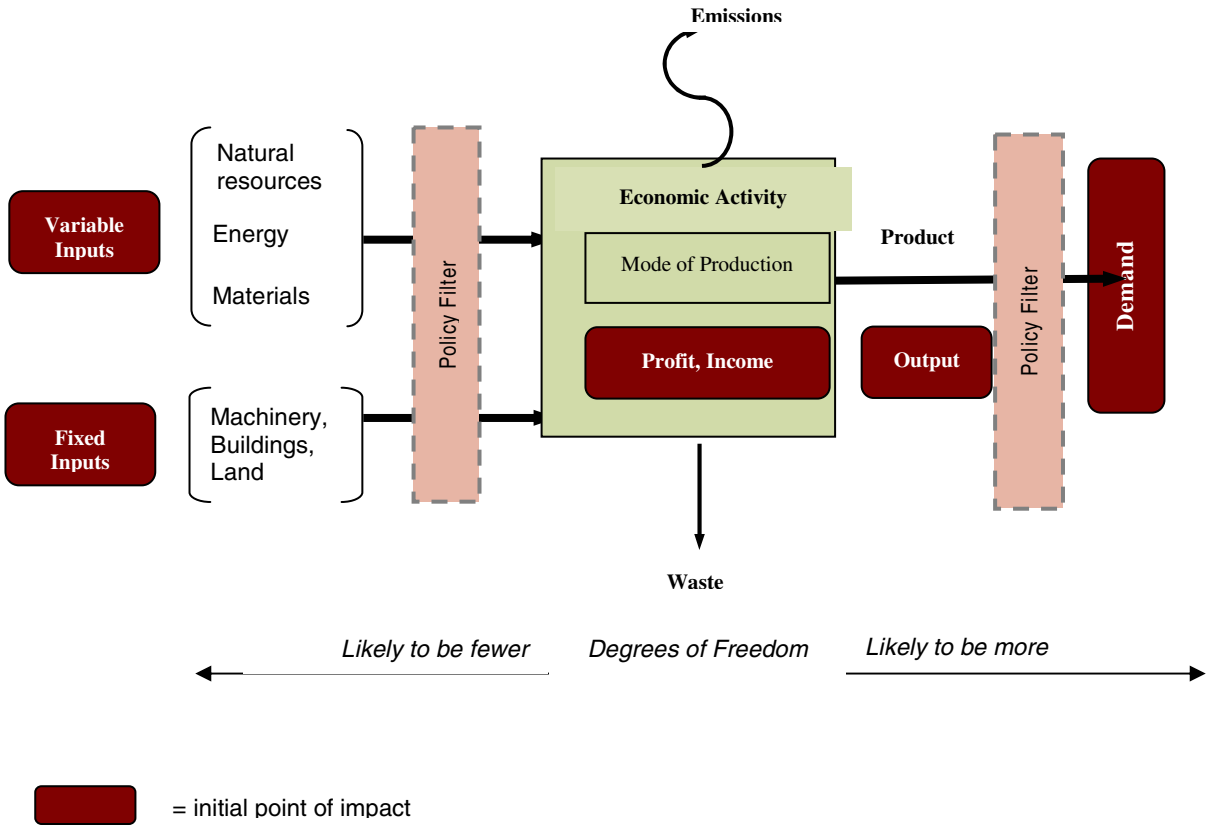
Preferential low VAT rates, the provision of infrastructure below cost, as well as other governments services below (long term marginal) costs, such as government-paid marketing and product promotion. Removing these subsidies (to consumers) does not affect the subsidised firms directly but decreases the demand for their products. If the

supply curve is inelastic, a decrease in demand due to the removal of the subsidy will have little effect. This could be the case when governments decide to have road users pay more for using congested roads, while the possibility of increasing the capacity of other modes of transport is low or non-existent. In the first case, congestion will have depressed demand, while being subsidised. If the roads were not congested, the effect of charging more for the use of infrastructure is likely to be significantly larger.

Degrees of Freedom

By degrees of freedom we mean that the number of alternatives available to the economic agent are not affected by the subsidy. Subsidies that are conditional on the level of output only, for example, leave the economic agent with all the options he might have in changing his modes of production, and consequently the choice of whatever inputs. A subsidy, conditional on profit or income or demand (only), leaves the economic agent with an even larger number of degrees of freedom, because he might even change his level of output. The more degrees of freedom are left, the less a removal of the subsidy is likely to have large impacts on the environment. As a result, reducing the environmental impact of the subsidised economic activity is likely to be better served by environmental policy measures than by removing the subsidy. This may be illustrated in a generalised way by Figure 2.2 below. Generally speaking, points of impact on the left result in fewer degrees of freedom compared to the points of impact on the right. Note that variable inputs and land use in particular may have significant upstream environmental effects. If the product is an input for other industries, it might have downstream environmental effects.

Figure 2.2. Initial points of impact and degrees of freedom



There are important exceptions to the general rule that the number of degrees of freedom increases if one moves to the right in Figure 2.2. Subsidies to research and development, or low interest loans (in Table 2.2, listed under "inputs") enable the economic agent to deploy environmentally more beneficial modes of production (now or later). Subsidies to fixed inputs may result in more degrees of freedom than subsidies to variable inputs, if they allow for the use of different natural resources, energy carriers or materials. Often, however, the opposite is true. Machinery, in particular, is in most cases dedicated to processing particular inputs. Moreover, the policy filters may affect the environmental effects of both input use and volumes of production.

Conclusions

Subsidy removal is likely to have a larger impact if:

- the subsidies have been implemented for a long time;
- they have been targeted at environmentally relevant variable costs;
- they have had (upstream) effects on industries that are relatively polluting or resource intensive by themselves; and
- they have been applied to existing production capacity, not just new additions.

Subsidy removal, by contrast, is likely to have a lesser impact if:

- there are other environmental constraints that are not removed together with the subsidy;
- they have been in place for a short time;
- they have not affected relatively polluting or resource intensive sectors.

Table 2.3 presents the results of the previous analysis in more detail.

Table 2.3. Overview of the expected effects of subsidy removal

Categories	Main points of impact	Environmental effects[1]		Remarks
		Short term[2] reduction in emissions or rates of exploitation, due to:	Long term[2] reduction in emissions or rates of exploitation, due to:	
Output	▪ Market price support	Lower production levels	Lower production levels	Consumer prices will drop, in spite of lower production levels. Less input requirements may lead to strong environmental effects in the production of materials and energy phase. Production may shift to areas of low cost production, leading to a possible displacement of the environmental burden
	▪ Deficiency payments	The same as above	The same as above	
	▪ Sales premiums	The same as above	The same as above	
Input use	▪ Materials, energy	Higher marginal costs of all subsidised "firms"; immediate discontinuation of some production activities. Exit of the least efficient production units, if marginal revenues drop below marginal costs	Disappearance of the lock-in effect, which frees the way to substitution and savings on inputs. If accompanied by effective environmental policies this creates a window of opportunities for environmental improvement[3]	Strong effects may be expected due to reductions in the production of materials and energy or rates of exploitation that often are relatively environmentally harmful
	▪ Short-lived equipment	The same as above	The same as above	
	▪ Particular types of fixed capital	Exit of the least efficient production units, if marginal revenues drop below marginal costs	Disappearance of the lock-in effect, depending on the specificity and duration of the conditionality	If substitution of capital equipment opens the way to more efficient use of materials or energy (or the substitution of less harmful ones), strong effects upstream may be expected
	▪ Access to natural resources	Increases the price of natural resources for downstream users, increasing their resource efficiency	Higher barrier to entry or disappearance of the least efficient production units, or both	Strong effects on entry with possibly large beneficial effects on rates of depletion
	▪ Low interest loans	Possibly a (limited) effect on marginal costs	Higher barrier to entry or disappearance of the least efficient production units, or both	
	▪ Research and development		Deployment of environmentally more benign technologies, if accompanied with effective environmental targets.	If the subsidy is large, it may be an exploitation subsidy to capital costs in disguise. In those cases the

				effects are unclear
		Environmental effects[1]		
Categories	**Main points of impact**	**Short term[2] reduction in emissions or rates of exploitation, due to:**	**Long term[2] reduction in emissions or rates of exploitation, due to:**	**Remarks**
Profit and income[4]	▪ Preferential low rates of income taxes	Possibly somewhat lower marginal costs. If so, exit of the least efficient production units, if marginal revenues drop below marginal costs	Higher barrier to entry. Higher prices reduce demand	
	▪ Preferential low rates of capital taxes	The same as above	The same as above	
	▪ Debt write-off	The same as above, unless it is a one-off write-off	The same as above, unless it is a one-off write-off	
	▪ Allowing insufficient provision for future environmental liabilities	Exit of the least efficient production units, if marginal revenues drop below marginal costs	Higher consumer prices and more environmentally benign modes of production	
	▪ Exemptions from (environmental) standards	The same as above	The same as above	
	▪ Low rate of return requirements		Higher consumer prices and higher internal discount rates. The latter shortens the planning horizon of the "firm" and thereby the lock-in effect	
Demand	▪ Low rates of VAT	Exit of the least efficient production units, if marginal revenues drop below marginal costs	Undetermined, since dependent on externalities	Some "upstream" effects may be expected
	▪ Marketing and promotion by government	The same as above	The same as above	The same as above
	▪ Provision of infrastructure below costs	The same as above	The same as above More decentralised production close to the place of consumption; different technologies	The environmental effects depend also on site-specific environmental conditions

1. As stated before, elements of the policy filter (quota, limitations in infrastructure) may become, or remain the limiting factors to production and thereby to the environmental effects of subsidy removal. In this table this is ignored.
2. In the short run, technology remains the same. That is, there is no substitution between factors of production or inputs for that matter.
3. Choosing a particular input often casts the technology in stone and *vice versa*.
4. Removal of subsidies based on historical entitlements, or direct payments to producers in exchange for production(modes) that are environmentally beneficial have been omitted from the table, because such removal is likely to damage the environment.

Developing the Checklist

Analyses Prior to the Application of the Checklist

As stated before, the checklist does not contain elements that determine whether one is dealing with a subsidy or not, nor does it contain items that indicate the nature and severity of the environmental damage (pollution or resource depletion). The checklist concentrates on answering the question whether the removal of a subsidy is likely to result in environmental benefits.

This implies that an analysis of the environmental effects of industries (that are often site specific) must be carried out first, or at least separately (if subsidy removal is being considered for non-environmental reasons anyway, but governments want to know whether adverse environmental effects would add to the desirability of their removal). This typically requires environmental impact assessments whose types, methodologies, applicability and data requirements are extensively documented in the literature. Such analyses tell governments whether a certain sector causes serious environmental harm (including overuse of natural resources) and whether there are environmental grounds in the first place (Flowchart 2.1). Of course the more serious the environmental impacts, the more pressing the question of whether removal of that subsidy would change environmental conditions for the better.

After applying Flowchart 2.1, governments subsequently have to carry out a sectoral analysis of the political and economic environment in which the sector operates. Such an analysis should provide three types of information:

What are the forward and backward linkages. If such linkages are strong, a subsidy to the sector under investigation may have considerable consequences for the environmental impacts of the upstream or downstream sectors. This implies that those impacts should be taken into account when evaluating more benign alternatives and the effects of the subsidy under investigation on the production levels of the upstream and downstream sectors (arrow 'd' in the Flowchart). If these two sectors are subsidised as well, the entire analysis should be broadened to include these other sectors and must lead to a more comprehensive set of subsidies to be scrutinised (arrow 'a' in the Flowchart). If such an analysis reveals that the present situation leads to relatively favourable environmental impacts caused by those other sectors, subsidy removal in the sector under consideration might be ambiguous (not depicted in the flowchart).

Is the sector subsidised and if so in what manner and to what extent? There are two rather normative steps involved. First, the definition of "the sector". If, for example, the analysis is applied to the entire transport sector, the sectoral analysis must identify all subsidies to all modes of transportation. The second rather normative step concerns the assessment of the subsidies involved and the desirability of changing them. This implies establishing government objectives concerning the sector. For example, if the policy objectives concerning the energy sector include reducing emissions at least cost to society, the volume and composition of energy production and use will differ from one that yields least private costs. (For examples of the importance of policy objectives, see Box 2.1.) These considerations have a bearing on the selection and description of the relevant subsidies, which is the starting point of the checklist (arrow 'b' in the Flowchart).

The existence of policy filters. The sectoral analysis should include all important sector-specific policy measures, including all measures that pose limitations on the

production levels that effectively limit environmental damage caused by the sector under investigation.

Box 2.1. Policy objectives influence the selection and definition of subsidies that should be considered for removal

In the case of *water*, the issue is often how to optimally price water as a common pool reserve. Such an optimal price not only depends on the relative abundance of the common pool, but also on societal preferences with respect to preserving the reserve for future generations. This benchmark determines what actual prices are deemed as being too low or too high and thus gives rise to what has to be defined as a "subsidy" (the deviation from the "optimal" price). A number of policy measures may lead to deviations of this "optimal price". Ideally all of them would be analysed.

In the *transport* sector, the most common policy objective appears to be optimal pricing of the various (competing, but also complementing) alternative modes of transport, taking into account the aim of minimising the private and social costs of the entire transport system. Social costs, just because of their size, play an important role in determining the optimal price structure. Deviations from the optimal price structure call for policy actions that may involve changing relative prices by government measures. Again, this may imply that various policy measures (such as subsidies to parking space, provision of infrastructure below costs, subsidies to public transport and so on) should be scrutinised.

In *agriculture* the main issue is to reform subsidies to make them more compatible with free international trade. Here the focus is much more on an already well defined and well documented set of subsidies. Whether subsidy removal would benefit the environment or not depends on the comparison between agriculture under the present subsidisation and agriculture under free trade (with non-trade-distorting subsidies). If free trade leads to least private-cost production and thus to specialisation and intensification based on comparative advantage, the environmental results may be ambiguous. Again, ideally one should consider all policy measures that may affect relative agricultural prices as a package (such as subsidies to irrigation water, fertilizer, or outputs, just to name a few), not just one in isolation.

In the case of *energy*, the main concern seems to be increasing the efficiency of energy production and use, taking externalities into account. Since important externalities (*e.g.* SO_x, NO_x, CO_2 and other emissions or – nuclear – waste) are as yet seldom fully internalised into energy prices, sectoral energy policies, aimed at efficient energy policies are likely to involve sizeable government interventions in energy prices. Again, it is the deviations from the optimal price structure that constitutes the "subsidies". Remedying these deviations will generally include policy packages that affect the relative prices of the various types of energy production and use rather than singular measures that stimulate or penalise one type of energy production or use.

The Framework of the Checklist

As already stated, the aim of the checklist is to select from a list of subsidies whose removal might lead to environmental improvements, those subsidies whose removal is likely to yield environmental benefits. In order to put a subsidy on the list of subsidies whose removal might benefit the environment, some preliminary analysis is necessary. First, it should be known whether the sector uses or produces inputs or substances whose subtraction from or release into the environment might threaten cherished environmental values. Second, sectoral analysis must reveal whether there are strong links with other sectors that handle such inputs or substances. Third, sectoral analysis must also reveal whether the sector or one or more of its linkages is being subsidised or subject to other relevant policy measures, such as those that might act as policy filters (see top of Figure 2.1). In all cases in which sectors with their linkages are subsidised, while at least one of the sectors or its linkages handles substances that when released or subtracted from the environment may cause environmental harm, we have a case in which subsidy removal might benefit the environment.

Basically the checklist analysis builds on these findings, and refines and complements them in order to sift from the list of subsidies whose removal *might* benefit the environment those subsidies whose removal *is likely* to benefit the environment (but no guarantees can be given).

The next steps involve the application of the checklist. As noted before, the checklist is based on analytical steps 1-3 in Figure 2.1. The subsidy removal affects prices and volumes produced and may reverse some directions in technical change that have been stimulated by the subsidy. Next, the effects of subsidies may have been mitigated or reinforced by accompanying policy measures (that include the building of infrastructure). Finally, "autonomous" technical change may have resulted in environmentally more benign alternatives whose deployment has been prevented by the subsidy. Following this overall view, three clusters of questions emerge:

- What restrictions to production, pollution or resource depletion levels result from the policy filter, and of course, what will happen to the policy filter once the subsidies are removed?

- What technologies and products are likely to replace the previously subsidised products and modes of production, and subsequently how do the environmental profiles of these competing products and modes of production compare with those of the previously subsidised ones?

- What are the likely responses of the previously subsidised industries in terms of production volumes, rates of exploitation of natural resources? This depends on the size and conditionality of the subsidy as well as the distribution of market power.

First, it should be verified whether other restrictions (either political or technical in nature) that counteract the subsidy are in place. If so, the effect of subsidy removal may be limited or non-existent. For example, if milk production is constrained by quota, a subsidy to milk production may have little or no effect. Consequently, removing this subsidy while maintaining the quota will leave things more or less unchanged. On the other hand, if both the subsidy and the quota are removed, milk production may change as a result of removing the subsidy. The new production volume may be less, equal to, or more than the quota.

Second, it should be checked whether there are environmentally more benign alternatives available or likely to emerge in the short and longer term. Of course, long-term availability may be a matter of judgement. The basic question is whether the implementation of these alternatives is hampered by the subsidy under scrutiny.

The third step, investigating the role of conditionality (initial points of impact) on the directness of the link between subsidy removal and its environmental effects, is based on the basic reasoning laid down in sections 1.5 and 2. Summarising the results of those sections, part 3 of the checklist emphasises the following issues:

- The availability and potential environmental impacts of close substitutes for the products of the subsidised activities once the subsidisation stops, which, in consequence, are likely to replace (some of) the previously subsidised products.
- The forward and backward linkages of the industry that loses a subsidy. If these linkages are strong, other subsidies should be taken into account, running down the checklist for each and every subsidy that applies to these forward and backward linkages. This is depicted by arrow 'd' in Flowchart 2.1.
- The restoration of incentives to continuous technical change by subsidy removal. Hence items are included to identify subsidies that are contingent on

environmentally relevant categories of variable costs (energy, materials, water).

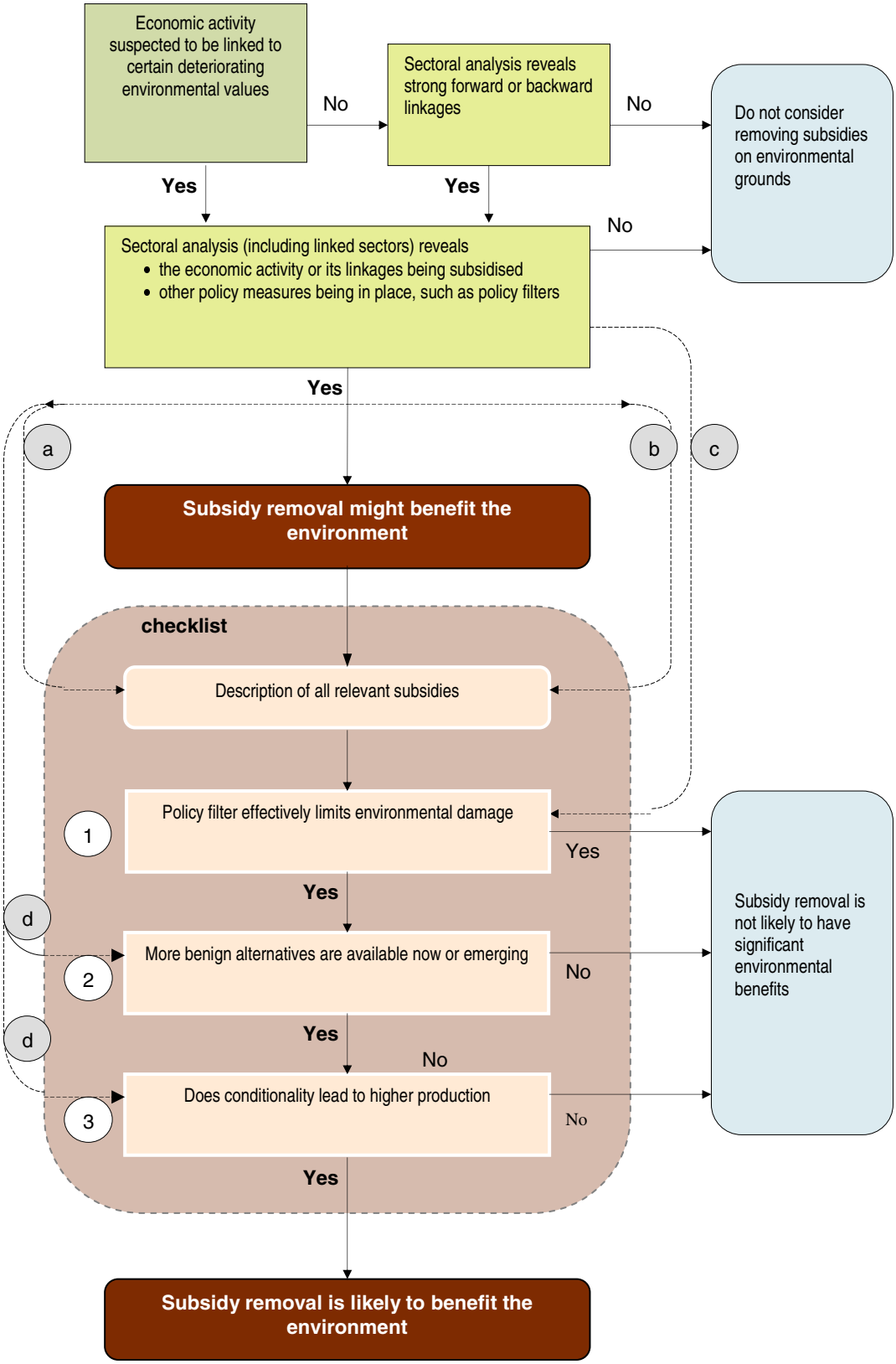
- Identifying subsidies to capital equipment that are implicit subsidies to certain inputs that are environmentally relevant.

- The effects of subsidisation on one-off decisions such as starting an operation or investing in capital equipment with a long life-span. These decisions can have large environmental effects, but whether they are detrimental or beneficial to the environment depends on the alternatives that may come to the market after the subsidy has been granted. Such subsidies may lock in technologies that are not so "clean" after all.
- Identifying, on the one hand, subsidies whose removal would influence day-to-day decisions and would have an immediate effect on the environment, and, on the other, subsidies whose removal would affect decisions that would only gradually affect the environment.

The checklist is devised to scrutinise one single subsidy (a policy measure that contributes to a deviation of the "optimal price"). As noted before, in practice a number of policy measures together do often lead to such deviations. The checklist, however, can be applied to packages of subsidy removals under consideration, taking each of the single subsidies separately. The checklist then can assist in finding those elements in the package that are likely to render the most environmentally relevant changes in policy measures.

The detailed items in the checklist (Table 2.4) are meant to help answer the three clusters of questions indicated above. Applying a checklist like the one developed here serves as a "quick scan". More definite answers can only be arrived at by applying more detailed analyses, preferably using general equilibrium models or an econometric modelling approach. In fact, several items under step 3 can only be answered more or less convincingly by applying such models. The checklist, however, may be of some help in deciding whether more elaborate analyses are required, and what items should be included. Since the effects of subsidies depend on so many factors, this first attempt to arrive at a checklist is unlikely to be complete.

Chart 2.1. Flowchart of the checklist



The Checklist

Table 2.4. Factors that determine the environmental effects of subsidy removal

Main item	Item	Crucial factors	Remarks
		Step 1. Policy filter	
Effective policy measures that reduce emissions or rates of extraction	Tradable pollution or extraction quota	The size of the quota after subsidy removal Clear definition and strict enforcement	Removal of a subsidy to the industry may have a limited or no environmental effect, if the quota *was* and remains the limiting factor after the subsidies have been removed. (The prices of quota which have varying effects will drop (e.g. depending on whether they are product quota or pollution quota). However the environmental effects remain those associated with the number of quotas issued.)
	Production or extraction limits	The level of the limits Clear definition and strict enforcement	Subsidy removal may have a limited or no effect,if the quota was and remains the limiting factor after the subsidies have been removed
	Emission standards	The level of the standards Clear definition and strict enforcement	Ancillary benefits by means of reductions in other emissions may not occur if they are already (sufficiently) restricted by regulation
	Environmentally based taxes, charges or fees	Rates of taxation Demand and supply elasticities of the taxed item	Maintaining such taxes may reduce the effect of subsidy removal
Other limitations to production or use	Shortfall in infrastructure	Size of the shortfall Options for expanding infrastructure Costs of the expansion Time needed for expansion of infrastructure	Subsidy removal may have a limited or no effect,if the available infrastructure was and remains the limiting factor after the subsidies have been removed.

(*Table 2.4 continued)*

	Shortfall in other limiting factors of production: *i.e.* qualified labour, space	Size of the shortfall Options for expanding the supply of the limiting factors Cost of the increase in supply of the limiting factors Time needed for expansion of supply of the limiting factors	Subsidy removal may have a limited or no effect,if the factors limiting production are still present after the subsidies have been removed. (Note that the resulting high prices of the limiting factors may trigger additional supply of those limiting factors, if possible)
Step 2: Availability of environmentally more benign alternatives: Identifying lock-in effects			
Alternative products	What competing products would benefit from the subsidy removal	Environmental profile of the subsidised product Environmental profile of the readily available competing products that would benefit from the subsidy removal Probable environmental profile of emerging alternative products Time span the subsidy has been in place	Removing subsidies opens the way to the development of more environmentally benign alternatives. Long-standing subsidies are likely to be the most damaging. Enhancing the effectiveness of environmental policy (financial and non-financial instruments) with respect to emerging technologies may be needed to reap the benefits of technical change Temporary subsidies to assist the development of emerging products and modes of production may be called for to increase the effectiveness of subsidy removal. Investigating the available options for environmentally benign modes of production includes looking into the items listed under “conditionality”. In the case of alternative modes of production, the points of impact of the subsidy determine which alternatives would benefit from the subsidy removal.
Alternative modes of production	What modes of production would benefit from the subsidy removal	Environmental profile of the subsidised mode of production Environmental profile of readily available alternatives Probable environmental profiles of emerging alternatives Time span the subsidy has been in place Points of impact of the subsidy	
Size of the subsidy	Monetary value of the financial subsidy relative to turnover	Elasticities of supply and demand	Market price support can be expressed in terms of monetary value.

(*Table 2.4 continued*)

Step 3: Higher volumes due to size, duration and conditionality of the subsidy			
Duration of the subsidy	Number of years the subsidy is in place	Technological development in competing products or modes of production outside the subsidised sector	The longer the subsidy is in place, the stronger its lock-in effect is likely to be, thus the larger the potential environmental gains if the subsidy were to be removed.
Conditionality:			
Variable costs	Specified energy supplies, and materials	The quantitative effect of the subsidy removal on variable cost Substitution elasticities between alternative energy supplies and materials Environmental profiles of the actual supplying industries Environmental profiles of the energy and materials-supplying industries that would replace the actual suppliers	"Materials" include (irrigation) water Removing energy and materials subsidies shifts the industries supply curve upward and therefore immediately reduces supply at all levels of demand of the (finished) product. It will also reduce entries and eliminate lock-in effects. The environmentally beneficial effects of the reduction in production of the (finished) good may be diminished if other suppliers step in at prices only slightly above the (previously) subsidised supplies, especially if their environmental profiles are less benign.
	Specified short-lived equipment	The quantitative effects of the subsidy removal on variable costs Effects on the environment of the deployment of alternative types of short-lived equipment	Removing these subsidies has the same effect as removing subsidies to energy supplies and materials. If, however, they have been conditional on energy- or materials-saving characteristics, the effect will be ambiguous.

(*Table 2.4 continued)*

Fixed costs	Specified types of fixed capital Specified types of fixed capital that allow for the use of low cost, environmentally damaging inputs Specified types of fixed capital that require the use of a particular environmentally relevant input	The quantitative effect of the subsidy removal ▪ on fixed costs ▪ on variable costs (if applicable) The (negative) effect of the subsidy removal on entries	Removing subsidies to fixed capital reduces the profitability of the subsidised sector and will discourage entries. However, if the profitability of the subsidised sector remained low while subsidised, the effect of the subsidy removal on entries would be minor or negligible. Often the choice for a particular type of fixed capital also implies the use of certain inputs. In some cases capital subsidies may allow cheaper inputs to be used, thereby changing variable costs. Removing such subsidies (to fixed costs) eliminates potentially strong lock-in effects.
Total costs	Royalty concessions	The quantitative effect of the subsidy removal ▪ on fixed costs ▪ on variable costs (where applicable) Environmental profiles of the subsidised activities and their alternatives	Adjusting royalty concessions to their market value will reduce future demand for these royalties. When adjusting royalties to their market price involves concessions for extraction, a strong effect may be expected on rates of depletion. Since this removal may result in higher prices for inputs for downstream activities, variable costs of these downstream activities may be lowered with strong volume effects.
	Low interest loans	The quantitative effect of the subsidy removal ▪ on fixed costs ▪ on variable costs (where applicable) Environmental profiles of the subsidised activities and their alternatives	If low interest loans are used to reduce the costs of fixed capital, removing such subsidies will have the same effect as removing other subsidies to fixed costs If granted to incumbents as well as newcomers, no barriers to entry will be created. Dependent on the relative profitability of the sector, this may lead to effects on production volumes.

(*Table 2.4 continued)*

	Research and development	The size of the subsidy relative to total operating costs Effects of the removal of the R&D-subsidy ▪ on fixed costs ▪ on variable costs Effects of the removal of the subsidy on diminishing the environmental profile of the subsidised activity	If the removed subsidy was large compared to operating costs, it would have been a subsidy to operating costs in disguise. If the subsidy removal would imply less technical progress towards more environmentally benign technologies, the ultimate environmental effects of subsidy removal is ambiguous
Profit and income	Preferential rates of taxation Debt write-offs	The effect of the subsidy removal on profitability The profitability of the sector while subsidised The environmental profiles of the subsidised and the alternative competing economic activities The environmental profiles of upstream and downstream economic activities	Decreased profitability due to the subsidy removal will discourage entries, but if entries had already been discouraged because of low profitability of the sector while subsidised, the effects on entries will be minor, if not negligible When the sector produces energy and materials, downstream effects of removing the subsidy may be strong, dependent on the offer prices of competitors
	Insufficient provision for future environmental liabilities	The nature of environmental liabilities The effect of imposing sufficient provision of future liabilities on variable and fixed costs by means of changing modes of production, or adequate insurance The environmental profiles of upstream and downstream economic activities The environmental profiles of the (previously) subsidised sector and its competing alternatives	Imposing sufficient provision for liabilities can render entire industries unprofitable. The environmental effects of the subsidy removal depends on the environmental profiles of the alternatives that will replace the previously subsidised sector. Strong effects on downstream sectors may be expected if the previously subsidised sector supplies energy or materials, dependent on the offer prices of competing energy supplies and materials.

	Exemptions from (environmental) standards	The quantitative effect of removing the subsidy on profitability and variable and fixed costs The effect of reduced profitability on the production volume of the sector The environmental profiles of upstream and downstream economic activities	Removing these exemptions obviously benefits the environment immediately by reducing the emissions or input use of the previously subsidised industries. Moreover, the volume effects on production volumes in upstream and downstream industries will benefit the environment.
	Low rates of return requirements	The effect of removing the low rates of return requirements on the internal discount rate of the firms	Higher internal discount rates favour shorter-lived investments. As a result, new technologies will be deployed more rapidly (and reduce the lock-in effect). If environmental policy ensures that those new technologies are more environmentally benign, reducing the lock-in effect will benefit the environment.
Demand	Low rates of VAT Marketing promotion by governments	The tax differential relative to sales prices The effects of marketing promotion on sales volumes The price elasticities of demand and supply	Demand will decrease because of subsidy removal. Its effect on production and input volumes depend on the relevant price elasticities. In the long run, the supply curve of the entire industry will be influenced by the occurrence of external effects and barriers to entry.
	Provision of infrastructure below cost	The quantitative effect of internalising the cost of infrastructure on demand The price elasticity of supply Geographical “hot spots” where infrastructure fall short or the use of infrastructure cause high emission levels or congestion or both The environmental profiles of the products that use that particular infrastructure	In the long run, the supply curves of the industries that have benefited from the provision of infrastructure below costs (*e.g.,* transport firms and those industries whose products are shipped) will be influenced by the occurrence of external effects and barriers to entry. Introducing full payment for infrastructure can increase exits from the industry. Possibly, the decrease in demand will not be sufficient to eliminate congestion or other signs of infrastructure shortfall, thereby reducing the environmental benefits.

Notes

1. This chapter has been contributed by Jan Pieters, Senior Economic Advisor, Ministry of Housing, Spatial Planning and the Environment, The Netherlands. For reasons of simplicity, the focus is on subsidy removal only, and not subsidy reform. Subsidy reform is seen to be a combination of removing elements of a subsidy package and replacing those elements with other that have a more favourable environmental profile. A checklist that indicates subsidies for which removal benefits the environment, would facilitate both, pinpointing subsidy elements that should be removed on environmental grounds and avoiding replacing them with subsidy element that could cause environmental harm.

2. So far subsidy removal is most often based on the negative impacts they have on the efficiency of markets (providing marketable goods and services at lowest costs). Few if any have been removed solely for environmental reasons. If subsidies were to be removed on the basis of environmental considerations, the criterion becomes a broader welfare concept that besides the efficiency of markets, also includes the efficiency of government policies in providing non-marketable goods and services.

3. Quantitative assessments of subsidy removal may differ strongly due to the choice of the counterfactual "what if no subsidy were deployed" scenarios that serve as a benchmark.

4. Note that these requirements include, materials and energy used in "cleaning-up" during the production process or afterwards.

5. There is a strong similarity with permitting policies. Permit requirements that prescribe a certain technology are less dynamic efficient than permit requirements that stipulate environmental performance.

6. The lock-in effect means that a certain technology simply by being applied (widely) has a competitive advantage over other (new) technologies. The lock-in effect plays a role in the path dependency of technical change.

7. Consider for example a subsidy to energy that is used to pump irrigation water. If that subsidy is removed the costs of irrigation water rises immediately. If the acquisition price of the pump had been reduced by a subsidy, removing that subsidy would not alter the sunk costs of the pump and therefore would not raise the costs of irrigation water. The existing irrigation practices will only reduce once the pumps in use are scrapped. At that time, the higher costs of the pumps will reduce irrigation. It is likely that the use time of the pumps will be extended, reducing the effect of subsidy removal

8. Note that removing market price support will decrease the price of the previously subsidised goods. Nevertheless, such removal will spur the development and deployment of novel technologies, since market price support must be accompanied by measures to ensure production levels above market equilibrium.

9. The latter include "existence subsidies" that are independent of production

10. All subsidies that distort trade lead to a geographical relocation of environmental impacts. This means that the environment within the country that removes its subsidy could be put under more or less strain. Likewise the "world environment" could be better or worse off. The checklist allows for identifying such developments, if applied, to include all the relevant sites of production.

*Appendix 2.*1

Selected Case Studies

Introduction

Unfortunately, quantitative assessments of the effects of subsidies vary over extremely wide ranges, even if they apply to the same sort of subsidies (see, for example, OECD, 1997a-d). This is partly due to differences between definitions of a subsidy and the comprehensiveness of the policy package (policy design of the particular subsidy) under study. Other explanations are the circumstances under which the subsidies are applied (Figure 2.1), the differences between the models *(e.g.* top-down or bottom-up)[1], and the economic and technical assumptions which underlie the calculations. Often the differences between the assumed alternative technology or economic activity that will emerge when the subsidy is removed (the benchmark) has a strong effect on the outcomes of the analyses (see, for example, OECD, 1997a). Looking at numerous case studies, however, reveals factors that seem to be important in many analyses.[2] The simplified and by no means comprehensive descriptions that follow in the next paragraphs only serve to highlight the various ways subsidies may affect volumes produced and consumed. It is selective, including only those elements that the author thinks have a strong bearing on the environmental effects of subsidy removal. These elements are elaborated upon in section 3.

Agriculture

Few areas have been studied in more detail than agricultural subsidies. OECD work on the "Policy Evaluation Matrix", based on transfer efficiency formulas, and using a vast amount of available statistical data, has revealed the remarkable differences between the effects of various types of subsidies (basically: deficiency payments, market price support, subsidies to acreage, subsidies to other inputs) on the incidence and transfer efficiency of agricultural subsidies (see for example OECD, 2001b). This leads to an important conclusion regarding the economic characteristics that make subsidies environmentally harmful. A very large portion of financial support leaks away to input suppliers, non-farming landowners and other sectors of the economy, and leads to significant upstream changes in production volumes. In addition, subsidies that lead to lower agricultural prices are implicit subsidies to the food-processing industries. Therefore, any study of the total environmental effects of subsidies to agriculture must

1. Top-down models are based on the usual demand and supply functions. Bottom-up models start from descriptions of technological alternatives and use an algorithm to calculate optimal solutions

2. Reviewing all available case studies is beyond the scope of this paper. The reader is referred to review studies, such as Porter (2002).

also include the supplying sectors. Another conclusion would be that although these subsidies are not effective in improving farmers' incomes, they can lead to more production if not restricted by other measures or circumstances.

Although there are several studies indicating that production and input subsidies lead to more intensive farming practices (Porter, 2002), there are few studies that investigate the effects of subsidy removal. Rainelli (1998) argues that replacing a subsidy to irrigation water with a subsidy on historical revenues will not reduce the use of irrigation water, since the new subsidy will not decrease the price of land, therefore continuing to contain an incentive to intensive farming. However, the need for irrigation water might be reduced as investments to increase the efficiency of irrigation become more profitable. After all, the mode of production chosen by the farmer depends on the relative prices of factors of production.

A recent study for the Netherlands (Massink and Meester, 2002), based on a comparison of several policy scenarios, one of which is a recourse to free trade, indicates that total subsidy removal would lead to significant income transfers, changes in the composition of Dutch agricultural production and, especially relevant to the subject of this paper, a *further intensification* of agriculture.[3]

Apparently, neither changing subsidy regimes nor abolishing subsidies altogether will automatically reverse the incentive towards intensification that has resulted from agricultural policies that included the subsidies. This asymmetry between introducing and removing subsidies necessitates close examination of the "economics on the farm level", and a more precise definition of all the relevant policy changes made. Most unfortunately, details matter.

Energy: Electricity and Coal

The OECD report on *Reforming Energy and Transport Subsidies: Environmental and Economic Implications* (1997) includes two large case studies on the benefits of removing subsidies, which lead to different conclusions.

The DRI study (1997), on the impacts of phasing out coal subsidies in OECD countries using the PSE definition of subsidies and applying a top-down trade model structure, found that this would have limited effects on the environment. Phasing out coal subsidies (of the market price support type) would mainly result in the use of imported coal instead of domestically produced (and subsidised) coal. According to this study, due to the economics of fuel use, coal would remain the preferred fuel for electricity generation, both in the short and long run.

By contrast, Naughten *et al.* (1997), analysed the effects of various elements of energy policies using a bottom-up (linear programming) model for Australia, based on a database of technologies, and defining subsidies as the difference between the minimum cost of an optimal combination of technologies that satisfy a certain level of electricity demand, on the one hand, and the costs of policy-determined alternatives on the other.. These policy elements include a deliberate choice for a certain fuel (coal) for a newly built power plant, capital subsidies and trade distortions. For each of such policy elements, the subsidy is defined as the wedge it creates with the least-cost solution for generating the demanded electricity.

3. The environmental effects of increased intensification are probably ambiguous, since larger areas may become available for less environmentally damaging uses.

They found that removing subsidies that are implicit in energy policy — notably loan guarantees, provision of loans at below market rates to (government-owned) coal-fired power stations and trade restrictions between Australian states that prevailed before regulatory reform — would result in a significant fuel shift towards combined cycle gas turbine (CCGT) electricity generation. This result is based on the higher capital intensity of coal-fired electricity generation, shorter lead times in building a CCGT-plant compared to a coal-fired plant, as well as the more modular character of CCGT generation which makes it more economical if production has to respond to changes in demand. Removing the subsidies to capital and privatising power plants would result in higher rate-of-return requirements (from 8% to an assumed 15%) and would therefore result in a shift to gas, even if coal remains the cheapest fuel per Kwh, if power plants are designed according to their technical optimal size.

It is important to realise that subsidies to energy producers and energy products (such as low preferential tax rates) will be (at least partially) passed on to industries and households. Removing them will affect downstream emissions.

Irrigation Water

Removing subsidies to irrigation water can generally have two distinct effects: agriculture on previously irrigated land would cease to be profitable if not entirely impossible, or lead to inefficient use of water, or both. Increased efficiency, of course, can mitigate the effect on profitability. Most studies have focused on optimal pricing of water using either the yardstick of full-cost recovery or the marginal value product of the water, which equals the value of the incremental volume of production due to the use of one unit of water.

Little is known about the environmental effects of removing water subsidies (by whatever definition), and what information is available is difficult to generalise because of the country and site specificity of the institutional arrangements, the multiple uses served by water infrastructure and environmental conditions. Presumably the following conclusion could be drawn. The feasibility of establishing water pricing systems that better reflect the cost of water or its marginal productivity and environmental effects is strongly interwoven with other policies and comprehensive water management systems. As stated in OECD (1999b), referring to Australian experiences, "water pricing reforms must be accompanied by other important mechanisms, in absence of which pure pricing mechanisms might yield few benefits."

Existing infrastructure represents sunk costs. Removing subsidies that consist of users not paying in full for infrastructure will shift the financial burden from the taxpayer to the consumer, which may lead to firms leaving the industry. If that leads to a reduction in demand, under-utilisation of existing infrastructure may arise. The "optimal" price structure when subsides are removed, may therefore differ from the "optimal" price structure if no subsidies had been granted. In addition, the environmental effects of the waterworks do not disappear when the subsidies are removed.

Transport

In the transport sector considerable attention has been paid to the social costs of transport (such as pollution, accidents, congestion). If these marginal social costs are not internalised, they could be labelled as (implicit) subsidies. Apart from subsidies arising from any incomplete internalisation of these social costs, very substantial subsidies are

the result of non-internalisation of the costs of infrastructure. The costs of infrastructure are particularly relevant because of the high ratios of fixed to variable costs and high sunk costs (Porter, 2002).

As a result, much recent work concerning subsidy removal (*e.g.* Roy, 2000), predominantly boil down to removing inequalities in the treatment of the cost of infrastructure, although other elements such as preferential low tax rates on particular fuels and tolls may cause distortions in variable costs as well. Generally there is over-pricing and under-utilisation of rail, and under-pricing and over-utilisation of roads.

The way subsidies to infrastructure lead to higher transport volumes, transport-related pollution and congestion is quite complex. This can be illustrated by a simplified example.[4] If, for example, a road between points A and B is constructed or improved, transport costs (and time) between the two points is reduced. Moreover, demand for road transport between A and B increases, either because a latent demand is activated (a shift along the original demand curve) or because the lower costs of transportation by road attract transport demand that was previously satisfied by other modes of transportation (a shift of the demand curve itself). If road transport does not pay for the improvement of this road infrastructure, a new subsidy is created that increases demand. Quite possibly this higher level of demand leads to more congestion on the road between A and B, but also on other roads leading to A or B, which in turn will lengthen the travel time, and hence costs, between A and B as well as to A or B. This will be accentuated if at the same time, subsidies to particular road users exist, such as preferential tax rates on fuel, capital or labour.

The environmental effects of subsidies to various modes of transport consist of two distinct categories: the effects on transport volumes and the effects on the level and geographical distribution of economic activities. Studies reveal that the price elasticities of demand for transport strongly depend on the availability of alternative modes of transport and other route-dependent factors. Estimating the environmental benefits of changes in the price structure of transport therefore requires rather detailed modelling. The other environmental effects of removing subsidies to transport, those related to the level and geographical distribution of industrial emissions, are even harder to predict. Needles to say, they can have significant effects on local environments.

Fisheries

Hanneson (2001) points to the importance of management regimes on the effects of subsidy removal on fish stocks. He distinguishes three such regimes: (1) *open access*, where there is no control over the quantity of catches or over fishing effort. This is probably no longer very representative of OECD countries; (2) *catch control*, where the total amount caught is regulated; and (3) *effective management*, under which the amount of catches is set at an economically optimal level and the costs to catch this amount are minimised, for example by means of individual transferable quotas. If the total amount of allowed catch is perfectly enforced (a big "if"), subsidy removal will not lead to fewer catches under the catch control or effective management regime, provided that the regime poses limits on the catches below the level that would occur after the withdrawal of the subsidy. Under open access, by contrast, removing cost-reducing subsidies could very well lead to new entrants and continued over-fishing. In all these cases, removing cost reducing subsidies has little, if any, effect.

4. See, for example, the description of the TRENEN model in Roy (2000).

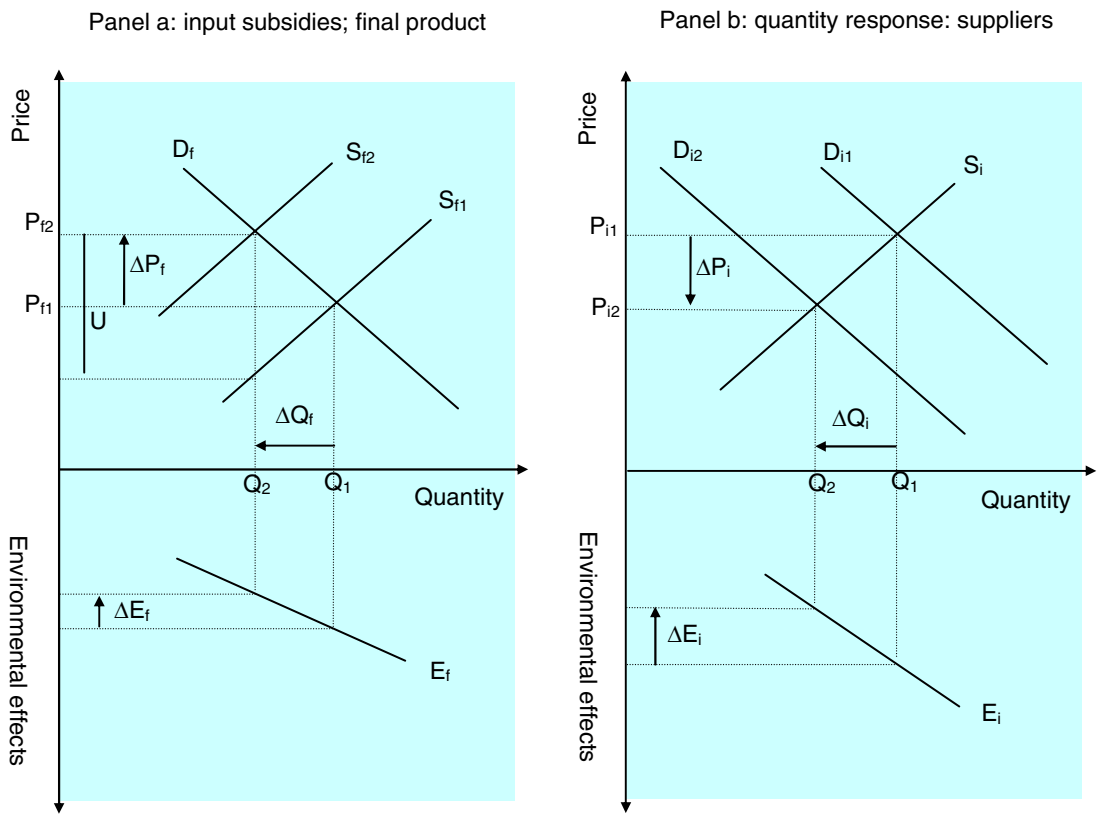
As is true in most sectors, subsidies come in a wide variety (WWF, 2001), and the responses of fishermen to these various types of subsidies may differ strongly. Subsidies to fuel, for example, immediately affect the cost of each trip and deprive more energy-efficient propulsion and refrigeration from some, if not all, its cost advantage. Removing these subsidies is likely to have an immediate effect. Removing subsidies that affect the costs of the vessel, by contrast, will primarily reduce the entrance of new vessels. Fishing-port infrastructure is likely to open up or enlarge markets at no cost to the fishermen; stimulating demand and supply, and removing subsidies can make fishermen leave the sector. Foreign-access payments by governments enlarge their fishing grounds at no cost to the fishermen. Substantial subsidies are paid for alleviating the hardships of restructuring the fishing industry. Although they may not be as effective could be wished, removing them could make reducing capacity politically even more difficult than it is. Holland *et al.* (1999) highlight the importance of differences in design and other circumstances for the effectiveness of fishing vessel buy-back schemes. This sounds as a warning that policy design and circumstances might be decisive for the effectiveness of other subsidy removals.

Appendix 2.2

The Role of Elasticities

Subsidies tend to leak away from their intended recipients. Suppliers will raise their prices in view of increased demand and customers will pay less if supply is increased. When subsidies are removed, in general the opposite will occur. The degree to which this happens depends on the price elasticities of both supply and demand for the final product of the subsidised sector. In Figure A.1 the role of price elasticities, as well as the effect of forward linkage is illustrated.

Figure A.1. Quantity responses of suppliers due to subsidy removal



Key

D:	Demand curve	P:	Price	S:	Supply curve
E	Environmental effect curve	Q:	Quantity	U	Subsidy

With and without a subsidy respectively
Suffix f, i: Final product, input respectively
ΔQ_f, ΔQ_i: Quantity decrease in the sales of the final product and the input respectively

Assume no substitution between inputs (no change of technology). Then the decrease in sales of the final product equals the decrease in input sales. The total environmental burden then decreases with the sum of ΔE_f and ΔE_i. If the production of the input has a larger environmental burden per unit of output, which is often the case, then the larger the portion of the environmental improvement caused by the reduction in the demand for the input will be.

$\Delta Q_{f \text{ and } i}$ depends on the size of the subsidy and the elasticities of supply and demand of the final product as follows:

In panel a, let β_f be the price increase due to the loss of the subsidy U, and γ_f be the relative volume decrease related to the relative price increase in terms of the withdrawn subsidy U.

$$\beta_f = \frac{\Delta P_{f1}}{U} \text{; and} \qquad \gamma_f = \frac{\Delta Q_f / Q_{f1}}{U / P_{f1}}$$

The price elasticities of demand and supply (absolute value) are:

$$\eta_f^d = \frac{\Delta Q_f}{\Delta P_f} * \frac{P_{f1}}{Q_{f1}} \text{; and} \qquad \eta_f^s = \frac{\Delta Q_f}{U - \Delta P_f} * \frac{P_{f1}}{Q_{f1}}$$

Then:

$$\beta_f = \frac{\eta_f^s}{\eta_f^s + \eta_f^d} \text{; and} \qquad \gamma_f = \eta_f^d * \beta_f$$

In panel b, the relative price increase of the input is:

$$\frac{\Delta P_i}{P_{i1}} = \frac{1}{\eta_i^s} * \frac{\Delta Q_i}{Q_{i1}} = \frac{1}{\eta_i^s} * \frac{\Delta Q_f}{\Delta Q_{i1}}$$

This is a very much simplified model. In reality the weighted average of the supply elasticities of the inputs equals the supply elasticity of the final product. But this (over-) simplified model nevertheless illustrates the role of the demand and supply elasticities in determining the effects of the removal of a subsidy that lowers marginal production costs. The quantitative relationships between subsidy removal and volume effects can only be established using partial or, preferably, general equilibrium models.

The conclusion remains that the removal of a cost-reducing subsidy might have significant upstream environmental effects. All other things being equal, the larger the supply elasticity of the input, the more this occurs.

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Chapter 3

The Political Economy of Environmentally Harmful Subsidies

Abstract

The removal of environmentally harmful subsidies offers the tantalising prospect of a "win-win" situation for both the economy and the environment. Yet, despite growing environmental awareness and pressures on government budgets, governments around the world have been reluctant to dismantle perverse subsidies. This chapter therefore attempts to identify the political and economic impediments to subsidy reform in developed economies. Since government policies are ultimately a consequence of political choices, it is necessary to examine the political incentives and motives of policy makers. Accordingly, three main issues are addressed here. First, the reasons as to why otherwise responsible governments support policies that are both economically and environmentally harmful are identified. Second, the tactics used by various groups to influence policy decisions are discussed, providing insights into the reasons why governments shelter some sectors to the detriment of society at large, but not others. Finally, in the light of these political realities, the discussion examines ways of tackling some of these obstacles and impediments to reform.

Introduction[1]

Environmentally damaging subsidies are a ubiquitous feature of the economic landscape. While precise estimates remain elusive, owing to differences in definitions and lack of published data, the magnitude of the problem is well established (Steenblik, 2003). For instance, estimates suggest that farmers in OECD countries receive subsidies of USD 200 billion per annum (OECD 2002)), fisheries subsidies total between USD 14.5 and USD 20.5 billion annually (Milazzo 1998), while energy sector subsidies are estimated at USD 245 billion (IEA 2001). There is widespread concern that many of these policies promote environmental damage in addition to fostering economic inefficiencies: a lose-lose outcome.

Examples of the environmental damage caused by subsidies abound. In Europe, Japan and Korea governments have paid over USD 7.3 billion to pig farming, which has aggravated problems of water pollution. Although certain groups may benefit from these policies, society as a whole loses as a result of price distortions and pollution costs. In the US, government subsidies to sugar farmers have resulted in increased pollution in the Everglades, leading to a reduction in biodiversity. More generally, it is estimated that over 80% of the subsidies paid to the agricultural sector are environmentally harmful (Myers and Kent 1998). Pollution problem are exacerbated by energy subsidies that encourage the use of fossil fuels, through higher emissions of greenhouse gases (Anderson and McKibbon 2000). Subsidies that encourage coal mining have resulted in permanent damage to groundwater supplies in Europe (Anderson 1995).

The economic damage caused by subsidies is also widespread. Subsidies tend to distort price signals, shelter inefficient industries and are generally detrimental to economic well-being and growth. An IEA study estimated that energy subsidies result in net welfare losses of USD 275 billion (IEA 2001). Furthermore, the absolute and relative magnitude of these subsidies has distorted trade patterns and impeded progress on trade liberalisation.

Not only are many subsidies economically wasteful and environmentally damaging, but they may also be counterproductive and fail to meet their stated objectives. For instance, despite considerable overcapacity in the fishing industry, governments continue to subsidize the fishing sector. This simply promotes further fishing effort which has contributed to the decline in global fish stocks. Paradoxically, the industry is being undermined by the very subsidies that are provided to protect incomes in the industry. Similarly, subsidies to agriculture induce higher production, which in turn lowers equilibrium prices, leading to demands for increased support for the sector in a growing number of countries.

The removal of such harmful subsidies therefore offers the tantalising prospect of a "win-win" situation, for both the economy and the environment. Yet governments around the world have been reluctant to dismantle perverse subsidies, despite growing environmental awareness and pressures on government budgets. This paper therefore attempts to identify the political and economic impediments to subsidy reform in developed economies. Since government policies are ultimately a consequence of political choices, it is necessary to examine the political incentives and motives of policy makers. Accordingly, this paper addresses three main issues. First, we attempt to identify the reasons why otherwise responsible governments support policies that are both economically and environmentally harmful. Second, we examine the tactics used by

various groups to influence policy decisions, which provides insights into the reasons why governments shelter some sectors to the detriment of society at large, but not others. Finally, in the light of these political realities, the discussion turns to ways of tackling some of these obstacles and impediments to reform.

At the outset a clarification is in order. Definitions of environmentally harmful subsidies vary. An OECD (1996) study defined subsidies as "*any measure that keeps prices for consumers below market levels, or for producers above market levels, or that reduces costs for consumers or producers*". Other studies use a broader definition which encompasses policy inaction – such as the failure to correct environmentally and socially harmful externalities. The discussion in this paper is not limited to any one definition. The principles that are described apply to any policy distortion which arises when the (marginal) costs of the policy exceed the (marginal) benefits. Accordingly, the terms subsidy, policy concession and policy distortion are used interchangeably in what follows.[2]

The analysis in this chapter is organised as follows. The basic political economy framework is presented first and is followed by a section exploring the factors that determine the demand for government support, followed in turn by one that deals with constraints on the government in delivering policy concessions and concludes with a discussion of politically feasible subsidy reform strategies.

The Political Economy Framework

This section presents a general framework that captures the key tensions and conflicts that are likely to influence subsidy policy making in a democratic system. To do so, it is necessary to abstract from the institutional details and the full complexity of political processes that are specific to particular countries and sectors. Despite this simplification, the approach offers some useful general policy insights.

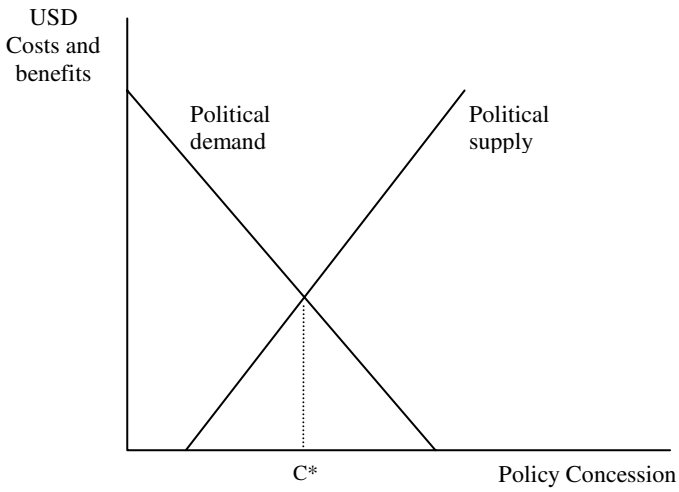
The political economy literature begins with the presumption that individuals act in their own self interest. This assumption precludes neither altruistic motives, nor enlightened leadership by policy makers. It is recognised that individuals (voters) often do care about the well-being of their fellow citizens and the environment. Similarly, politicians derive satisfaction from pursuing socially beneficial policies. The self interest assumption captures the notion that behaviour is governed by attempts to maximize certain well defined objectives – which may include both altruistic and egotistical motives.

Governments are likely to be motivated by a number of factors such as ideological objectives, social welfare and above all, the desire to retain office. Government policy decisions will reflect these complex objectives. On the other hand, citizens who are affected by government decisions may attempt to influence policies by signalling their preferences through various channels. For instance, policy preferences can be "voiced" by lobbying the government for policy favours, or through political campaigns, or through voting choices. The manner in which policies are determined is therefore analogous to an implicit political market, where citizens signal their policy demands (or preferences) and the government responds with policy supply schedules.

Figure 3.1 portrays a hypothetical political market for a policy concession such as an environmentally damaging subsidy in, say, the agricultural sector. Since the policy confers benefits mainly to farmers, they may be willing to expend both effort and resources to signal their preferences to the government. The empirical evidence indicates

that interest groups communicate their demands to politicians in three ways: (*i*) providing information to legislators, (*ii*) lobbying to gain access to key politicians and decision makers, and (*iii*) political contributions paid to either political parties or individual legislators (Grossman and Helpman, 2002). Clearly, the greater the costs involved in signalling sectoral preferences to policy makers, the lower the level of effective demand for the policy will be. Hence, the demand curve for policy concessions will have the usual downward slope. Conversely, the government's willingness to supply policy favours will increase with political and other benefits that accrue to it from implementing the policy. Hence the government's policy supply curve slopes upwards. The equilibrium level of subsidies to the agricultural sector is determined by the intersection of these demand and supply curves at C* in Figure 3.1.

Figure 3.1. A hypothetical political market for a policy concession



Political, legal and economic institutions determine the limits and effectiveness of each group in achieving its desired objectives. Well organised and cohesive political pressure groups are usually more successful in translating their policy preferences into political demands than, say, unorganised individuals. Similarly, in democracies voter resistance may act as a constraint on the ability of a government to deliver narrow sectoral concessions. These and other factors (discussed in the following sections) determine the success of various groups in achieving their desired policy objectives. This very simple framework can go a long way to explaining the prevalence of subsidies in some sectors of the economy and the political impediments to subsidy removal.

The Political Economy of Policy Concessions: the Demand Side

What factors determine how governments allocate scarce resources among competing demands? It is instructive to divide government spending programmes into two general categories: (*i)* expenditure on broadly targeted public goods such as defence, health and education, and *(ii)* expenditure on narrowly targeted programmes, like agricultural support, or fishing subsidies. Since different groups in society are likely to value these

differently, each represents a specific type of economic and political pressure (*i.e.* demand) on the government.

The benefits of a broadly targeted programme, and the tax costs of funding these programmes, are widely and uniformly dispersed in the economy. Moreover, because of their (public good) nature, the benefits of these programmes cannot be easily tailored to the needs of specific groups. Since these programmes confer benefits and costs upon a large number of individuals, the scope and details of these programmes are likely to be determined and debated in electoral contests.

In contrast, the benefits of a narrowly targeted programme are concentrated, while the tax costs are thinly diffused over society at large. Thus, the general tax-paying voter can afford to ignore these targeted programmes, since each bears only a small fraction of the supply cost. On the other hand, because of the higher stakes involved, the beneficiaries have a greater incentive to be politically active and lobby the government to defend the policy. It follows that the size and form of targeted programmes will reflect features such as lobbying intensity and political priorities, rather than voter preferences.

In addition, these policies will be highly skewed in favour of those sectors that are better able to translate their policy preferences into effective political demands – typically organised and politically vocal lobby groups. In terms of Figure 3.1, the political demand schedule of a group that can successfully organise itself into a political lobby will be higher than that of an unorganised group. Hence, such groups receive greater government support. This conclusion dates back to Tullock (1959) and Becker (1983) amongst others.

Returning to the problem of environmentally damaging subsidies, it is clear that the benefits of perverse subsidies are concentrated and accrue to producers, rendering lobbying highly profitable for these groups. However, the financial burden of supplying these benefits and the environmental damage are widely diffused across society at large. Hence, there is little countervailing lobbying pressure, or electoral pressure, for the elimination of these perverse subsidies. Political resistance to these subsidies is made even more difficult since the environmental consequences are usually less visible, eventuate with a lag, and hence are harder to attribute to a specific policy concession. Thus, demonstrating the economic and environmental costs of subsidies is difficult, whereas beneficiaries can more easily provide concrete anecdotes of the direct social benefits (*e.g.* employment, regional growth, etc.), while ignoring all the indirect effects (costs).

Since the policy favours secured by a sector depend upon its ability to translate preferences into effective political demands, it is necessary to determine why some groups are more effective in signalling their needs in the political market than others. The problem of lobby group formation and lobbying intensity has been the focus of much research at least since Olson (1965). On the one hand, individuals who have similar preferences have much to gain from pooling their resources to pursue a common policy goal. However, there is a temptation for each participant to "free ride". Those who share the group's objectives can benefit from its political efforts, without contributing to any of the lobbying costs. For example a farmer will benefit from a subsidy, whether or not (s)he contributes to the lobbying effort. It is often assumed that lobbying is easier to organise and sustain in smaller groups, with more homogenous interests (Olson 1965). However, empirical support for this conjecture is mixed. Andres (1985), Masters and Keim (1985), and Humphries (1991) find that small numbers induce greater lobbying, whereas, Grier *et al.* (1991) report an inverted-U shaped relationship between the level of lobbying. In contrast, Zardkoohi (1985) reports ambiguous results.

The success of large and disparate sectors (such as the agriculture and fishing industries) in securing government support suggests that neither small group size, nor homogeneity is necessary for lobbying success. Instead, the intensity of lobbying by individuals is related to the amount that is at stake. The greater the individual benefits (rents) created by a policy, the greater is the willingness to devote resources to protect these benefits (rents). Analogously, when the losses from the withdrawal of a subsidy are large this will unleash greater political opposition and lobbying against attempts to abolish the subsidy. Thus, the magnitude and the distribution of benefits jointly determine the size of rents created and the constituency of beneficiaries. These in turn influence the intensity of lobbying. In the case of agriculture the subsidies are sizeable and heavily skewed in favour of large farmers (OECD 1995). Since the benefits are highly concentrated, each (large) beneficiary has a strong incentive to lobby intensively against removal of the subsidy. Thus governments face strong political barriers to the removal of farm subsidies. This has implications for the design of subsidy reform programmes – an issue that is discussed later in this paper.

Explaining the Pattern of Support

Table 3.1 provides an estimate of the level of support, as measured by the Effective Rate of Protection (ERP) in two of the manufacturing industries that have been classified by the World Bank (2000) as among the most pollution intensive (leather and metals) and the two least polluting industries (electronic equipment and transport equipment).

Two comments are in order. First, whether by accident or design, the more environmentally damaging sectors of the economy are the recipients of greater government largesse than are the cleaner sectors. Second, the environmentally damaging industries are in the old and declining "sunset" sectors of the economy. The decline is often attributed to competition from cheaper developing country imports.

The pattern of government support could of course simply reflect a desire to protect incomes in declining sectors of the economy. While this is perhaps a valid government objective, it cannot explain why some declining sectors receive greater support than others (Cassing and Hillman, 1982). Nor can it explain why governments choose to ignore the pollution costs.

In conventional political economy terms too, this pattern of support is difficult to rationalise. In general, declining (sunset) sectors with fewer resources at their disposal should be less successful in lobbying governments and influencing polices than the richer, rapidly growing "sunrise" industries. For governments too, the economic benefits of support for a growing industry (*e.g.* higher growth, exports etc.), must surely exceed the benefits of support for a declining, low productivity sector. Furthermore, an industry having to battle (lobby) on two fronts – trade protection and environmental concessions – will exhaust its limited lobbying resources more rapidly than an industry that lobbies on only one policy issue, say, protection. Thus, the more pollution-intensive industries should be less effective in lobbying governments for protection and should receive less government support than their growing cleaner counterparts. We now turn to possible explanations for this seemingly paradoxical pattern of protection.

Table 3.1. An estimate of the level of support in the two most pollution-intensive and the two least polluting industries as classified by the World Bank (2000)

Effective Rate of Protection	Aus	NZ	Can	USA	GBR	Deu	Dnk	Swe	Fin	REU	Average
Transport Equip (clean)	0.04	-.08	0.01	0.03	0.01	0.01	0.01	0.01	0.01	0.02	0.007
Electronic Equip (clean)	0.08	0.06	0	0.02	0.05	0.06	0.02	0.02	0.04	0.05	0.04
Leather Prods (polluting)	0.85	0.24	0.3	0.21	0.07	0.06	0.06	0.03	0.04	0.05	0.191
Metals (polluting)	0.41	0.14	0.06	0.06	0.04	0.05	0.05	0.02	0.03	0.02	0.086

Source: Elbehri and McDougall 2000.

Consider first the tendency to support the more environmentally damaging industries. Environmentally damaging industries can influence government decisions in a variety ways – one of which includes direct lobbying for policy favours. There are, however, other more subtle channels of influence. An industry can impede, or at least slow the pace of, reform by adopting strategies that raise the political and economic costs to a government of undertaking undesired policy changes. For instance, by eschewing investments in clean technologies, or more efficient (often less labour intensive) technologies, firms can credibly demonstrate to policy makers their dependence on government support. Since the industry has locked-in to a subsidy-dependent mode of production, this raises the social and economic costs of subsidy removal. Hence, policy reform is made more difficult and politically painful for the government (Damania, 2001, 2003). Subsidies and protection thus create incentives for firms to remain inefficient and under-invest in new and more efficient technologies. Such policies therefore create an economically and environmentally damaging culture of subsidy dependence.

Under these circumstances policy concessions once introduced will be difficult to eliminate. When an industry commits (locks in) to a subsidy-dependent mode of production, supporting the *status quo* becomes politically attractive for governments. Hence subsidies persist, even when it is clear that they have failed to satisfy their intended objectives and may even be counter-productive.

Empirical support for such behaviour can be gleaned from a variety of sources. In an econometric study of environmental policy in the agricultural sector, Eliste and Fredriksson (2000) find that the greater the degree of environmental degradation variables, the higher the level of government compensation, which neutralizes the effects of more stringent environmental regulations. The authors interpret their results as implying that high polluters obtain greater support through more effective lobbying. The authors argue that: *"One possibility of our results is that the combination of environmental policies and associated transfers may in the aggregate worsen environmental quality…"*

The experience of protected "infant industries" in developing countries provides yet another example of such behaviour. Infant industries continue to be protected many decades beyond the anticipated period of protection. Moreover, increased protection has been associated with higher production costs [Krueger and Tuncer (1982), Baldwin (1988), Baldwin (1992), Lucas (1984)]. The reason is clear: underinvestment in cost-saving initiatives can be credibly used to raise the political and economic costs of reform

and sustain high levels of protection. Hence, governments have discovered that dismantling protection for these industries has been politically difficult.

Consider next the ability of environmentally damaging and old industries to secure government support and concessions on a number of policy fronts. Evidence suggests that the more environmentally damaging industries not only receive greater trade protection and industry subsidies (on average), but also face laxer environmental controls. Recent work by Spagnollo (2000) indirectly addresses this issue.[3] Firms in industries that are naturally polluting (*e.g.* due to their input requirements), and therefore incur pollution abatement costs, will face an *additional* policy battle compared to other industries, everything else equal. This enables such industries to sustain greater co-operation and lobbying because firms that face multiple areas of regulation have more to lose should co-operation on lobbying fail. Hence, these industries find it easier to overcome collective action problems and sustain lobbying. If there are increasing returns to lobbying, as is often suggested, this simply reinforces the tendency to lobby more intensively when faced with multiple regulations. The empirical evidence based on a cross-section of U.S. manufacturing industries is consistent with this explanation. Industry political action committee contributions, and the level of lobby group co-operation and lobbying, are greater in industries that are affected by both environmental factors and trade policy regulations (Damania, Fredriksson and Osang, 2003).

Constraints on Rent Seeking: the Supply Side

The discussion so far has focused mainly on the political demand (lobbying) for policy favours. The ability of a government to respond to these demands will depend upon the institutional and political constraints within which it operates. Clearly, policy concessions to individual groups will be greatest when political institutions are conducive to governments exchanging policy favours in return for some of the rents generated by these policies. There is a general presumption in the literature that electoral competition tends to constrain such rent-seeking behaviour, and drives political parties towards policies that are beneficial to broad segments of the electorate (Treisman, 2000, Deacon 2003, Rose Ackerman 1999, Johnston 1999). There is also some empirical support for this conjecture. For instance, Deacon (2003) finds that after controlling for a variety of factors, the level of public good provision is greater in democratic regimes than in autocracies.

While electoral competition limits the degree of policy distortions, however, this disciplining force is far from perfect. Special interest groups may not only influence policy choices of appointed representatives, but may help to elect representatives who serve their interests. For instance, the rents (*e.g.* political contributions) paid by lobbyists can be used to influence the outcome of an election. Political advertising is one obvious way in which political contributions can be used to gain a possible electoral advantage (Grossman and Helpman 1996). Alternatively, governments may build political coalitions with representatives of sectoral interest groups, thus eroding the beneficial effects of political competition.

There are other more subtle reasons why political competition may not eliminate policy distortions. With greater political competition, deviations in policies from voters' preferences will impose greater electoral costs on a party. However, rival political parties can insulate themselves from these electoral costs by allowing their policies to converge (and thus offering the electorate no real choice between parties). Doing so allows the main parties to extract rents (political contributions) from special interest groups, while

neutralising the political (electoral) costs of the ensuing policy distortion. Thus, even though electoral competition may act as a beneficial force, it cannot be relied upon to deliver policy improvements when there is sufficiently intense lobbying by special interest groups. Moreover, the greater the amount at stake, the greater the degree of lobbying will be. The somewhat gloomy conclusion that emerges from the literature is that institutional structures cannot necessarily be relied upon to eliminate rent-seeking behaviour.

Strategies for Reform

The arguments presented in this paper suggest that the main obstacles to subsidy reform stem from economic and political incentives. Narrowly targeted policy concessions give beneficiaries strong incentives to resist reforms. Since the economic and environmental costs of these policies are widely spread and less visible, there is little countervailing lobbying or electoral pressure for the abolition of such policies. The obvious implication is that policies which curtail the political (lobbying) power of sectoral interest groups will be most successful in achieving policy reform. However, these are the very policies that will be most strongly resisted by powerful interest groups. Moreover, since political incentives are shaped by institutional and legal factors, which cannot be easily altered in the short run, there is probably not much that can be done in a specific policy context to directly curb the level of rent seeking by special interest groups. Strategies for subsidy reform must therefore take rent-seeking behaviour as a fixture. The problem is therefore one of designing reforms that are politically feasible and do not ignite strong political opposition.

The relationship between subsidy cuts and political pressures is complex and depends greatly upon the specific economic and political climate in each country. The effect of subsidy reforms will also vary greatly across any given sector. Hence, identifying losers, in particular the most politically vocal ones, and thresholds at which political opposition intensifies, is likely to be a difficult process. Existing studies tend to be stronger at highlighting the obstacles to policy reform, rather than specifying the mechanisms that can be used to deliver policy reform. There is unlikely to be a single set of strategies that would work across all sectors, in all countries. Rather the appropriate set of reforms will be specific to each country and industry. It therefore seems appropriate to evaluate the political prospects of some of the more promising reform strategies that have been suggested.

Competition and Competition Policy

The intensity of lobbying by the beneficiaries of policy concessions is typically related to the rents that accrue from a policy (Grossman and Helpman 1994). Fostering greater competition (both domestic and international) is clearly one way in which these rents can be reduced. There is growing evidence that more open economies adopt more stringent environmental policies and that sectors exposed to greater international competition generally pollute less (Hettige *et al*. (1992), and Antweiler *et al*. (2001)). This is a direct consequence of the lower rents earned in more competitive industries, which in turn reduce the lobbying power of domestic interest groups, leading to improvements in environmental regulations and outcomes.

However, the very factors that allow a sector to impede reforms in one domestic policy domain (*e.g.* subsidies), can of course be used to resist reforms on other policy issues (*e.g.* trade or competition policy). Hence, while introducing competition-enhancing

reforms is highly desirable, they may prove to be as difficult to introduce as subsidy reform itself.

Information

It is possible that voter resistance to environmentally harmful subsidies is muted since public knowledge of the economic and environmental costs of perverse subsidies is lacking. In such situations, the provision by government of greater information could stimulate voter opposition to subsidies and make subsidy reform less politically damaging for governments. However, as noted earlier, even with stronger voter support, subsidy reform is not assured when the lobbying stakes are high. Policy convergence allows rival parties to secure the rents from policy concessions, without suffering significant electoral loss.

Policy Redesign

If the political obstacles to subsidy removal are insurmountable in the short run, it may be necessary to adopt a less ambitious approach. Reform may only be feasible by compensating potential losers. Governments could continue to offer subsidies, but ensure that the subsidy targets more beneficial objectives.

Social goals such as poverty alleviation and income support are legitimate government concerns. If income support is the ultimate goal of policy, it is questionable whether subsidies achieve this objective. Subsidies are an inefficient and blunt tool for addressing poverty problems. First, there is evidence that the bulk of agricultural support accrues to large farmers – arguably not the intended target of income support.[4] Second, input- and output-related subsidies trigger over-production and pollution, thereby adding to the social costs of the subsidy programme. Third, subsidies artificially create a larger constituency of lobbyists whose interests may not necessarily coincide with those of the industry.

One way of reducing the dependence of the sector is to directly assist those in need. The EU is pursuing such a policy by "de-linking" subsidies from production. However, the reforms to date have been modest and most support remains linked to production levels. This is unsurprising since such a change can be expected to spur opposition from recipients who might fear that a direct transfer would make transparent the extent of support to particular sectors and thus to stimulate voter opposition.

If environmental improvement is the main policy objective, policies such as environmental taxes, permits or quotas could be used to reduce environmental damage. However, any environmental policy that raises production costs is likely to be met with strong sectoral resistance. The political forces that allow special interest groups to impede subsidy reforms would also preclude the introduction of any cost-increasing environmental regulation. Hence the empirical evidence indicates that even when more stringent environmental policies have been introduced, they are accompanied by other policy concessions which negate the environmental benefits (Eliste and Fredriksson 2000).

Political feasibility may therefore require that subsidies (which compensate losers) be used to control environmental damage. However, subsidies are known to be less efficient at correcting environmental problems than other policy instruments (*e.g.* pollution taxes, or tradable permits). This is partly a consequence of poor subsidy design. Most environmental subsidy schemes offer a producer (polluter) a fixed, predetermined sum of

money to undertake (curb) some environmentally desirable (harmful) activity. However, the costs of undertaking these activities and the incentives of producers will vary across any sector. Hence, some producers will receive more than would be necessary to induce them to undertake the desirable activity. This is one reason why environmental subsidies tend to be less effective in controlling environmental harm than other policy instruments.

Recent innovations in Australia suggest ways in which these problems can be addressed. A (sealed bid) auction was used where each farmer submitted a bid on the subsidy (s)he required to achieve an environmental objective. The auction was found to be 60% more cost-effective at achieving environmental goals than other more conventional environmental policies (Stoneham, 2002). In the current context there are four obvious advantages to such an approach. First, since participation is voluntary, the self-selection mechanism serves to curb the degree of lobbying opposition to the policy. Second, the auction automatically targets the most responsive (elastic) components of the sector. Third, competition between bidders in (a well designed) auction will reduce (minimize) the amount that will need to be paid to "purchase" any given environmental outcome. Finally, this reduces the size of the constituency of lobbyists whose interests (inadvertently) lie in pursuing environmentally damaging activities. The success of this initiative suggests the need for further research on ways to improve the efficiency and effectiveness of subsidies in achieving their stated goals.

Notes

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2. It is recognized that not all subsidies are harmful. For instance where the marginal benefit of an activity exceeds the marginal social cost, it may be optimal to subsidize the activity, one example being immunization against infectious or contagious diseases.

3. Spagnolo (2000) models (theoretically) issue linkage in international agreements. He does not discuss lobby group formation, or the determination of trade protection or environmental policies. See also Bernheim and Whinston (1990) and Conconi and Perroni (2001).

4. In the case of US cotton production subsidies, limiting payments per farm simply led to the subdivision of large farms to the threshold size such that most of the subsidy still goes to the previous beneficiaries.

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Annex

A Stocktaking of OECD Work on Subsidies[1]

Background

OECD Ministers asked the OECD Secretariat to initiate work on environmentally harmful subsidies in 2001. In 2004 they renewed their long-standing commitment to reduce trade distorting and environmentally harmful subsidies. The World Summit on Sustainable Development had also addressed the problem of environmentally harmful subsidies and the adopted Plan of Implementation includes several references to them. While the OECD is internationally recognised as a leading organisation in the field of subsidy measurement and analysis, especially for agriculture, fisheries and coal, the work is characterised by a range of methodological approaches, patchy and incomplete data, and non-comparable subsidy estimates across the various sectors.

This annex provides an overview of subsidies[2] in OECD countries. It is based on the work carried out by the Directorate for Food, Agriculture and Fisheries, the Environment Directorate, International Energy Agency, the Directorate for Science, Technology and Industry, the Trade Directorate and the European Conference of Ministers of Transport. It draws heavily on the background papers prepared for the OECD Workshop on Environmentally Harmful Subsidies.

In some sectors work has been carried out to assess the environmental impacts of subsidies. While most of this work consists of *ad hoc* studies, work on agricultural subsidies has been more systematic in identifying the relative impacts of support on the environment. The approach used in agriculture could provide a possible way forward to identify environmentally harmful subsidies in the other sectors. This approach, however, does not help to assess the extent to which subsidies accomplish other policy objectives and, consequently, cannot be used to identify which specific subsidies should be phased out. It would nevertheless appear that a lot of the existing subsidies are potentially harmful to the environment and reforming or phasing them out would benefit society as a whole.

Overview of Subsidies in OECD Countries

Many OECD countries are committed to reducing subsidies in the different sectors of the economy, but they have made only limited progress in this over the past ten years. Although the methodologies and coverage differ, and consequently the subsidies data are not directly comparable across sectors, the figures do give an indication of the relative importance of the different sectors in this regard. Agriculture is the sector with the most complete data in terms of coverage and methodology. It is also the sector with the highest subsidy figures. Subsidies measured for the other sectors, such as transport and energy, amount to only a fraction of the figure for agriculture (Table A.1).

Support to agriculture is high. In 2001, estimated total support to agriculture amounted to USD 311 billion (OECD, 2002d), which represents 1.3% of GDP in OECD countries. During the 1990s many OECD countries began to take steps to reduce and restructure their support policies in an effort to reduce overproduction and trade distortions, and to encourage more environmentally sound use of land, soil, and water. The pace of these developments has been modest and subsidies remain high in many OECD countries and for some commodities, causing production and trade distortions as well as adverse effects on the environment. In 2001, support to farmers represented 31% of the value of their farm receipts, compared with 38% in the mid-80s.

Table Annex 1. Subsidies in OECD countries

	Billion USD			
	1990	**Most recent data [year]**	**Coverage**	**Comments**
Agriculture	351	311 [2001]	Total support estimate; includes market price support, budgetary payments and support for general services; covers all OECD countries.	Equivalent to 1.3% of GDP.
Transport (road and rail)		40 [1998]	Subsidies estimated as the difference between total revenues and total social costs; includes the European Union, Hungary and Switzerland.	Nash *et al.* (2002) estimated that revenues cover on average 36% of rail system costs.
Energy production	n.a.	20-30 [1999]	Aggregate estimate.	
of which *- Coal production*	11	5 [2000]	Includes market price support, budgetary payments and support for general services; includes France, Germany, Japan, Spain, Turkey and UK.	Equivalent to USD 68 per tonne of coal produced.
Manufacturing	44 [1993] *49 [1992]*	*22 [EU]*	Net government expenditures to industry. Figures in *italics* cover the EU only and include grants, interest subsidies, tax exemptions, equity participation, soft loans, tax deferrals and loan guarantees, converted into cash grant equivalents.	Figures in *italics* from the EU State Aid Survey.
Of which *- Shipbuilding*	.. *2.5 [1995]*	0.75 [2000] *1 [2000]*	Figures in italics cover the EU only and include grants, interest subsidies, tax exemptions, equity participation, soft loans, tax deferrals and loan guarantees, converted into cash grant equivalents	Figures in *italics* from the EU State Aid Survey.
- Steel	*2.2 [1995]*	*- [2000]*	Includes grants, interest subsidies, tax exemptions, equity participation, soft loans, tax deferrals and loan guarantees, converted into cash grant equivalents; EU only.	Figures from EU State Aid Survey.
Fisheries	n.a. [9 in 1996]	6 [1999]	Government financial transfers to the marine capture fisheries; includes direct payments, cost-reducing transfers and general services. The 1999 figure excludes Australia, Belgium, Mexico, the Netherlands, Poland and Turkey	Equivalent to 20% of landed value.
Water	..	10	Aggregate estimate.	
Forestry	..	6	Aggregate estimate; includes only Canada and the United States.	

Notes: Data and calculation methods not comparable across sectors.
Sources: OECD (2001b; 2001c; 2002d), EU (2002), IEA (2001), ECMT (2000), Nash *et al.* (2002), Myers and Kent (1998, 2001).

Some OECD countries have restructured their agricultural support policies and shifted from price support to less production and trade-distorting payments. Nevertheless, by 2001, price support (market price support and output payments) still accounted for nearly 70% of producer support, which is about ten percentage points lower than in the mid-80s. To the extent that support is necessary, support provided through targeted budgetary measures is preferable to price supports or subsidies tied to the use of inputs (OECD, 2002d). The former are generally more transparent, potentially less distorting of product markets, less environmentally damaging, and might be more effectively targeted. In implementing the Agricultural Agreement of the Uruguay Round of multilateral trade negotiations, the OECD countries also started to increase access to their domestic markets and reduce export subsidies for agricultural products.

Both explicit and implicit subsidies are found in the transport sector. Subsidies for road and rail transport in the European Union, Hungary and Switzerland amounted to about USD 40 billion in 1998 (Nash *et al.,* 2002). The estimate is based on a broad definition of subsidies that compares total revenues with total social costs for each mode of transport (in other words internalises externalities).[3] In nearly all countries, revenues from road transport cover the total social cost, whereas other modes of transport are heavily subsidised. Thus phasing out transport subsidies would divert traffic from other modes, especially rail, to road. Although there might be some reduction in the total amount of transport, the increase in road transport would have negative effects on the environment. According to Nash *et al.* (2002), passenger and freight revenues cover, on average, 36% of rail system costs.

Subsidies to energy producers in the OECD countries are estimated to be around USD 20-30 billion per year (IEA, 2001). A third of these energy subsidies support coal production, which has decreased dramatically in OECD countries along with the subsidies. Consequently, there has been no major reduction in coal subsidies measured in USD per tonne of coal produced over the past ten years (IEA, 2001, 2002)[4]. Subsidised production is expected to decline further over the next few years, as coal production is expected to decrease further and several OECD countries plan to phase out their remaining subsidies.

Manufacturing subsidies have decreased significantly over the past ten years. In the European Union, state aid to manufacturing amounted to about USD 22 billion in 2000. Industry subsidies are increasingly directed to horizontal causes such as regional development, R&D and SMEs rather than to specific sectors such as steel and shipbuilding.

Fisheries subsidies in OECD countries amounted to around USD 6 billion in 1999, representing 20% of the total value of landings (Cox, 2002). The figure refers to government financial transfers to the marine capture fisheries, which includes direct payments, cost-reducing transfers and general services. Most transfers go to general services devoted to fisheries infrastructure, research, management and enforcement. Although the transfers are aimed at ensuring the sustainable use of fish stocks and the aquatic ecosystem, they have contributed to over-capacity in fishing fleets and to over-fishing of some fisheries. Many of these transfers still persist, and are preventing or inhibiting necessary structural adjustments. In recent years, OECD countries have increasingly been directing transfers towards removing capacity. In 1997, they spent USD 350 million to decommission vessels and retire licences (OECD, 2000c). In the absence of adequate harvest and participation controls, however, payments aimed at reducing fishing effort have not improved the sustainability of resource use, as vessels

that remain are both more efficient at harvesting fish and are employed for longer hours. Ensuring coherence between transfer policies and resource management policies can reduce the negative environmental impacts of some types of transfers. Furthermore, some of the incentives for vessel retirement in OECD countries have led to an export of this excess fishing capacity to non-OECD countries, contributing to over-exploitation of resources in their fisheries as well.

There are only anecdotal estimates on subsidies in the forestry and water sectors. Forestry subsidies in Canada and the United States are estimated to be around USD 6 billion and water subsidies in the OECD countries around USD 10 billion (Myers and Kent, 1998, 2001). According to Myers and Kent (2001), the figures are uncertain, but they claim that at least in forestry this is less important as the subsidies in the sector are relatively small. There are all too few data on water subsidies in almost all OECD countries. Irrigation subsidies are included in the figures for agricultural subsidies, although the information on these is often patchy and data gaps remain.

Methodological Differences

Although the focus of this annex is not on the different methodologies used to estimate subsidies, it is important to highlight the extent to which methodological differences and data gaps limit the comparability of subsidy figures across sectors (or as the case may be, within a sector). The strengths and weaknesses of the main approaches used in domestic and international subsidy assessments are summarised in Table A.2. In a programme-specific approach, subsidies are measured by adding the value transferred to market participants from particular programmes. In a price-gap approach, subsidies are measured as the difference between the observed and the "world-price" for a commodity. Producer and consumer-support estimates are based on a methodology that captures both pricing differences financed by consumers (market transfers) and transfers financed by taxpayers (budgetary transfers).

The approaches used to estimate subsidies differ in the amount of data required to calculate them and in the degree to which budgetary payments and market transfers are measured accurately. A programme-specific approach captures the value of government programmes benefiting (or taxing) a particular sector, whether these benefits are to the advantage of consumers (as lower prices), producers (through higher revenues), or resource owners (through higher rents). Unless integrated into a macroeconomic model, this information tells little about the ultimate incidence of the subsidy programmes and their effect on market prices. By definition, the price-gap approach highlights observed price distortions, though it misses the often substantial budgetary support that does not affect consumer energy prices but does affect the structure of supply. The producer and consumer support estimates provide insights into both.

The OECD calculates producer and consumer support estimates for agriculture and coal production. A programme-aggregation approach is used for fisheries and manufacturing. A marginal social-cost approach is used for transport. Consequently, the extent to which the estimated subsidies produced by the three different methodologies can be compared is very limited.

Table Annex 2. Overview of subsidy measurement approaches

Approach/Description	Strengths	Limitations
Programme-aggregation: Quantifies financial transfers associated with various government programmes. Aggregates programmes into overall level of support.	Captures transfers whether or not they affect end-market prices. Can capture intermediation value (which is higher than the direct cost) of government lending and insurance.	Does not address questions of ultimate incidence of pricing distortions. Sensitive to decisions regarding inclusion of programmes. Requires programme-level data.
Price-gap: Evaluates positive or negative "gaps" between the domestic price and the world price. Also known as Market Price Support.	Can be estimated with relatively little data. Useful for multi-country studies. Good indicator of pricing and trade distortions.	Sensitive to assumptions regarding "free market" and transport prices. Understates full value of support by ignoring transfers that do not affect end-market prices.
Resource rent: Estimates the difference between the full economic rent and the price paid for exploiting a natural resource.	Relevant for natural resource sectors such as forest and water.	Data intensive. Sensitive to assumptions.
Marginal social cost: Estimates the difference between the marginal social cost (that internalises all externalities) and the price paid.	Most comprehensive approach. Used for transport.	Data intensive. Requires a significant amount of modelling. Sensitive to assumptions and has a wide range of uncertainty.
Producer/consumer support estimate: Systematic method to aggregate budgetary transfers and consumer transfers (through market price support calculation) to specific industries.	Integrates budgetary transfers with market price support into holistic measurement of support. Distinguishes between support to producers and consumers.	Data intensive. Currently calculated for agriculture and coal production, but not for other sectors.

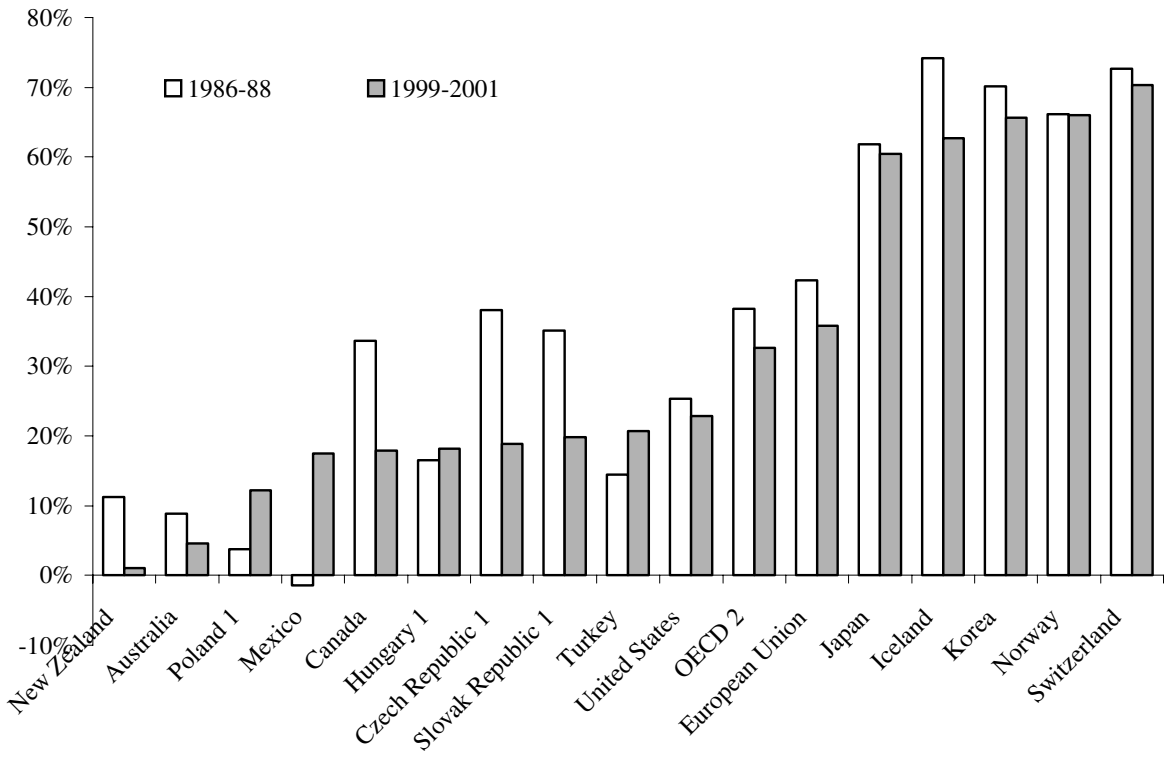
Source: Based on Koplow and Dernbach, 2001.

Agriculture

The OECD Producer Support Estimate (PSE) measures the annual monetary value of gross transfers from consumers and taxpayers to support agricultural producers, measured at the farm-gate level, arising from policy measures that support agriculture, regardless of their nature, objectives or impacts on farm production or income (OECD, 2002d).

The OECD calculates PSEs for the EU as a whole, the other OECD countries, and a number of non-member countries. In the case of the EU they cover policy transfers from the EU, national and sub-national budgets, while only the latter two budget levels are relevant and covered in all other countries. The calculations cover the period starting in 1986 and are updated every year in light of the most updated information available in the Secretariat. The calculation for the year on which the calculations are made is always preliminary or provisional. Although results are presented on a calendar-year basis, they generally cover crop season for crop-specific data, and budget year for other data, which often cover parts of two consecutive calendar years.

Figure Annex 1. Producer support as a share of farm receipts (percentage)



Notes: Countries are ranked according to 1999-2001 levels.

1. For the Czech Republic, Hungary, Poland and the Slovak Republic 1986-88 is replaced by 1991-93.
2. For 1986-88, the Czech Republic, Hungary, Poland and the Slovak Republic are excluded.

Source: OECD, PSE/CSE database, 2002.

The work on the Producer Support Estimate and the Policy Evaluation Matrix (PEM) together with the conceptual work on the impact of support on environment allow support measures to be ranked according to their relative impacts on the environment (OECD, 2002d). Details on the ranking are shown in Box. A.1.

Box Annex 1. Relative potential impacts of producer support measures on the environment

All other things being equal, the main categories of PSE measures can be ranked according to their relative impacts on the environment as follows:

Market Price Support and ***Payments based on output*** both increase the price received by producers for a specific commodity such that the more the commodity is produced, the higher will be the support. Thus, the higher these forms of support, the greater is the incentive for monoculture, for increasing the use of inputs (such as chemicals), and/or for using environmentally sensitive land, and the higher the pressure on the environment. Moreover, these payments have the lowest effectiveness in achieving environmental goals, as they are sector-wide payments that cannot be targeted to any environmental goal or situation that are generally local.

Payments based on input use reduce the cost of inputs used by producers such that the more the input is used the higher will be the support. Thus, the higher these payments, the greater the incentive to use the input, and the greater the impact on production and the environment. The more the payment is specific to a variable input (*e.g.* fertiliser, pesticide) the greater the incentive for production intensification, and the pressure on the environment. For example, the environmental impact of a credit subsidy for purchasing fertilisers or pesticides is potentially higher than a credit subsidy for acquiring farmland or extending farm buildings. Therefore, these payments may have a higher, the same, or a lower effect on production and the environment than an output payment depending on the type of input on which the payment is based.

Payments based on area planted/animal numbers reduce the cost of land/livestock for current plantings/ animal numbers. As producers have to plant a specific crop or own specific animals, these payments may be an incentive for keeping environmentally sensitive land producing commodities that are environmentally-unfriendly on such land. Although these payments may be targeted to a specific environmental goal or situation, they provide an incentive to bring additional land or animals into specific production and encourage monoculture in the same way as the payments based on output. However, as producers are not encouraged to increase yields and to produce as intensively as they are with the forms of support outlined above, the environmental impact of these payments is potentially lower.

Payments based on historical entitlements (past support, area, animal numbers, production, or income) and ***Payments based on overall farming income*** (paid on the condition that the overall farmers' income is below a pre-defined level) also have the potential for retaining environmentally sensitive areas under production. However, as producers are not obliged to plant, own animals, or produce any particular commodities in order to receive these payments, they allow for individual choices on environmentally-friendly production techniques, and do not encourage production intensification and/or monoculture. Therefore, the impact of these payments on the environment is relatively benign or lower than the forms of support mentioned above.

Payments based on input constraints are paid on the condition that farmers respect certain constraints (reduction, replacement or withdrawal) on the use of inputs, often for environmental purposes. These payments may be targeted to specific environmental situations to address specific environmental issues associated with agriculture. They may be instrumental in offsetting the reduction of a positive environmental impact or limiting the increase of a negative environmental impact of farming activities benefiting, in many cases, from one or more of the preceding forms of support. These mainly use input constraints to reduce production intensity, encourage production diversification, or put environmentally sensitive land aside from production, in relation to what would otherwise occur. The environmental impacts of these payments depend on the type of constraint, but they have the potential to reduce environmental pressure and to be the most environmentally effective PSE measures.

Source: OECD, 2002d.

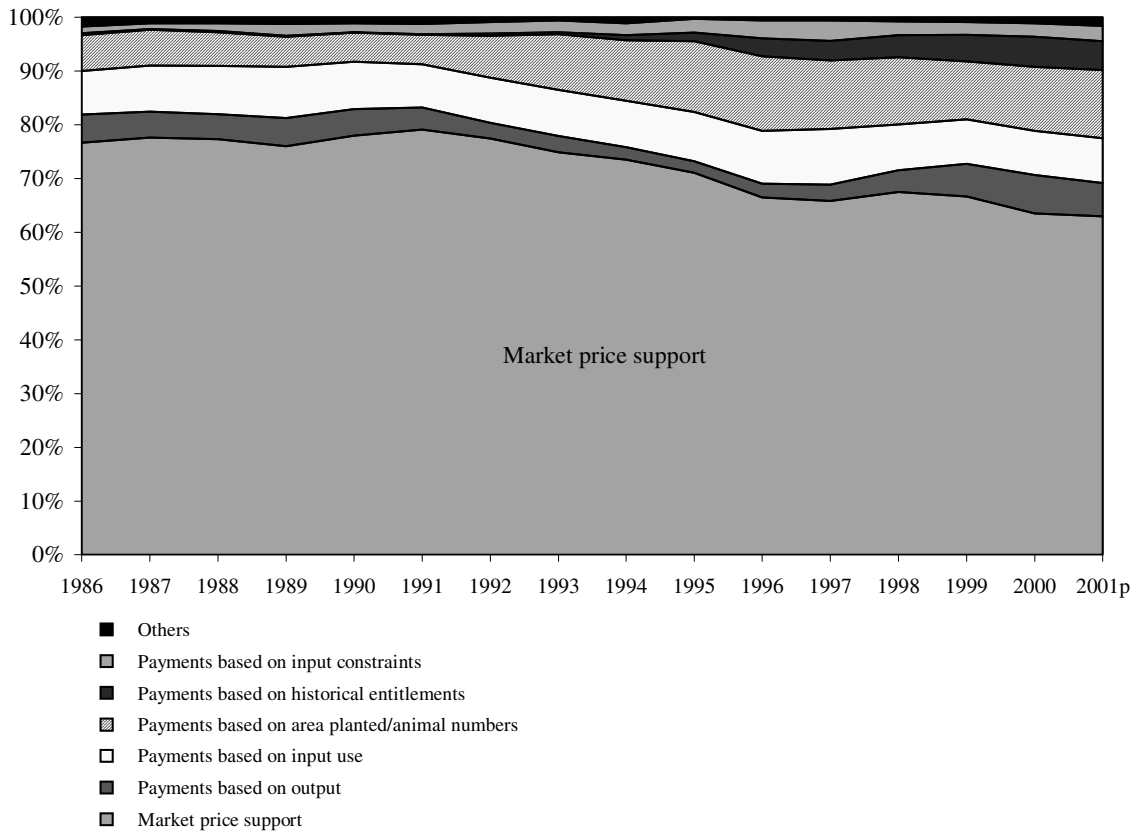
Trends in OECD Countries

In 2001, total support estimate to agriculture amounted to USD 311 billion (OECD, 2002d), which represents 1.3% of GDP in OECD countries. During the 1990s many OECD countries began to take steps to reduce and restructure their support policies in an

effort to reduce overproduction and trade distortions, and to encourage more environmentally sound use of land, soil, and water. The pace of these developments has been modest and subsidies remain high in many OECD countries and for some commodities, causing adverse effects on the environment. In 2001, support to farmers represented 31% of the value of farm receipts, compared with 38% in the 1986-1988 period (Figure A.1).

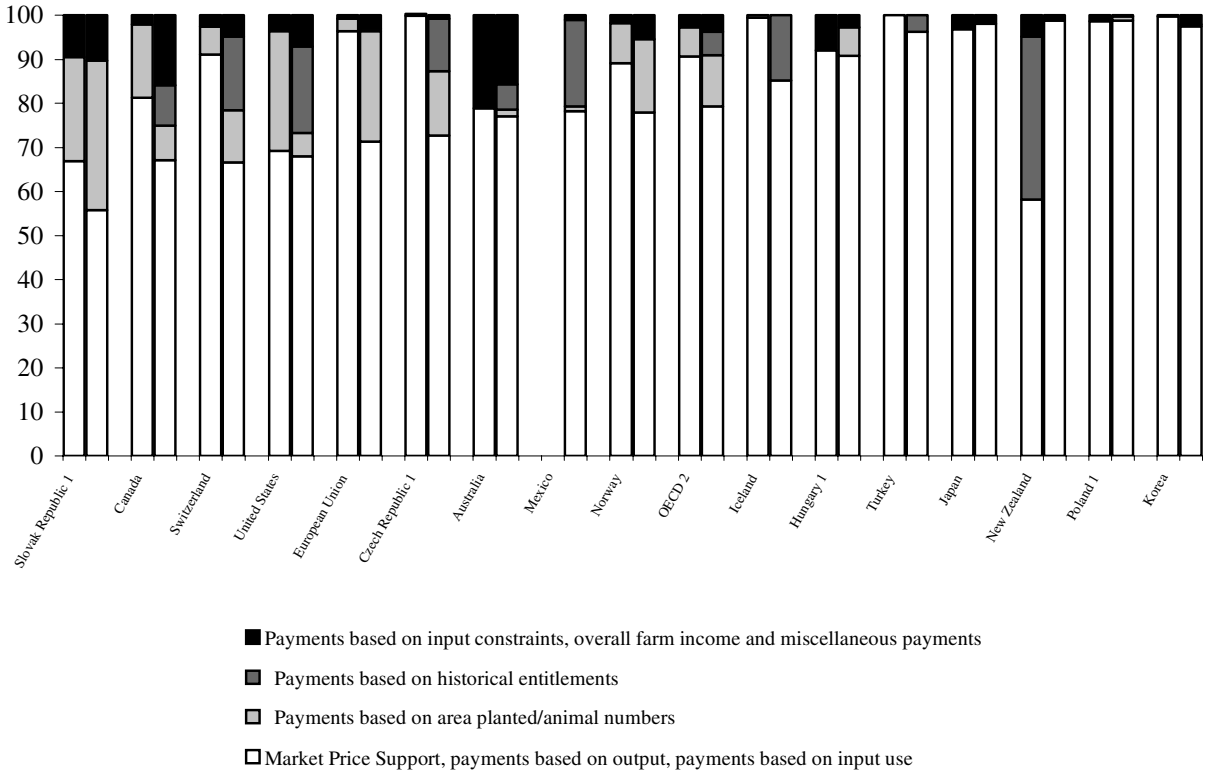
The share of market price support, output payments and input subsidies (such as interest, water, fertiliser, and energy subsidies), which are potentially the most environmentally harmful types of support, fell from 91% of support to producers in the mid-1980s to 78% by the end of the 1990s (Figure A.2). This share varies across countries, and is highest in the countries with the highest levels of support (Figure A.3). For example, over the period since 1986-88 it has remained above 95% in **Japan** and **Korea.** However, it decreased by 11 percentage points to 78% in **Norway**, and by 25 percentage points to 66% in **Switzerland**.

Figure Annex 2. Composition of Producer Support Estimate (PSE) (1986-2001)



Source: OECD, PSE/CSE database, 2002.

Figure Annex 3. Composition of Producer Support Estimate by country 1986-88 and 1999-2001 (percentage share in PSE)



Notes: Countries are ranked according to 1999-2001 levels of market price support and payments based on output.

1. For the Czech Republic, Hungary, Poland and the Slovak Republic 1986-88 is replaced by 1991-93.
2. For 1986-88, the Czech Republic, Hungary, Poland and the Slovak Republic are excluded.

Source: OECD, PSE/CSE database, 2002.

Fisheries

The Fisheries Committee has collected data on financial support to fisheries in 1965, 1971, 1980, 1993, and for 1996-1999. The OECD collects data on direct payments, cost-reducing transfers and general services to the marine capture fisheries. Other international data sources for fisheries subsidies include the WTO and the EU State Aid Survey, details of which are shown in Table A.3.

Table Annex 3. Fisheries subsidy data available

Source	Coverage	Reliability	Frequency
OECD	Government financial transfers to marine capture fisheries, includes direct payments, cost-reducing transfers and general services.	Good.	Every two years.
WTO	Measures reported under the WTO Agreement on Subsidies and Countervailing Measures: direct transfers of funds, fiscal incentives, and government provision of goods and services other than general infrastructure.	Variable, many programmes not reported. Inconsistencies in reporting among member countries.	Annual.
EU State Aid Survey	Grants, interest subsidies, tax exemptions, equity participation, soft loans, tax deferrals and loan guarantees, converted into cash grant equivalents	Good.	Annual.

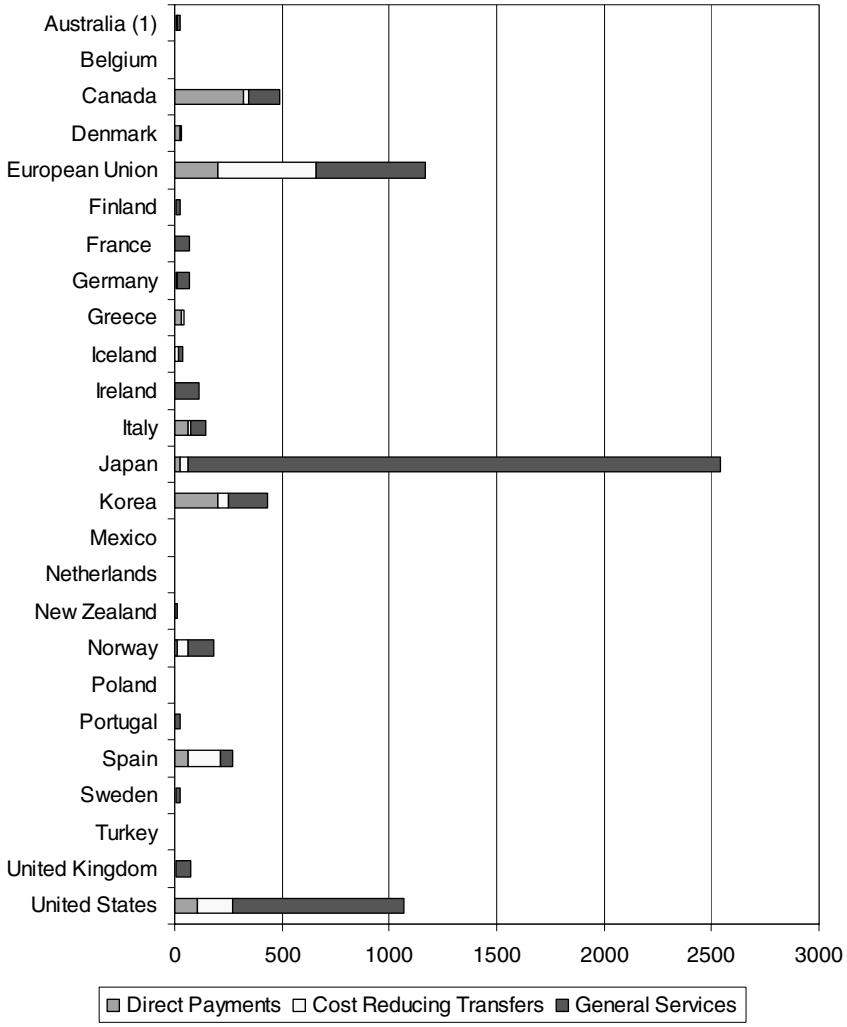
Source: OECD Secretariat.

Trends in OECD countries

The OECD countries have supported their fishing industries with significant amounts of money and over long periods of time. The latest estimate for fisheries subsidies in the OECD countries is USD 6 billion in 1999 (OECD, 2001c) (Figure A.4). This corresponds to 20% of the value of landings (Figure A.5). Japan provides the largest fisheries subsidies in the OECD, followed by the European Union, United States, Canada, Korea, Spain and Norway.

Most of the government financial transfers in the OECD countries are for general services. Expenditures on research, management and enforcement activities are important as they can contribute to ensuring the sustainable use of fish stocks and the aquatic ecosystem. In some countries, however, the bulk of the expenditure on general services is on fisheries infrastructure and fisheries enhancement programmes that can contribute to over-fishing (Cox, 2002). The introduction of cost-recovery programmes for some research, management and enforcement expenditure in some countries implies that some of these activities directly benefit fishers, rather than society as a whole (Cox, 2002). Capacity-reducing transfers, including vessel buyback programmes, licence retirement schemes and payments to fishers to leave the industry, have been widely used in OECD countries in response to over-fishing and over-capacity (Cox, 2002).

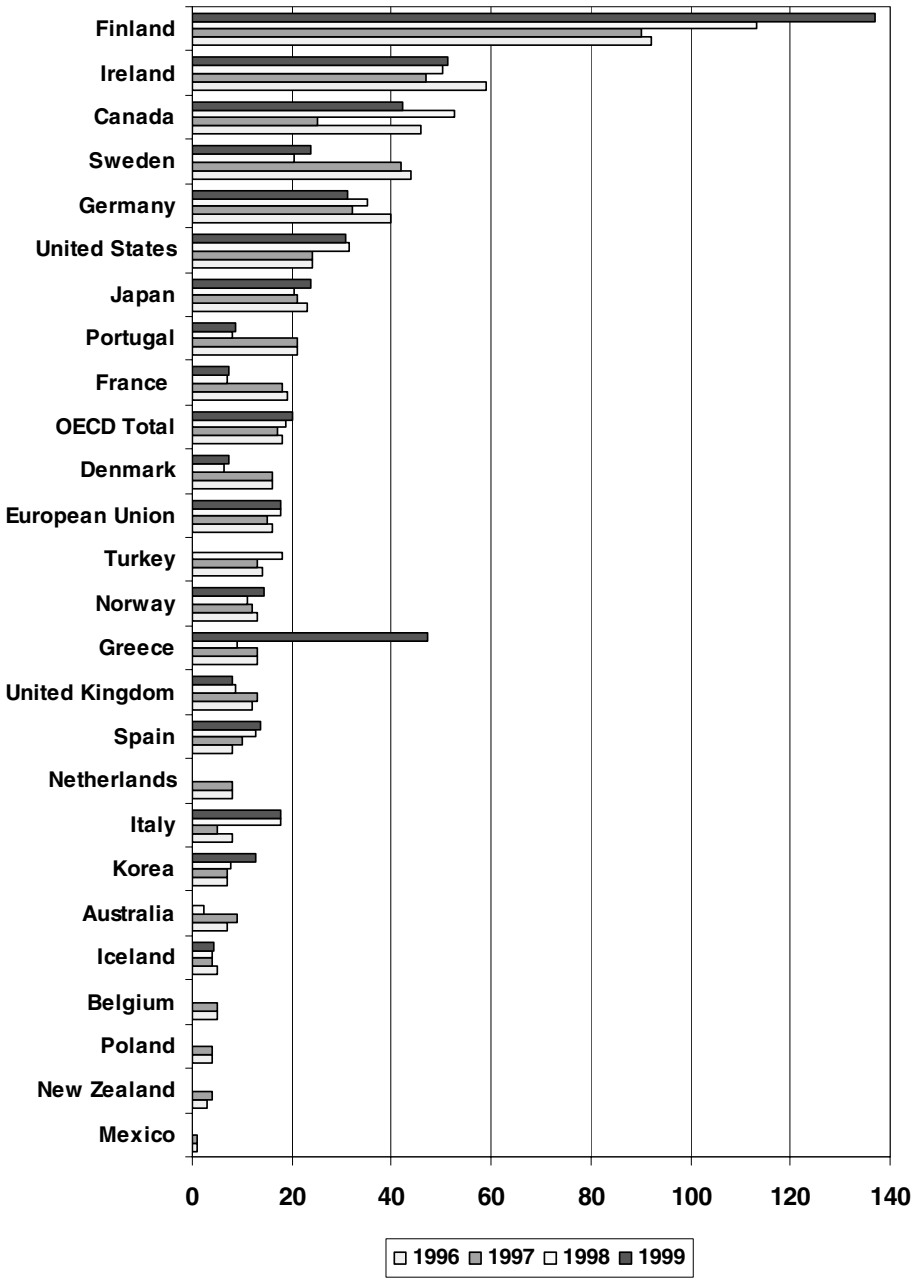
Figure Annex 4. Financial transfers in OECD countries in 1999



Notes: (1) Figures refer to 1998.

Source: OECD, 2002.

Figure Annex 5. Financial transfers as a share of landings (percentage)



Source: OECD, 2002.

Forestry

The OECD has not collected information on forestry subsidies. Nor have any of the other international institutions, and consequently there is no dataset on government transfers to the forest sector for OECD countries or for other groups of countries. The

European Forest Institute, however, launched a four-year international research project in 2001 called "Evaluating Financing of Forestry in Europe" (EFFE). This project is the most comprehensive effort to collect data on forestry subsidies. It aims at evaluating public forestry expenditure programmes in twelve European countries between 1990 and 1999. Data collection was carried out during 2002 and country reports containing national data made available in early 2003. The data was analysed in the course of 2003, and the project results disseminated during 2004. The OECD has established contacts with the EFFE Secretariat and will draw on the EFFE data once these become available.

Three general types of subsidies have been widely recognised in the literature as having been provided to producers of forest products: resource rent subsidies; budgetary subsidies for road-building or other services of value to the sector; and quantitative restrictions on timber exports or high log export taxes, which benefit wood-processing industries. The most typical forestry subsidy is the deliberate failure to capture the full economic rent associated with the right to log (*i.e.* the price for timber paid by the processing industry is set at an unrealistically low level). Consequently the logging company effectively enjoys a cost-reducing subsidy and collects a windfall profit. In addition, logging companies may also benefit from hidden support through poorly designed forest concession policies and allocation procedures and the nature of fees and taxes (van Beers and de Moor, 2001). The most common types of forestry subsidies are for:

- Cutting/transport: mainly grants for harvesting in difficult terrain, transport, felling of broadleaved trees (to regenerate with spruce), technical equipment, planning of timber trade, and employment measures.
- Road-building: grants for forest road construction (where difficult terrain and remote timber supply regions have had priority), the subsidising effect of loans and tax exemptions for road construction and employment measures.
- Drainage: grants for drainage and the subsidising effect of tax exemptions.
- Sylviculture: mainly grants for sylviculture, thinning of young stands, afforestation of agricultural land, net costs of state-owned forest nurseries and the "forest seed service" and employment measures, forest improvements, sylvicultural investments and investments in forest seed plantations.
- Environment: grants for measures to enhance biodiversity or conserve cultural heritage (this also includes no action, when the alternative is timber production), forestry in broadleaved forests of high value, and inventory of key habitats and swampy forests.
- Fixed-term, interest-free loans: Loans for regeneration thinning, new drainage and forest roads have been somewhat cheaper than others.

Trends in OECD Countries

As already stated, the OECD does not collect information on forestry subsidies. The EFFE project at the European Forest Institute is the most comprehensive effort to collect data on forestry subsidies. According to Porter (2002), earlier efforts have consisted of one-off studies for certain countries (*e.g.* World Resources Institute for the United States and the Sierra Club of Canada for Canada) or incomplete estimates for larger regions (*e.g.* the European Union). The estimated total sum of EU forestry subsidies (EAGGF)

during 1994-1999 is over 2.5 billion euros[5]. About half of this sum was allocated to afforestation programmes, resulting in about 500 000 ha farmland afforestations by 1997. Another half of the forestry subsidies was targeted to various forestry development measures. Subsidies were allocated fairly disparately among EU member countries, with Spain, Italy, Germany, France, Portugal and Ireland being among the largest target countries. Myers and Kent (2001) estimate forestry subsidies in Canada and the United States to be around USD 6 billion.

Energy

The International Energy Agency (IEA) calculates the amount of financial assistance to indigenous hard coal production in France, Germany, Japan, Spain, Turkey and the United Kingdom using the producer subsidy equivalent (PSE) measure. Subsidies for coal production in other OECD countries, namely Canada, the Czech Republic, Hungary and Norway are significantly smaller than in the six "PSE"-countries (IEA, 2002 — WEO).

The IEA also reports periodically on its members' energy policies, including policies aimed at supporting energy producers. Energy subsidies range from measures such as grants and tax exemptions that directly affect costs or prices, to indirect measures, such as those that flow from government interventions that skew the market in favour of a particular fuel or government-sponsored technology research and development (UNEP/IEA, 2002, NIEIR, 1996; de Moor, 2001). The different types of energy subsidies and their impacts are summarised in Table A.4.

Table Annex 4. Types of energy subsidies

Government intervention	Example	What the subsidy does
Direct financial transfer	Grants to producers	Lowers production cost
	Grants to consumers	Lowers consumer price
	Low-interest or preferential loans to producers	Lowers production cost
Preferential tax treatment	Rebates or exemptions on royalties, duties, producer levies and tariffs	Lowers production cost
	Tax credit	Lowers production cost and/or consumer price
	Accelerated depreciation allowances or energy-supply equipment	Lowers production cost
Trade restrictions	Quotas, technical restrictions and trade embargoes	Raises production cost
Energy-related services provided directly by government below full cost	Direct investment in energy infrastructure	Lowers production cost
	Public research and development	Lowers production cost
Regulation of the energy sector that gives rise to subsidies	Demand guarantees and mandated deployment rates	Lowers or raises production cost
	Price controls	Raises production cost
	Market-access restrictions	Raises production cost

Source: UNEP/IEA (2002).

Trends in OECD Countries

Estimates of support for coal are more systematic and complete than for other forms of energy. The IEA publishes annual PSE figures for the primary production of coal, which are the only regular, systematic reporting of energy subsidies carried out by an international body. Total support to the coal industry in OECD countries fell throughout most of the 1990s from USD 11.4 billion in 1990 to USD 5.4 billion in 2000 (IEA, 2001). Germany and the United Kingdom are the countries with the biggest decreases in support (Figure A.6). Coal production declined significantly over the same time period and, consequently, support per tonne of coal equivalent increased (Figure A.7).

Figure Annex 6. Support to coal in selected OECD countries (million USD)

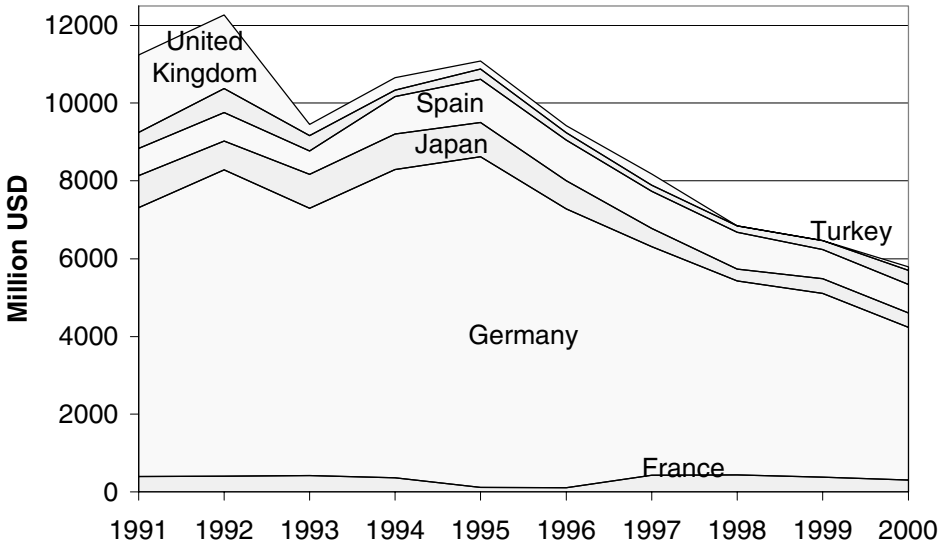
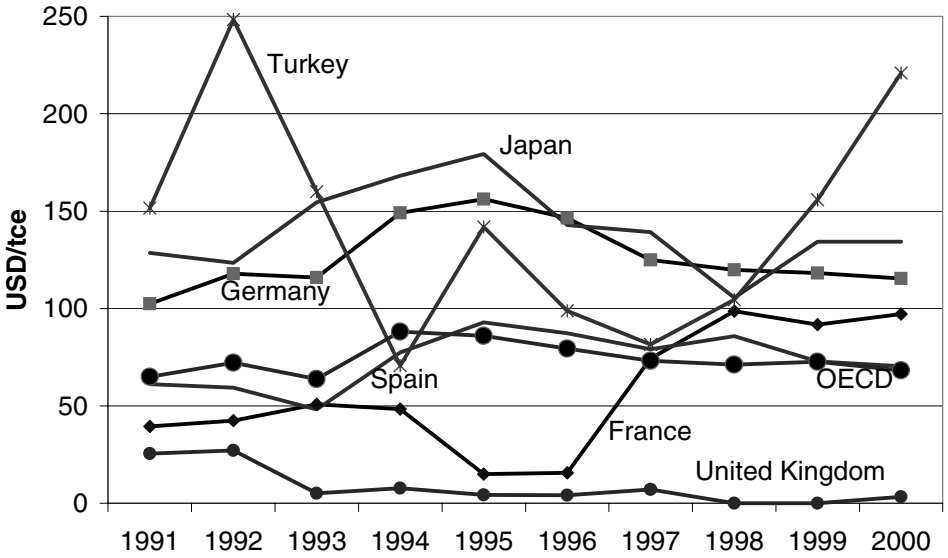


Figure Annex 7. Support to coal in selected OECD countries (USD/tce*)



* tce = Tonnes of coal equivalent.
Source for both Figures:: IEA.

Manufacturing

The Industry Committee has published several reports on support to industry. Most recently it has calculated public support in terms of Gross Government Budget Expenditure (GGBE) and Net Cost to Government (NCG) (OECD, 1998a,b). GGBE measures the total amount of funds transferred to beneficiary companies and the total amount of uncollected tax liabilities from them per year of programme. NCG measures the difference between the cost of funding a programme and the revenue generated for the public budget by the same programme in any given year. Public support was classified into ten policy areas identified as priority objectives of industrial support policies. Other data sources for manufacturing subsidies include the System of National Accounts, WTO, EU State Aid Survey and the Productivity Commission for data for Australia (Table A.5).

The Industry Committee work classifies the industrial support programmes according to their objectives. Some of the objectives are considered to benefit the environment, in particular government expenditure for improving energy efficiency and environmental protection. Other objectives can be considered to be environmentally neutral. Such objectives include support to SMEs, labour and training, and regional development. The remaining categories are sectoral aid, crisis aid, R&D and technological innovation, general investment incentives and exports and foreign trade. Apart from sectoral aid for some very specific sectors, where the negative environmental impacts are well established, it is difficult to say anything definite about the environmental impacts of the other types of support. Because some manufacturing sectors have a greater impact on the environment than others, it is important to look at which sectors receive most support.

Many support programmes aim at stimulating investments, production, or exports in the sector. In some cases subsidies are used to protect an infant or dying industry when economic development is fragile. In other cases they are motivated by regional employment or development objectives. There have been no systematic efforts to assess the environmental impacts of manufacturing subsidies.

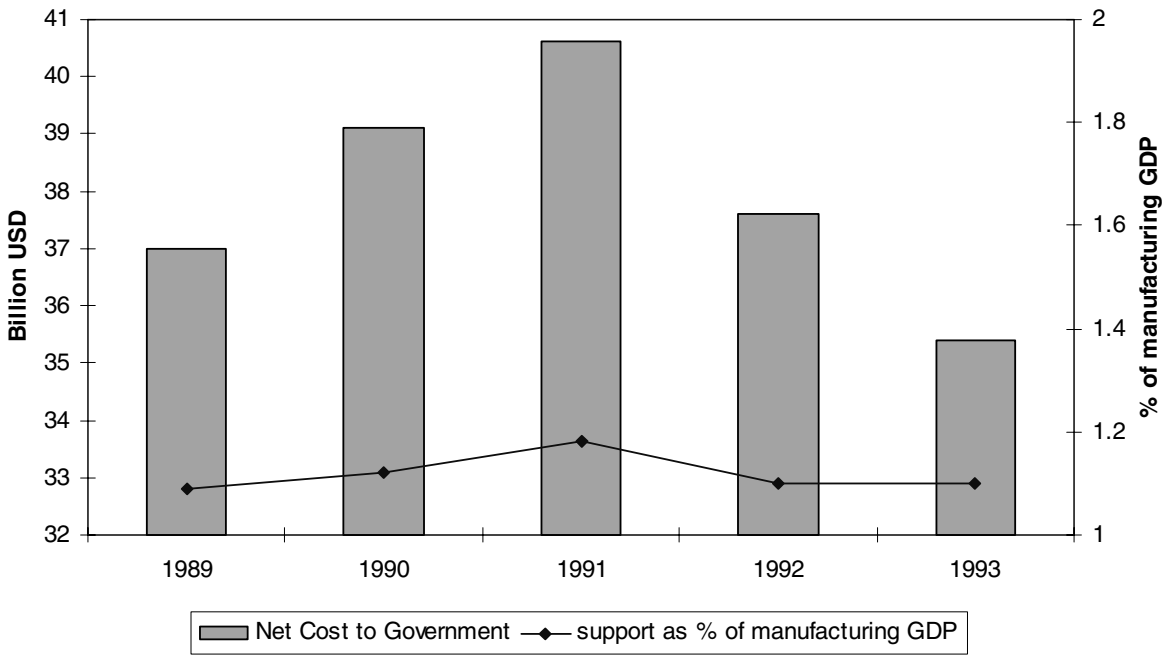
Table Annex 5. Manufacturing subsidy data available

Source	Coverage	Reliability	Frequency
OECD: Industry Committee	Industry Committee	Good.	Data collected for the period 1989-1993.
OECD: System of National Accounts	Direct grants to producers in terms of gross budgetary outlays. Excludes tax concessions, credit subsidies, consumer subsidies, market prices support, etc.	Good, but coverage is limited.	Annual
WTO	Measures reported under the WTO Agreement on Subsidies and Countervailing Measures: direct transfers of funds, fiscal incentives, and government provision of goods and services other than general infrastructure.	Variable, many programmes not reported. Inconsistencies in reporting among member countries.	Annual.
EU State Aid Survey	Grants, interest subsidies, tax exemptions, equity participation, soft loans, tax deferrals and loan guarantees, converted into cash grant equivalents.	Good, but data often too aggregated for the purpose of analysis.	Annual.
Other	Australia: Productivity Commission.	Good.	Annual.

Trends in OECD Countries

Support to manufacturing, measured in constant prices, declined from 1986 to1989, reaching USD 37 billion in 1989 (OECD, 1998a). Support peaked at USD 45.7 billion in 1991 before dropping to USD 43.7 billion in 1993 (Figure A.8). There was a 24% growth in support in nominal terms from 1989 to 1993, corresponding to a 4% decrease in constant terms during the period (OECD, 1998a).

Figure Annex 8. Support to industry in OECD countries
(USD 1993 billion and % of manufacturing GDP)

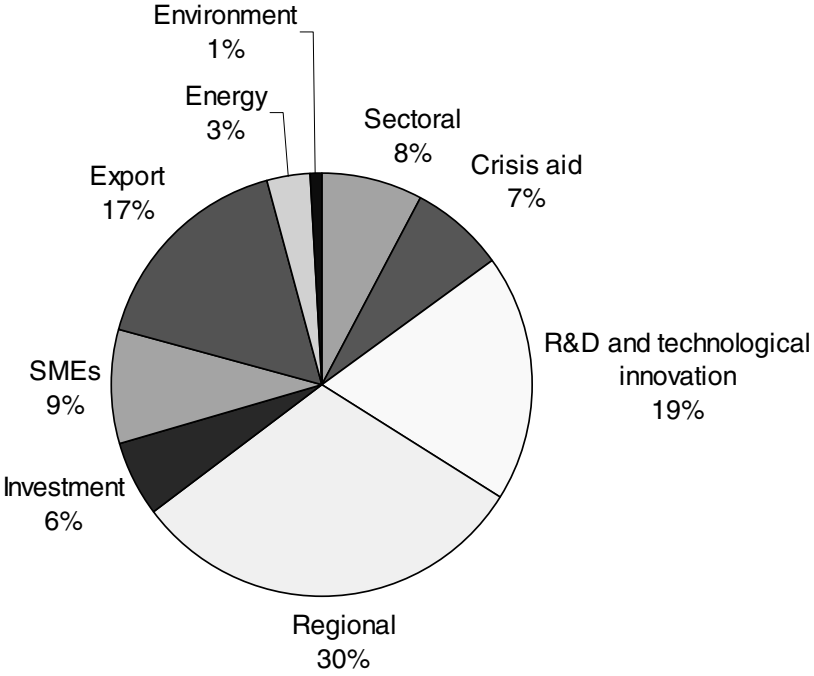


Source: OECD Industrial Support Database, OECD (1998a).

There is a continuing trend away from subsidies for particular sectors towards more horizontal objectives, including regional development, research and development (R&D) and small and medium-sized enterprises (SMEs) (OECD, 1998a). Indirect means of support, such as public procurement, R&D contracts, and R&D intermediary institutions, channel far more financial resources to manufacturing industry than direct support. Even if the support element in indirect measures only represents a very small percentage, it would still be very significant. As there is no agreed methodology for measuring the support element in indirect support, uncertainties remain as to its role as a policy instrument and, more specifically, as a tool of support to manufacturing industry. The distribution of support by policy objective is shown in Figure A.9.

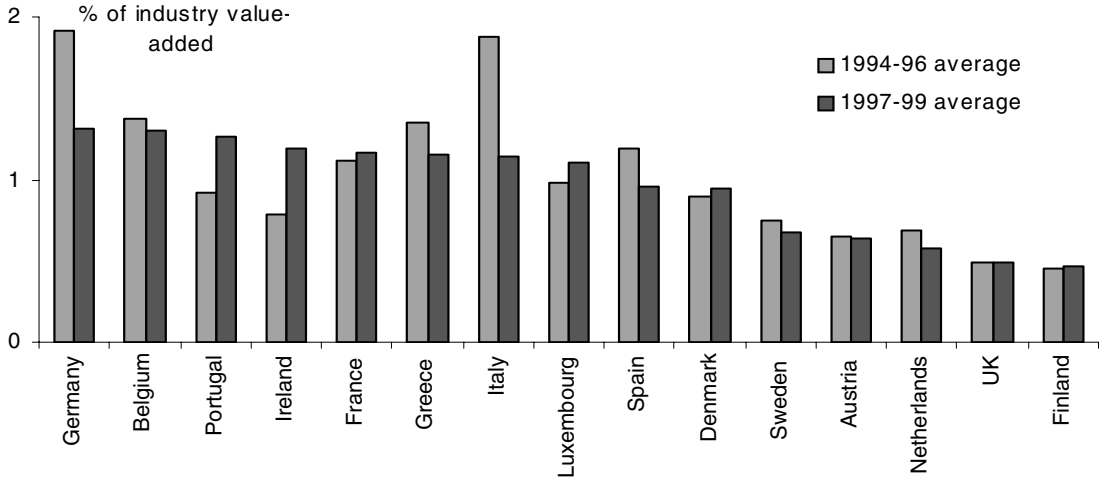
Figures A.10 and A.11 show state aid as a percentage of industry and manufacturing value-added.

Figure Annex 9. Industrial support by policy objective (as a percentage share of total support)



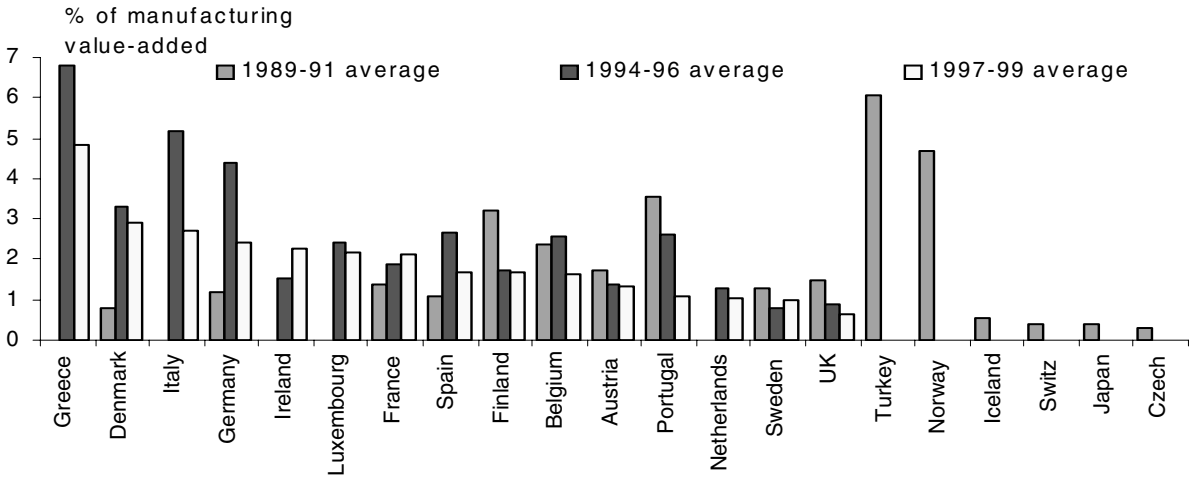
Source: OECD Industrial Support Database, OECD (1998a).

Figure Annex 10. State-aid to industry as a share of industry value-added (percentage)



Note: Industry excludes the primary sector.
Source: Based on EC (1998, 2001*b*).

Figure Annex 11. State-aid to manufacturing as a share of manufacturing value-added (percentage)



Note: The 1989-91 subsidy rates from the OECD may not be strictly comparable with the 1994-96 and 1997-99 state aid rates from the EC due to differences in coverage, methodology and definition.

Source: 1989-91 average from OECD (1998), other years based on the EC (1998, 2001*b*).

Programmes intended to support one or selected manufacturing sectors are of special interest from the environmental point of view. Most sectoral programmes target the shipbuilding industry. Other industries where sectoral programmes are common include fish processing, textiles and the steel industry. The support for the aircraft and space industries is also channelled through R&D programmes, equity capital injections, and intermediary space agencies.

Shipbuilding

The Council Working Party on Shipbuilding collects information on government subsidies provided by Member and Observer countries. Although it does not currently cover all member countries (as some have not provided the information), it covers most of the OECD area (and therefore global) shipbuilding production. The reports also provide an overall appraisal of the measures, as well as comparing the levels of support in each reporting country, based on the monetary values of the individual support measures. No specific work has been undertaken on the effects subsidies to shipbuilding have on the environment.

The monetary values included in the inventory are not always strictly comparable (for example some are direct grants, while others are only guarantees), but they do provide a measure of the financial exposure incurred by governments in providing those support measures to their industries. The comparison between support measures and production will to some extent reflect how successful government support has been in boosting output in that country. Therefore, a high average level of support will indicate (but not definitively prove) that those support measures were ineffective in producing a comparable increase in output.

The total value of cash support measures is presented in Table A.6, which shows a wide range in the amounts provided by reporting countries to their shipbuilding

industries. These range from Sweden which reported no support measures whatsoever in the last three years, to Italy which provided the equivalent of USD 973 million in support (OECD, 2001). This was nearly 50% more than the next highest, Norway. Both Turkey and Romania reported that their support activities were of a type that was not capable of being converted into monetary values. Of the major producing countries, Korea (USD 18 million) and Japan (USD 7 million) stood out as providing minimal cash support to their industries.

In total, the responding countries provided grants and subsidies to the value of USD 2.7 billion for the years 1998 to 2000. This support was highest in 1998 when a total of almost USD 1.2 billion was provided, but clearly governments have begun to reduce this type of support as this amount declined in each of the two subsequent years. In particular, the EU and Norway decided to stop providing contract-related subsidies from 2001 onwards, and this major change should be reflected in the next update of the Inventory (OECD, 2001).

Table Annex 6. Total value of cash support measures (USD million)

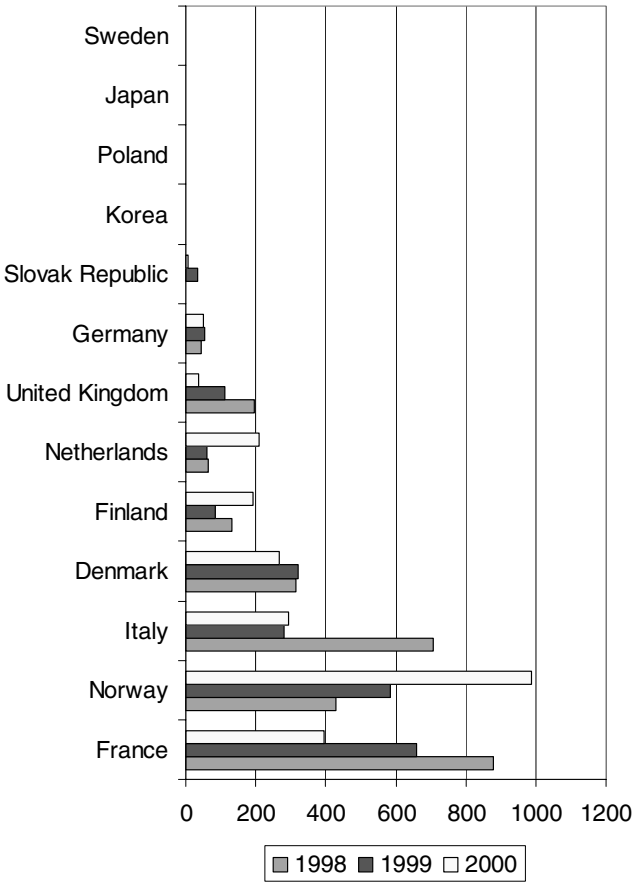
Country	1998	1999	2000	Total
Italy*	575,0	215,2	182,9	973,1
Norway	143,6	185,5	166,7	495,8
France	200,2	162,4	119,8	482,4
Denmark	112,0	104,8	69,0	285,8
Netherlands	29,2	31,9	94,3	155,4
Germany	45,2	42,8	45,3	133,3
Finland	34,4	22,2	54,0	110,6
United Kingdom*	17,5	6,3	6,4	30,2
Korea	5,5	4,1	8,7	18,3
Japan	1,7	2,4	2,7	6,8
Poland	0,2	0,5	0,9	1,6
Slovak Republic	0,3	0,3	0,2	0,8
Sweden	0,0	0,0	0,0	0,0
Turkey	n/a	n/a	n/a	n/a
Romania	n/a	n/a	n/a	n/a
Total	1 164,8	778,4	750,9	2 694,1

Where US currency equivalents were not provided, these were calculated by the Secretariat from values applicable on 30 June in the year in question.

Source: Olsen and Associates, Zurich, from its OANDA subsidiary web page.

In order to get a more balanced picture of shipbuilding subsidies, it is useful to look at support per compensated gross tonne of output as shown in Figure A.12.

Figure Annex 12. Shipbuilding: Support in USD per compensated gross tonne of output



Source: OECD Secretariat.

Steel

Work by the OECD Steel Committee shows that subsidies and related government supports have played a key role in creating and sustaining global over-capacity in steel. The steel industries in many countries have benefited significantly from subsidies and related government supports, over time. The assistance has been provided to meet a number of objectives. Grants, loans and related financial assistance, for example, have been used in developed and developing countries alike to promote the construction of facilities. Such support has been based on the strategic importance that has often been assigned to the industry by governments, and the formidable costs associated with building facilities and providing the necessary infrastructure (*e.g.* port and transportation facilities, utilities, and the like). Lacking such support, private capital may in many instances not have been sufficient to enable the construction of facilities and/or the ability of firms to attract outside capital may have been much reduced. The active promotion of investment in the industry continued in the OECD area up through the mid-1970s, at which time an economic recession and a less promising outlook suggested that over-

expansion had occurred. In other parts of the world, active promotion continued, however, in various forms throughout the 1990s.

Work by the OECD High Level Group on Steel shows that there is support among governments and private sector steel producers to reduce or, where possible, eliminate subsidies and related industry supports in the context of trade negotiations. There have been a number of developments to this effect. For example, the state aid to steel in the European Union has decreased dramatically in the past five years (Table A.7).

Table Annex 7. State aid for steel in the European Union

	USD million					
	1995	1996	1997	1998	1999	2000
Austria	4.6	4.6	4.0	4.0	3.7	2.3
Belgium	4.3	5.5	2.5	0.0	0.0	0.0
Denmark	0.0	0.0	0.0	0.0	0.0	0.0
Finland	0.0	0.0	0.0	0.0	0.0	0.0
France	0.0	10.3	0.0	0.0	0.0	0.0
Germany	104.3	6.2	2.5	0.0	0.0	0.0
Greece	0.0	0.0	25.6	0.0	0.0	0.0
Ireland	0.0	71.0	0.0	0.0	0.0	0.0
Italy	238.2	248.0	243.8	7.0	0.0	0.0
Luxembourg	2.6	0.0	0.0	0.0	0.0	0.0
Netherlands	0.0	0.0	0.0	0.0	0.0	0.0
Portugal	72.6	0.0	2.7	0.8	0.3	1.2
Spain	1 729.1	209.1	85.8	34.6	32.1	0.0
Sweden	0.0	0.0	0.0	0.0	0.0	0.0
United Kingdom	0.0	0.0	0.0	0.0	0.0	0.0
Total	2 155.7	554.6	366.8	46.4	36.1	3.5

Source: Ninth State Aid Survey, EU.

Transport

The European Conference of Ministers of Transport provides regular data on public transfers to transport infrastructure. It is currently trying to improve the comparability of the data reported by each of the 42 Member countries. The data consists of government outlays and thus cannot be interpreted as subsidies. Without the public sector there would be no transport infrastructure. Governments use a range of instruments to get back some of the money spent on government outlays through vehicle taxes, fuel duties, vignettes, highway tolls, VAT, and other user charges.

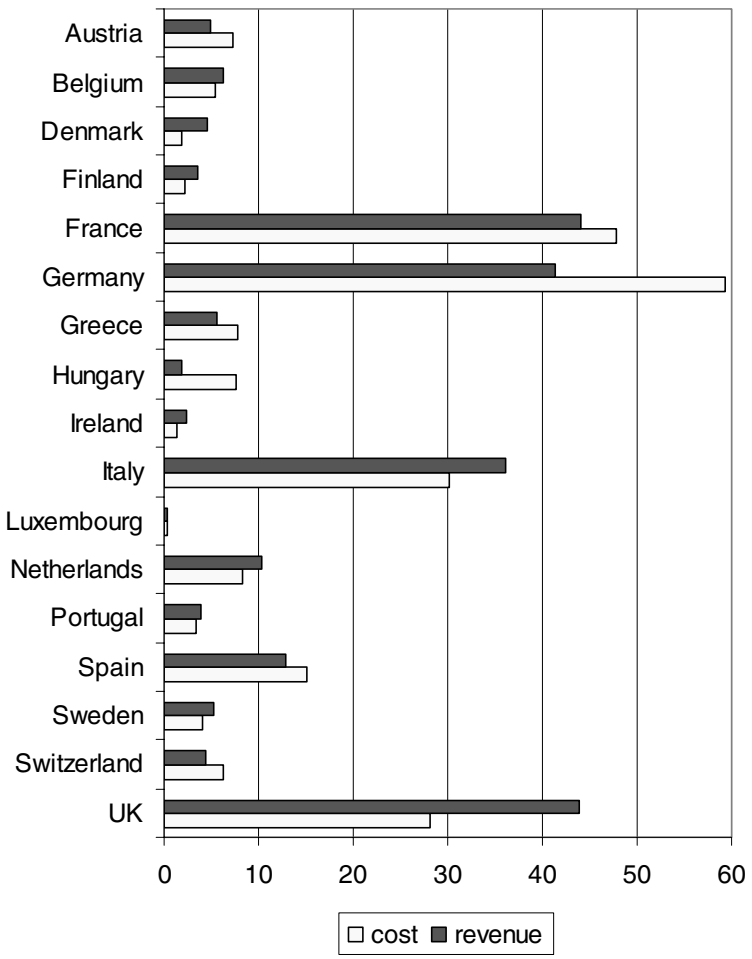
Trends in OECD Countries

Subsidies for road and rail transport in the European Union, Hungary and Switzerland amounted to about USD 40 billion in 1998 (Nash *et al.*, 2002). The estimate is based on a

broad definition of subsidies that compares total revenues with total social costs for each mode of transport (in other words internalises externalities). In nearly all countries, revenues from road transport cover the total social cost, as shown in Figure A.13. As other modes of transport are heavily subsidised, phasing out transport subsidies would divert traffic from other modes, especially rail, to road. Although there might be some reduction in the total amount of transport, the increase in road transport would have negative effects on the environment. According to Nash *et al.*, (2002), passenger and freight revenues cover, on average, 36% of rail system costs.

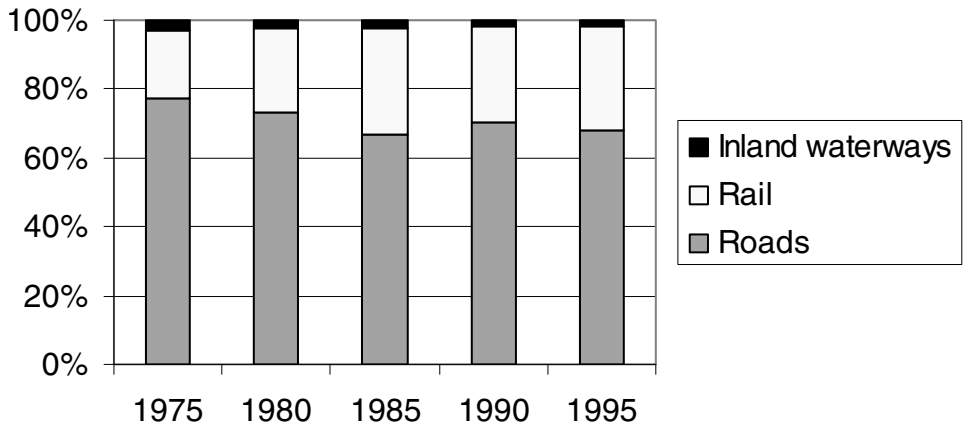
Investment in road infrastructure continues to dominate government infrastructure investment expenditures (Figures A.14 and A.15). Although the figures do not show the magnitude of the subsidies in the transport sector, they do give an indication of the extent of government involvement in encouraging different modes of transport. According to ECMT estimates, "positive transfers" amount to 23% of capital road infrastructure costs (ECMT, 2000).

Figure Annex 13. Road transport: total social cost and revenue (EUR million)



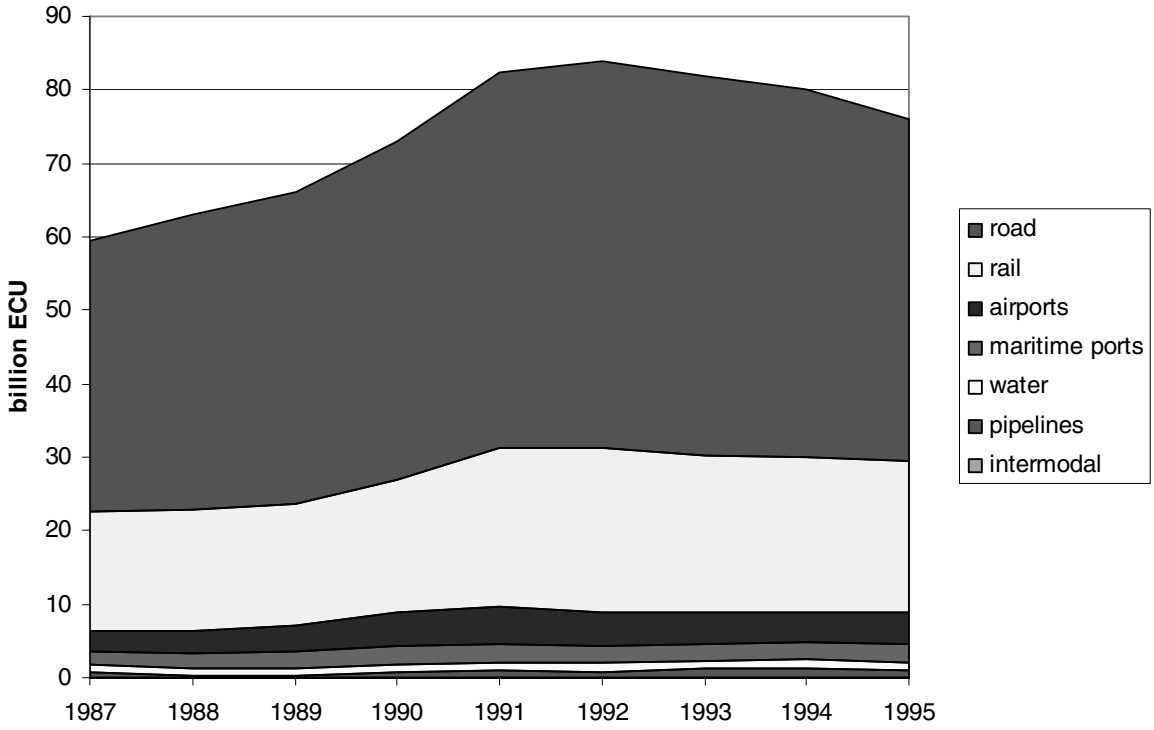
Source: Nash *et al.* (2002).

Figure Annex 14. Trends in investment share by transport mode in 18 OECD countries*



* The countries included are the 15 EU countries, Norway, Switzerland, and Turkey.
Source: ECMT (2000).

Figure Annex 15. Total investment in transport infrastructure in 18 OECD countries* (billion ECU)



* The countries included are the 15 EU countries, Norway, Switzerland, and Turkey.
Source: ECMT (2000).

Conclusion

Over the past twenty years, the OECD has made significant progress in the measurement and analysis of subsidies for sectors such as agriculture, coal production and fisheries. Factors contributing to the relatively modest progress in some of the other sectors range from complex methodological and data issues to demand for international subsidy figures. Trade-offs are made both at national and international levels as data collection is often resource intensive and aggregate subsidy estimates are only as good as the underlying data.

This annex provides an overview of subsidies in OECD countries. Although methodological and data constraints severely limit comparisons across sectors, work carried out by the OECD highlights agriculture as the sector with the highest subsidies. While the other sectors seem to pale in comparison, it is likely that subsidies are underestimated in these sectors due to the methodologies applied.

Notes

1. This annex has been written by Outi Honkatukia, Private Office of the Secretary-General, OECD.

2. This annex uses the term "subsidies", although in OECD work it is more common to refer to them as transfers, payments, support, assistance or protection associated with governmental policies. Sometimes these terms are used interchangeably, but often they are associated with different methods of measurement and thus different economic indicators. The 1995 OECD Workshop on Subsidies/Tax Incentives and the Environment defined subsidies as "economic and fiscal measures that have both clear budget impacts and negative side-effects on environmental quality" (OECD, 1996). Although the definition is pragmatic, it excludes market transfers (market price support in particular) and consequently is too narrow for the purposes of this report. Another definition of subsidies is that they "comprise all measures that keep prices for consumers below market level or keep prices for producers above market level or that reduce costs for consumers and producers by giving direct or indirect support" (see, for example, De Moor and Calamai (1997) or De Moor (2001)). This definition is consistent with the definition used in the 1998 OECD report on "Improving the Environment through Reducing Subsidies", where subsidies and tax concessions were defined to include "all kinds of financial support and regulations that are put in place to enhance the competitiveness of certain products, processes or regions, and that, together with the prevailing taxation jurisdiction, (unintentionally) discriminate against sound environmental practices". It is not necessary to make a distinction between subsidies and tax concessions as the latter can be regarded as implicit subsidies.

3. It is worth emphasising that non-internalised external costs related to air, water or noise pollution, accidents or environmental damage are generally not included in the definition of subsidy. In theory governments should intervene in these cases and internalise the external costs by introducing taxes. Some have argued that a failure to do so can be regarded as an implicit subsidy. Transport is the only sector studied in this annex that defines subsidies this way. External costs are generally not included in the definition of subsidy for two reasons. First of all, subsidies arise from active government intervention, where as non-internalisation of external costs refers to the lack of government policy. Measurement issues are the second reason; external costs are difficult to estimate or generalise, and involve considerable uncertainties, while figures on budgetary payments are more reliable. Similar arguments for excluding external costs have been used by other authors, such as van Beers and de Moor (2001).

4. Calculated using producer subsidy equivalents.

5. The data consists of the development programmes of EU structural funds in the member states, various statistics, interviews of experts and a mail survey to the ministries of forestry of EU-member states during 1998 (PTT, Finland).

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Environmentally Harmful Subsidies

CHALLENGES FOR REFORM

Subsidies are pervasive throughout OECD countries and worldwide. Every year, OECD countries transfer at least USD 400 billion to different economic sectors. Much of this support is potentially environmentally harmful.

Reforming environmentally harmful subsidies is a significant policy challenge facing OECD countries. However, untangling and assessing the effects of subsidies on the environment is a complex task. A systematic approach is required to ensure that appropriate policies are developed and the benefits of reform fully realised.

This report presents sectoral analyses on agriculture, fisheries, water, energy and transport. It proposes a checklist approach to identifying and assessing environmentally harmful subsidies. It also identifies the key tensions and conflicts that are likely to influence subsidy policy making. Can the political and economic impediments to subsidy reform be overcome? This book concludes with a discussion of politically feasible subsidy reform strategies.

FURTHER READING

Environmentally Harmful Subsidies: Policy Issues and Challenges (OECD, 2003)

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