Energy Taxes in the Nordic Countries

- Does the polluter pay?

National Statistical offices in
Norway, Sweden, Finland & Denmark

Final report

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Energy related taxes in the Nordic[1] countries

1. Introduction

The use of environmental taxes and especially energy taxes has been recognised as an efficient means to limit the use of harmful substances. The Nordic countries have some of the highest rates of environmental taxes as a percentage of the total taxes and as a percentage of GDP[2]. Earlier there has been a focus on energy taxes as a whole, the relationship between total energy taxes and GDP and energy taxes and total taxes. This project, on the other hand, focuses on energy taxes broken down by industries in the Nordic countries and addresses in particular the connection between who uses the energy and who pays the taxes.

Industry-specific taxes combined with information on energy use, air emissions and value added give unique possibilities to analyse whether there is a match between who pollutes and who pays the energy taxes. Or in other words: Does the polluter pay?

Figure 1.1 Energy use and energy taxes paid, 1999. Per cent.

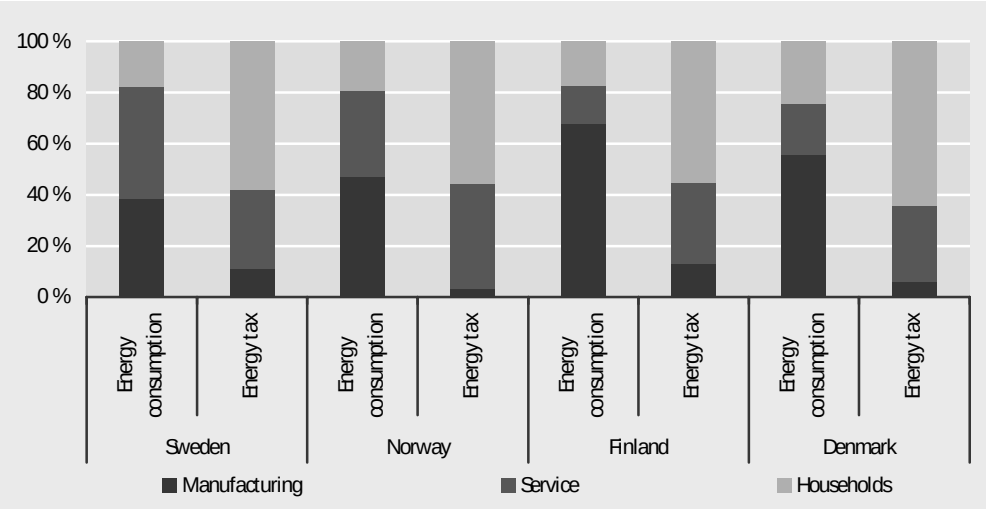

Figure 1.1 shows one of the key findings of the project. The energy use and the burden of the energy tax are not equally distributed. In general the industries pay less than they use and the households pay more than their relative energy use. This report presents, on one hand, who pays the taxes on energy, in particular electricity and petrol and who pays CO_2 taxes, and sulphur taxes. On the other hand, it presents who is using the energy and who pollutes with CO_2 and sulphur in the Nordic countries.

As the importance of taxes with an environmental purpose has increased, so has the need to be able to monitor these economic flows. The purpose of this project is to compile and present energy tax data on an industry level as well as collect experience on how to deal with energy taxes in the Nordic countries. It has been decided to include sulphur taxes although it is not an energy tax as defined in the EUROSTAT handbook (EUROSTAT, 2001). In the EUROSTAT handbook, the sulphur tax is a pollution tax.

Background of the project

A Nordic meeting was arranged in Stockholm (August 1–2, 2001) with participants from the statistical offices in the Nordic countries. The purpose of the meeting was to co-ordinate the development of European System for the Collection of Economic Data on the Environment (SERIEE) in the different countries and to initiate a harmonization of the statistical data in order to conduct comparative studies.

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[1] Except Iceland.

[2] Statistics in Focus, Economy and Finance; Theme 2 – 29/2002. and http://www.oecd.org/oecd/pages/home/displaygeneral/0,3380,EN-document-471-14-no-1-3016-471,FF.html#title3.

It was agreed that this work should begin with environmental taxes, and more specifically energy taxes, as these are defined and calculated in roughly the same way in the different countries.

Previous work

Environmental taxes have been the focus of many research projects. EUROSTAT (2001) has made a statistical guide to environmental taxes. The guide gives guidelines on definitions and concepts for environmental taxes and goes through the various sources and methods for these taxes. The environmental taxes are divided into four main categories: energy taxes, transport taxes, pollution taxes and resource taxes (see section 2.1 on definitions).

OECD (2001) has analysed benefits and effects of environmental taxes, especially regarding the theory of double dividend. The theory of double dividend claims that the benefits from environmental taxes are twofold. First, the environment benefits from a higher relative price on harmful substances and second, the revenue from environmental taxes can be used to lower taxes on income and it is then expected that employment will increase.

Environmental taxes and environmentally harmful subsidies in Sweden have been analysed by Statistics Sweden (2000). This study from Sweden is the first analysis of whether the polluter pays equally to the pollution it causes. The analysis shows that the energy taxes in Sweden are not equally distributed among the consumers of energy.

Current work

This project is partly financed by EUROSTAT and the overall aim of the project is first, to harmonize the statistics on energy taxes in the Nordic countries and second to compile and present data on energy taxes from all Nordic countries. This should include an analysis as well as a presentation of data on energy taxes by industry and by energy source together with other data within the system of environmental accounts, e.g. relevant air emissions (such as CO_2 or SO_2), energy use, value added etc.

Project proposal

The application for the grant emphasised the following:

The energy tax systems in the Nordic countries are constructed approximately the same way. All four countries have access to statistics in the national accounts regarding taxes and environmental taxes and all countries have used the definition developed by the EUROSTAT, OECD and IEA (International Energy Agency) to identify energy and environmental taxes.

Using the national accounts it is possible to present the energy tax data according to different economic activities (industries) and it is therefore possible to analyse these energy taxes according to economic activity.

The project can be divided into three different parts:

- Harmonization of the data
- Presentation and analysis of the total revenue from the different taxes
- Further analysis of taxes by activity, connected to other relevant data in the environmental accounts

Harmonization

To be able to make relevant comparisons between the Nordic countries, a harmonization must be carried out. One important issue is how the countries interpret the definition of energy and environmental taxes as well as the definitions of taxes, charges and fees in System of National Accounts (SNA).

This project describes the differences between the Nordic countries and reports the different types of environmental taxes. Harmonization of the statistical specification of the energy taxes should include guidelines on whether taxes should be gross or net amounts and how reimbursements should be treated. Another important issue is how to allocate the taxes into different environmental categories.

Total tax revenue

Data on the total tax revenue from different energy taxes will be gathered and presented in a time series. Comparative studies have already been conducted by organisations like EUROSTAT and OECD so this analysis will not be detailed. It is our aim to publish the results from this project in the Nordic statistical year book and to help to establish this as regularly published set of statistics at the national and nordic level.

The industry level

The analysis in this project will focus on the industry level (NACE groups) which is important as it has not been done at this detailed level before. Other data from the environmental accounts, for example the NAMEA-air tables, can also be linked at the industry level thus making it possible to analyse the tax structure in relation to pollution and energy use. The report presents data for 1999 broken down by industry (NACE rev. 1 on 2-digit level), energy taxes paid (broken down by tax categories), energy use and emissions of CO_2 and SO_2 .

How has the project worked?

The project was granted money in the end of 2001 and the work started in the beginning of 2002. On February 25 the first meeting of the project group was arranged with participants from Norway, Sweden, Finland and Denmark. The topic of the meeting was to agree on the framework of the cooperation and especially how the data should be reported to Denmark, who is the project manager. During the meeting it was also discussed how special issues connected to problems stemming from working across borders should be dealt with. Section 2.1 is based on these discussions (see minutes of the meting in annex 5).

November 22 2002 a meeting was held in Copenhagen to discuss the experiences of the work with the data and discuss the draft report.

This report

This report has been prepared by Klaus Balslev Pedersen, Statistics Denmark based on data and text contributions from each of the participating countries. Statistics Sweden wrote chapter 2.

The report is structured around an introductory chapter (chapter 1), a chapter on the methodology, definitions and limitations of the project (chapter 2). The analyses of the data are presented in chapter 3. Chapter 4 contains conclusions and recommendations.

The basic data on CO_2-, SO_2- and energy taxes, energy use, emissions and value added on the NACE 2-digit level for each country can be seen in Annex 1-4. Annex 5 is the minutes from the first meeting of the project group in Oslo, February 2002. The full text of the industrial classification is shown in Annex 6. Annex 7 gives data tables used to develop the figures.

Who was involved?

The following have participated in the project work:
Virva Terho, Statistics Finland
Merja Saarnilehto, Statistics Finland
Mårten Sjölin, Statistics Sweden
Viveka Palm, Statistics Sweden
Jenny Westin, Statistics Sweden
Kristine Erlandsen, Statistics Norway
Julie Hass, Statistics Norway
Tone Smith, Statistics Norway
Karin Blix, Statistics Denmark
Preben Etwil, Statistics Denmark
Klaus Balslev Pedersen, Statistics Denmark (project leader)

2. General methodology

The main purpose of this project is to analyse and present data on energy taxes by industry and together with other data within the system of environmental accounts, e.g. relevant air emissions (such as CO_2 or SO_2) and energy use in the Nordic countries. Therefore, it is important to examine the differences in methods of calculating taxes and the tax structures in the Nordic countries. Statistics on energy taxes in the Nordic countries is approximately compiled the same way. The most common way of calculating energy taxes by industries is to multiply the consumption of different energy products in industries with the relevant tax rate. However, there are some differences between the countries and these will be further examined in chapter 2.

2.1 Definitions

EUROSTAT has elaborated a definition of environmental taxes that has been accepted by the member states, making comparative studies possible between different countries in terms of tax structure, tax base, revenues, etc. According to this definition an environmental tax is:

"A tax whose tax base is a physical unit (or a proxy of it) of something that has a proven, specific negative impact on the environment."[3]

According to this definition, then, it is the tax base that determines whether or not the tax is an environmental tax. The explicit motivation is of minor importance, as a tax on energy, for example, has the same impact on the economy regardless of whether it is motivated by the interests of public finance or by environmental concerns. This approach makes it possible to avoid the risk of subjectivity and include every tax that is relevant to the environment in the accounts.

EUROSTAT has classified these taxes into four major categories based on the tax base, namely:

- Energy taxes (including CO_2 tax)
- Transport taxes
- Pollution taxes (including SO_2 tax)
- Resource taxes (excluding taxes on oil and gas extraction).

The tax bases for energy taxes are defined by EUROSTAT as:

- Energy products used for transport purposes
  - Unleaded petrol
  - Leaded petrol
  - Diesel
  - Other energy products for transport

- Energy products used for stationary purposes
  - Light fuel oil
  - Heavy fuel oil
  - Natural gas
  - Coal
  - Coke
  - Bio fuels
  - Other fuels for stationary use
  - Electricity consumption
  - Electricity production
  - District heat consumption
  - District heat production

According to this definition, the CO_2 tax (carbon dioxide tax) belongs among the energy taxes since it is in many countries strongly connected to other energy taxes on fuels. In other words it is difficult to separate CO_2 tax from other energy taxes whereas in the EUROSTAT framework the sulphur tax belongs to the pollution taxes.

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[3] Eurostat (2001): *Environmental taxes- A statistical guide*

In this report we will focus on the category "energy taxes" plus the sulphur tax in the Nordic countries.

Different taxes – different aims

The CO_2 tax is categorised as an energy tax but, as will be shown in chapter 2.2, the CO_2 taxes were introduced much later than the classic energy taxes and with a different aim. The energy taxes were introduced in most countries as a fiscal instrument to ensure revenue for the state. The CO_2 tax on the other hand, was introduced in the Nordic countries in the nineteen-nineties with the explicit aim of decreasing CO_2 emissions. This instrument can be considered as one approach to implement the so-called "polluter pays principle."

Polluter pays principle

The polluter pays principle expresses the idea that there should be a direct connection between the costs of pollution to the entire world and the gains being made from this pollution by those who pollute. According to economists, the ideal situation is reached when costs are equal to benefits (Douthwaite, 2000). Taxing certain types of emissions makes, for example, CO_2 emissions more expensive and hence emissions should be lower but how high should the tax be to balance the costs of the pollution?

When the relationship between who pollutes and who pays is analysed, it is important to see what is happening to the taxes that the industries actually are paying. Theoretically, there are two possibilities. First, the producer can keep the prices at the same level and pay the taxes from the profit. Alternatively, the producer can forward the burden to the consumers of the manufactured goods or services. This leads to higher prices and has a negative impact on competitiveness. It also causes polluting goods or services to have relative higher prices. Hence, the polluter pays when the consumer chooses the relatively less polluting product. This current study does not try to answer the question of how high the tax should be, but rather focuses on developing data that could be used for further analyses.

What is pollution?

Estimating the price of air emissions can be difficult enough but a polluting activity comprises more than just air pollution. Use of electricity produced using fossil fuels gives emissions to the air. But hydro power is not without damaging effects on the environment. Building dams damages the environment as the nature is changed dramatically. In a wider sense traffic can also be seen as causing more pollution than just the exhaust gas. A large part of the taxes on fuels for transport are motivated by other costs than environmental costs, such as road maintenance and accidents. For example, in Sweden it is estimated that 60 per cent of taxes on petrol and 38 per cent of the taxes on diesel are used for these other purposes (Kågesson, 2001).

Cost of CO_2

Cost benefit analyses made by the Danish Economic Council show that industries pay too little energy taxes in relation to the energy use from an environmental perspective. This makes the relative energy price for energy used in processes too low, which gives the wrong incentive for investments in energy savings. Households, on the other hand, pay too much in energy taxes as the high price on energy gives incentives to uneconomic energy saving investments (Det Økonomiske Råd, 2002).

Price of damage

If the "polluter pays principle" is to be satisfied, the carbon dioxide tax should help to include the external costs that the emissions cause if it is to act as an environmental tax. The level of CO_2 taxes is a difficult issue and many studies have been made, giving different answers. The Pan European ExternE project (ExternE, 2002) has investigated the damages of global warming. The ranges of prices of a tonne of CO_2 emissions were estimated to be between €18 and €46 (1995-prices)[4] or €3.8-139 depending on the assumptions on discount range, equity weighting and without including values for ecosystem damages.

Estimates of external costs of CO_2 emissions have been made by W. D. Nordhaus and S. Fankhauser, among others (SOU, 1996). If Fankhauser's estimate of the costs were to serve as the norm, all industries of the economy, including private consumers, would be in receipt of a large tax subsidy. If Nordhaus's estimate applied, this would mean a substantial tax sanction for all sectors except manufacturing, mining and quarrying (NACE 10-37). There is also a Swedish estimate, produced by Azar and Sterner, which result differs significantly from the other estimates (Azar and Sterner, 1996). In fact, it differs from the 1993 tax rate of € 105/m^3 by a factor of about ten (see *Table 2.1*), which means that in order to cover the

[4] ExternE, 2002: Methodology annexes, page 66-68

external costs that can arise as a result of carbon dioxide emissions, the tax on domestic fuel oil should have been € 1209/m^3.

The difference between the estimates is primarily due to the choice of discounting factors, the valuation of the welfare loss that can arise in poor regions and the fact that Azar and Sterner's calculations are based on a more highly developed model of the carbon cycle (ibid.). In this context it is also worth adding that both Nordhaus' and Fankhauser's estimates have been heavily criticized, above all for their choice of discounting factors and for the individual assumptions underlying their models (SOU, 1996).

Table 2.1 Different estimates of the external environmental costs that arise as a result of carbon dioxide emissions.

	Euro cent/kg CO_2	€/1000 litre diesel
Azar C., Sterner, T.	42.0	1 209
Fankhauser	6.5	186
Tax rate in Sweden (1993)	3.6	105
Nordhaus	1.6	46

Azar and Sterner estimated the external environmental costs at between 25.7 and 58.3 c/ kg of carbon dioxide. The value given in *Table 2.1* is an estimated average.

The reason why the different estimates of environmental costs vary so widely is the high degree of uncertainty that exists in this area. On the basis of the knowledge available now, it is difficult to assess the marginal cost to the national economy of carbon dioxide emissions.

Time period

The analyses in this report focus primarily on the year 1999. Time series back to 1990 are presented with the development of energy taxes in the Nordic countries during the 1990s. In the project proposal it was specified that both 1998 as well as 1999 would be covered, but it was decided to focus on good data for 1999 and onward. This was also necessary since the Norwegian tax system changed between 1998 and 1999 with the introduction of a separately identifiable CO_2 tax. This change made the Norwegian taxes more similar and comparable to the other Nordic countries.

Nomenclature

The industry level breakdown is based on the NACE rev 1 (Nomenclature Générale des Activités Economiques dans les Communautés Européennes). The NACE Rev. 1 has been used in the EU since 1993. The most detailed level in this analysis will be on the two-digit level, see appendix 6.

The data are further aggregated in this report and follows by far these categories:
Primary sector: NACE 1-14 (A+B+C)
Manufacturing sector: NACE 15-37 (D)
Electricity, gas etc. sector: NACE 40+41 (E)
Service sector: NACE 45-99 (F-Q)
Households

Energy use and emissions

Energy use

The energy use in this report is the actual energy used as presented in NAMEA. The data on energy use represents energy use in industries and households causing air emissions (in connection with national economic activities) – i.e. combustion of fuels that create air emissions. Fuels converted into another form of fuel or that are used as raw materials are not taken into account. Energy from biomass is included.

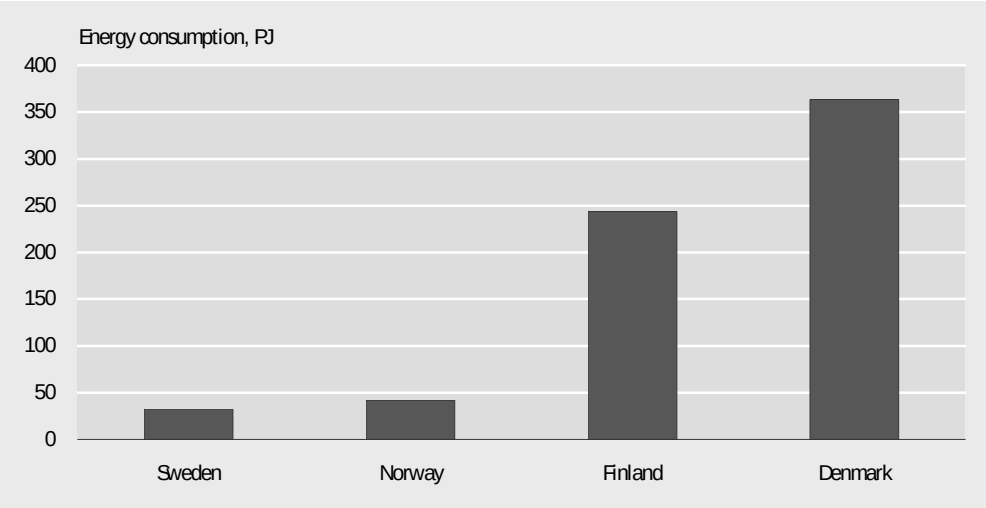
Emissions

The data for air emissions are comparable to those data (for example value added) of the national accounts. The national accounts only include economic activities and specifically

only national economies activities rather than activities on national territory. Non-energy related sources such as emissions from the activities with oil and natural gas in the North Sea are included. One could argue to use net energy use[5] in the analyses but we are interested in who makes the emissions and who is actually paying for the emissions together with the value added and in this sense the actual energy use is the best measure. Emissions from biomass are excluded.

The structure of the energy use in the energy sector is very different in the Nordic countries mainly because electricity is produced in different ways (figure 2.1).

Figure 2.1 Energy use in the energy sector (NACE 40-41), 1999



Sweden and Norway have the lowest energy use in the energy sector as it uses less than 50 Peta Joule (PJ) in both countries. This is due to the extensive use of hydro power for both countries and nuclear power in Sweden. Hydro power and nuclear power have no conversion losses. Denmark has the highest energy use in the energy sector as Denmark is highly dependent on the use of fossil fuels, which has a high conversion loss when converted into electricity and district heating. Finland has a similar high consumption in the energy sector also because of the use of fossil fuels.

Economic figures

Gross Domestic Product (GDP) and Value Added (VA) follow the definitions in the European System of National Accounts (EUROSTAT, 1996).

The figures for the taxes and value added are presented in Euros even though the countries did not use Euro at that time. The amounts in national currencies have been calculated into Euros using these exchange rates.

Table 2.2 Exchange rates, 1999

Exchange rates	DKK	SEK	NOK	FIM
Euro	7.44	8.80	8.31	5.95

Source: National Bank of Denmark

For the time series, it has been chosen to use current prices for the taxes, GDP and value added as it was difficult to find an appropriate deflator. Using the physical amount taxed would not show the correct development since it does not take the increases in the tax rates into consideration.

It has been chosen not to show developments in absolute figures, for example developments in the revenue from environmental taxes as it would be difficult to compare when there are

[5] Net energy use takes the conversion loss from the energy sector and distributes it relatively to the consumers of secondary energy sources; electricity and district heating.

different rates of inflation in the countries. Instead, only relative figures are shown, for example only developments in revenue from energy taxes as a percentage of the GDP. In this way we avoid having to deal with inflation since the denominator and numerator will both be affected by the same level of inflation.

2.2 Different tax systems in the Nordic[6] countries

Energy taxation is not a new phenomenon. In Sweden, for example, excise duty on petrol and alcohol motor fuels was introduced in 1929. In the 1950s, a tax on electricity was introduced and the tax on energy also dates to the same decade. These taxes were brought in for reasons of public finance and to cover expenses for road maintenance and traffic accidents, but in the last decades the energy and motor fuels also began to be justified by reference to environmental and energy policy. For further information see the OECD database on http://www.oecd.org/oecd/pages/home/displaygeneral/0,3380,EN-document-471-14-no-1-3016-471,FF.html.

In the early 1990s the Nordic countries introduced comprehensive green tax reforms. Finland was the first country in Europe to impose a CO_2 tax in 1990. Norway and Sweden followed suit in 1991 and Denmark in 1992.

The carbon dioxide tax is levied as a specific tax on oil, coal and coke, peat, natural gas, methane, liquefied petroleum gas and gasoline. However, the majority of Nordic tax systems are related to such products. In most cases these new taxes have offset reductions in existing taxes resulting in a more or less constant tax burden.

Sweden

The energy related taxation in Sweden consists of four different types of taxes:
1) Energy tax on fuels and electricity
2) Tax on energy production
3) CO_2 tax
4) Sulphur tax

Table 2.3 Overview of the tax systems in Sweden in 1999

Country	Energy taxes	Exemptions	Tax rates
Sweden	Energy tax	NACE 10-37, 61-62, 40-41, Some regions in Sweden.	Electr.: 1.7 c/kWh Fuels: different
	Tax on electricity production		Different
	CO_2 tax	NACE 10-37, 61-62, 40-41.	4.2 c/kg CO_2
	Sulphur tax	NACE 11, 12, 13, 21, 27, 40	3.41 €/kg sulphur
	Excise on petrol	NACE 62, 11 and 603	0.5 €/l

The *fuels* that are currently subject to energy tax are petrol, fuel oil, diesel oil, kerosene, liquefied petroleum gas, coal, natural gas and petroleum coke. The tax rates for the different fuels are not proportional to their energy content, which allows greater flexibility in adapting the tax rate to meet various political objectives. For example, diesel intended for transport is subject to a heavier energy tax than the same fuel intended for heating. Pilot projects aimed at developing environmentally friendly fuels are exempt from energy tax. Fuel used in commercial water transport, in mining- and manufacturing industries and by rail traffic is also exempt from energy tax, as is the consumption of aviation kerosene.

Energy tax is also charged on *electricity*, the taxation occurs upon delivery to the end user. Double taxation is avoided by exempting fuels used for electricity production from energy taxes. Mining and manufacturing industries are exempt from energy taxes and some rural regions in the northern parts of Sweden have a lower energy tax than in general.

[6] Except Iceland.

There are also a number of production taxes that burden *electricity production*. These are the nuclear energy tax, the hydro power tax and the charge/tax on storing nuclear waste and dismantling nuclear power stations. The charge/tax for dismantling and storing therefore only affects electricity produced at nuclear power plants. This tax was introduced concurrently with the expansion of nuclear power capacity in Sweden.

The *CO_2 tax* was introduced in January 1991, and is levied on all fossil fuels in proportion to their carbon content (Naturvårdsverket, 1997). When the tax was introduced in 1991, the tax rate was set at 2.8 c per kg of carbon dioxide, but in 1999 it was 4.2 c per kg of carbon dioxide. Fuel used for electricity production is exempt from the carbon dioxide tax, as are diesel and fuel oils used in commercial water transport and rail traffic, as well as aviation petrol and aviation kerosene. Manufacturing, mining and quarrying (NACE 10-37) pay carbon dioxide tax at a reduced rate, amounting to 50 per cent of the normal tax rate in 1999. Companies that use large amounts of energy can obtain further reductions when the tax exceeds a certain per cent of their sales value. The companies that receive this type of reduction mostly operate in the cement, lime and glass industries (Skatteförvaltningen 1994).

The *sulphur tax* was introduced in January 1991 with the intention of reducing sulphur emissions associated with the burning of oil, coal and peat. The tax is based on the sulphur content of all fuels that are liable for energy and carbon dioxide taxes.

Fuels used for ship propulsion, fuel production, recovery boilers and metallurgic processes, or for purposes other than generating energy, are exempt from sulphur tax (DS, 1994). Since 2002 sulphur-tax is not payable on fuels that have a sulphur content of 0.05 per cent by weight or less. The tax rate of 3.41 €/kg of sulphur has not been altered since the tax was introduced. If the sulphur emissions are treated or fixed in ash, deductions may be claimed on tax returns for the sulphur dioxide thus treated.

Norway

In 1999 the structure of the Norwegian energy taxes was changed. Previously, the tax on CO_2 consisted of CO_2-components present in various taxes. From 1999 onwards, the various CO_2-components were brought together into one single CO_2-tax. The same happened with the taxation on emissions of sulphur.

This of course had a great impact on the energy taxes. The tax on coal and coke and the general tax on mineral oils were ended, and new separate taxes on CO_2, sulphur and fuel oil were introduced. Other taxes, like for example the excise on petrol, which partly had consisted of a CO_2-component, were converted into a tax solely differentiated according to the contents of the lead in the petrol.

Table 2.4 Overview of the tax systems in Norway in 1999

Energy taxes	Exemptions	Tax rates	Comments
The CO_2 -tax	Mineral oils, petrol and coal and coke used as raw materials in NACE 10-45. Mineral oils used in NACE 5 and 611.	General: Mineral oil: 5.5 c/l Petrol: 11.1 c/l Coal and coke: 5.5 c/kg Reduced: Mineral oil: 2.8-3.1 c/l Petrol: 2.9 c/l	Reduced tax: Mineral oils and petrol used in NACE 11, 21.11, 15.2, 603 and domestic part of 62.Mineral oil used in freight transport in 613.
Tax on sulphur	Mineral oils used in NACE 611 and ocean transport in NACE 5	General: Mineral oil: 0.8 c/l if sulphur contents is 0,05% or more. SO_2 emission from use of coal and coke: 36.1 c/kg Reduced: Mineral oil: 0.2 c/l if sulphur contents of 0.05% or more. SO_2 emission NACE 23: 36.1	Reduced tax: Mineral oil in NACE 11, 603 and domestic part of NACE 62.

		c/kg
Excise on petrol	NACE 62, 11 and 603	52.7 c/l
Tax on auto diesel	NACE 01, 602	41.3 c/l
Tax on consumption of electricity	NACE 10, 13-37, some regions in the north of Norway	0.7 c/kWh

In 1999 the energy related taxes in Norway consist of 6 different taxes:
1) The CO_2-tax
2) CO_2-tax in the petroleum activity on the continental shelf
3) The tax on sulphur
4) Excise on petrol
5) Tax on auto diesel
6) Tax on consumption of electricity

The CO_2-tax is a tax on the use of mineral oil, petrol, coal and coke. The taxation of mineral oils comprises the use of products like fuel oils, auto diesel, jet fuel, kerosene, heavy distillates and marine oil. The tax-rate for mineral oils is the same for all products, but differs according to sector. The processing of fish products and the manufacturing of pulp face a tax rate per litre use of mineral oils that is half the amount of the general one, while sectors that earlier were exempted from the tax on CO_2 now face a reduced tax rate. These are domestic air transport, inland freight transport, coastal water transport and activities in connection to the petroleum activity on the continental shelf. The CO_2-tax on petrol is charged with a tax rate twice the amount of the one put on mineral oils. The CO_2 tax on coal and coke does not include sectors using coal and coke as raw material in their industrial processes. This means that approximately 90 percent of the total CO_2 emissions from the use of coal and coke are not levied with any tax on CO_2.

The reduced CO_2-tax put on activities in connection to the petroleum activity on the continental shelf, will mainly be charged on mineral oils used for heating and transport purposes. The specified CO_2-tax in the petroleum activity on the continental shelf comprises CO_2 emissions in connection to production of petroleum and to flaring. Double taxation of the activities on the continental shelf is avoided by exempting CO_2-tax on mineral oils and petrol when these products are charged with the specified CO_2-tax.

The tax on sulphur is a tax on sulphur emissions due to the use of mineral oils, coal and coke. The tax rate differs according to the amount of mineral oils used, as well as the sulphur contents in the mineral oil. Mineral oils with a content of sulphur less than 0.05 percent are exempted from taxation, the tax on sulphur therefore comprises the use of mineral products like fuel oils, heavy distillates and marine oil. Emissions of sulphur in the refinery sector, as well as from the general use of coal and coke face reduced tax rates. This is also the case for emissions of sulphur due to the use of mineral oils in domestic air transport and activities in connection to the petroleum activity on the continental shelf.

The excise on petrol and the tax on auto diesel are fiscal taxes, which revenues shall cover the external costs of accidents and the deterioration of roads and environment. The excise on petrol has different rates according to the contents of lead in the petrol. But, all petrol sold at the Norwegian market today is lead-free, which means that the use of petrol is charged with the same tax rates. The tax on auto diesel was introduced in 1993, replacing a tax on the amount of kilometre driven by cars using auto diesel. The auto diesel sold at the Norwegian market is divided into one auto diesel liable to duty and one free of duty. The use of auto diesel free of duty is restricted to some sectors.

In 1999, the taxation of electricity consisted of a tax on consumption of electricity. The consumers of electricity in the northern part of Norway, as well as some parts of Norwegian industry, are exempted from paying this tax. Between 1993 and 1998, there was also a tax on the production of electricity. To include the tax on production of electricity as an environmental tax is, however, a controversial issue in Norway. It can be argued that the tax on production of electricity has an element of capturing the resource rent. From 1998 on, the tax on production of electricity actually was converted into a new tax on resource rent, which is why this is no longer considered an environmental tax. Another argument for not including the tax on electricity production as part of the Norwegian environmental taxes is the fact that Norwegian electricity supply almost entirely comes from hydro power that

has negligible emissions to air. Though domestic production of electricity is clean, Norway has in dry years been a net importer of electricity based on Danish coal-fired plants.

Finland

Table 2.5 Overview of the tax systems in Finland in 1999

Energy taxes	Exemptions	Tax rates	Comments
CO_2 tax: (additional excise tax)	Electricity	17.16 €/kg CO_2	Reduced tax: Natural gas Peat
Excise tax on electricity	Electric railway traffic Non-domestic use of electricity.	0.69 or 0.42 c/kWh	Reduced tax: manufacturing industries Subsidies: small-scale power-plants, electricity produced by wood or waste-gas from metallurgic industry.
Other excise taxes on energy	Fuels used: as raw materials, for electricity production, for water transport, for professional fisheries, professional greenhouse production, as reserve supplies	Different: (see table 2.6)	Tax refund: energy-intensive production

A basic tax and an additional tax must be paid as excise taxes on liquid fuels, electricity and certain other fuels, and in addition, a precautionary stock fee (PSF) must be paid to the State on liquid fuels. The act concerning the excise tax on liquid fuels specifies the tax base for motor petrol (leaded, unleaded and blend), diesel oil (standard quality, sulphur-free), and light and heavy fuel oil (Law on Excise Taxes on Liquid Fuels, 1994). The tax base of electricity, coal, peat, natural gas and pine oil are recorded in the act concerning the excise tax on electricity and some fuels (Law on Excise Taxes on Electricity and Some Fuels).

Table 2.6 Energy tax rates in Finland, 1999

	Basic tax	Additional tax	PSF
Unleaded motor petrol, c/l			
– standard quality	52.03	4.02	0.68
– reformulated	51.19	4.02	0.68
Leaded motor petrol, c/l			
– standard quality	59.61	4.02	0.68
– reformulated	58.76	4.02	0.68
Blend of motor petrol, c/l			
– standard quality	55.82	4.02	0.68
– reformulated	54.98	4.02	0.68
Diesel oil, c/l			
– standard quality	28.02	4.52	0.35
– sulphur-free quality	25.50	4.52	0.35
Light fuel oil, c/l	1.83	4.54	0.35
Heavy fuel oil, c/kg		5.40	0.28
Electricity, c/kWh			
– tax category I		0.69	0.013
– tax category II		0.42	0.013
Coal, €/t		41.37	1.18
Fuel peat, €/MWh		1.51	
Natural gas, c/nm^3		1.73	0.084
Pine oil, c/kg	5.40		

The present tax base has been in force since 1 September 1998.

The basic tax is based purely on national economic considerations. The basis for determining the additional tax is the carbon content of the fuel so that the tax is € 17.16 per carbon dioxide tonne. An exception to this is natural gas with a tax concession of 50 per cent and peat for which the tax is determined separately. The additional tax on electricity is not tied to the carbon dioxide tax (The Use of Environmental and Energy Taxes in Finland).

The structure of energy taxation has been changed several times during the 1990s. The most essential change in the tax system was to start levying taxes on electricity at the consumption end instead of on primary energy. Heat generation fuels are still taxable. Tax subsidies have also been gradually introduced to the tax system to improve the position of renewable energy sources. Such are the subsidy for small power plants (peat, wind power, small-scale hydro power), the subsidy to wood generated electricity and the subsidy to electricity produced by waste gas.

To protect the competitiveness of the manufacturing sector, the electricity tax for the manufacturing sector is lower than that for other consumers and part of the energy taxes paid can also be refunded to energy-intensive manufacturing enterprises. If the excise taxes included in the purchase prices of certain fuels are more than 3.7 per cent of the value added of the enterprise, then the enterprise is entitled to reclaim on the excess amount 85 per cent of the excise taxes. However, only the amount exceeding € 50,000 is paid of the tax refund calculated in this way (€13.5 million was refunded on taxes paid in 1999). Tax concessions are also granted to professional greenhouse growers, professional fishers, and to rail and waterway transport. In addition, all fuels used as raw materials are exempt from taxes.

A sulphur tax was paid in Finland until 1993. At the moment, all diesel oil has a sulphur content below 0.05 per cent.

Denmark

The energy related taxation in Denmark consists of three different types of taxes:
1) Energy tax on fuels and electricity
2) CO_2 tax
3) SO_2/Sulphur tax

The *fuels* that are currently subject to energy tax are petrol, fuel oil, diesel oil, kerosene, liquefied petroleum gas, coal, natural gas and petroleum coke. The tax rates for the different fuels are not proportional to their energy content, which allows greater flexibility as in Sweden. For example, diesel intended for transport is subject to a heavier energy tax than diesel oil, which is basically the same fuel, intended for heating. Fuel used in commercial water transport, in mining and manufacturing industries and by rail traffic is also exempt from energy tax, as is the consumption of aviation kerosene.

An energy tax is also charged on *electricity*, the taxation occurs upon delivery to the end user. Double taxation is avoided by exempting fuels used for electricity production from an energy tax.

The CO_2 *tax* was introduced in May 1992, and is levied on all fossil fuels in proportion to their carbon content. The tax rate is balanced around €13.44 pr ton CO_2 released in connection with combustion or production of oil, gas, coal and electricity.

The *sulphur (SO_2) tax* was introduced in January 1996 for products with sulphur content above 0.05 percent, with the intention of reducing sulphur emissions associated with the burning of oil, coal and peat. The tax rate is €2.69 per kg sulphur or €1.34 per kg SO_2 released into air.

Table 2.7 Overview of the tax systems in Denmark in 1999

Energy taxes	Exemptions	Tax rates

Duty on petrol		0.59 c/l leaded 0.51 c/l unleaded
Duty on electricity	Passenger transportation running on electricity is exempted from the duty and a subsidy of 2.7 c/kWh is given to the amount of electricity produced with renewable energy delivered to the power supply net	7.0 c/kWh (6.5 until 30 June 1999) Used for heating dwellings of more than 4000 kWh per year: 6.1 c/kWh (5.6 c until 30. June 1999)
Duty on certain oil products	Public transportation	Gas and diesel as fuel: 31.6 (28.5 until 30 June) c/l
		Other gas and diesel oil 22.8 c/l.
		Fuel oil 25.7 c/kg
		Fire tar 23.3 c/kg
Duty on gas		Auto gas 19.5 c/l.
		Other gas: 29.3 c/kg
Duty on coal etc.		Coal: 168 €/ton
		Lignite: 122 €/ton
		Coke: 198 €/ton
Duty on natural gas		For natural gas used as fuel: 19.8 c/Nm3
		For heating value of more than 39.6 Megajoule: 0.1 c/Nm3
Duty on CO_2	Duty on coal not used for electricity production	Gas and diesel as fuel. other gas and diesel oil: 3.6 c/l
		Fuel oil 4.3 c/kg
		Fire tar 3.8 c/kg
		Electricity: 1.3 c/kWh
		Electricity used for heating dwellings of more than 4000 kWh per year: 1.3 c/kWh
		Auto gas 2.2 c/l
		Other gas: 4.0 c/kg
		Coal: 32.5 €/ton
		Lignite: 23.9 €/ton
		Coke: 43.4 €/ton
Duty on SO_2	Products with less than 0.05 per cent sulphur content is exempted	2.69 €/kg sulphur or 1.34 €/kg SO_2 released into air

2.3 Different methods in the Nordic countries

The energy related taxes in the Nordic countries are distributed in similar ways although there are some differences. Common for the Nordic countries is the determination of taxes on accrual basis. The national accounts are used as a source of information for the environmental taxes. This approach is different than the Ministries of Finance who usually use date of payment and take a sum of all the taxes paid in a time period, whereas the national accounts figure out when the tax was accrued and not when it was paid.

The actual distribution on branches of industry can be done in two different ways: a top down or a bottom-up approach. The top down methodology uses the total revenue on the specific energy related tax and then distributes it equally to the users of the energy product. This method is used in Norway.

The bottom up methodology uses the energy use as the starting point and multiplies the tax rate for the specific energy product. Exemptions and refund mechanism are corrected for. In

the end, the theoretical revenue as it is calculated is balanced to the actual revenue. This method is used in Finland, Sweden and Denmark.

The differences in the methodology usually reflect the organisation of the calculation of energy taxes. If the calculation is placed in the division for national accounts, the top down method is usually applied, whereas if it is in the division for energy statistics, it is usually a bottom up methodology. One method is not better than the other because they both follow the same principles, i.e. energy taxes should be balanced to the actual revenue and energy taxes should follow the actual energy use of the specific energy product (taking exemptions and refund mechanisms into account).

A real bottom-up method based on actual payments from the tax payers would be ideal. This, however, is very difficult to apply in reality as information from electricity distributors and oil companies are difficult to obtain for confidentiality reasons.

Sweden

All energy taxes are allocated to different industries by the programme for national accounts at Statistics Sweden. In general an annual average tax rate for a calendar year is calculated for a specific industry and fuel. For example, if the tax rate is raised, effective from October 1st of a year then the old tax rate will weight ¾ and the new tax rate ¼ when calculating the annual average tax rate for that year.

When calculating these tax rates, different exemptions in the tax system are taken into account, i.e. the CO_2 tax rate for mining, quarrying and manufacturing is 70 per cent lower than the general tax rate for 2002. The tax rate is then multiplied with the consumption of the specific fuel for the specific industry.

Example of calculating CO_2 tax for industry X and fuel Y.

(Industry X consumption of fuel Y) * (annual tax rate of fuel Y and industry X) = Industry X CO2 tax of fuel Y

The taxes by industry are then added up to the total tax revenue and adjusted to the actual tax revenue collected from the public finance. The methodology described above is valid for taxes levied on electricity as well as taxes levied on fuels.

Norway

The taxes defined as energy taxes in the Norwegian national accounts are, with the exception of the CO_2 tax in the petroleum activity on the continental shelf, taxes on products. The national accounts in principle record taxes on products accrued during the accounting period, while the fiscal accounts show the cash flow.

In the national accounts, the accrued values of the energy taxes are allocated to the different energy products charged with tax. For the CO_2 tax, the energy accounts are used as sources to determine the allocation of this tax on the various energy products, while the emission inventory is used as a source to determine the distribution of the tax on SO_2 on the various products.

In addition, the industries exempted from tax when using a charged product are defined. The National Account System (SNA-NT) then proportionally distributes the tax levied on a product proportionally among the users of that product. Both the CO_2-tax and the tax on sulphur operate with tax rates that vary due to different type of industries. This is dealt with by calculating the proportion of this industries' intermediate consumption of charged energy products that face the general level of tax rate.

The national accounts do not specify taxes by type or by purpose, which makes it difficult to obtain information solely concerning environmental taxes from the real accounts. When

calculating the distribution of energy taxes by industry and by product, calculation is made on the basis of the pre-systems of the national accounts, where these taxes are identifiable.

Finland

The calculation is based on energy use and the central government financial statement. Energy use and emissions by industry are derived from the calculation model developed for calculation of air emissions. The model is based on the information the energy sector reports annually to the environmental administration on emissions, use of different fuels and processes. The information is obtained by industry. Taxes by industry are derived with factors calculated from consumption data.

Denmark

The Danish supply and use system which forms the basis of the Danish national accounts and the input-output tables makes it possible to extend the Danish NAMEA system to include environmental and hereunder energy taxes. The national accounts record taxes on products accrued during the accounting period. With the balanced supply-use system as a basis, taxes on products are distributed by products and hereafter by the user of the products (130 industries and 80 categories of final use). Other taxes are only distributed by industries. When calculating the specific tax rates for specific industries and fuels different exemptions in the tax system are taken into account.

The Danish system does not take CO_2 reduction agreements into consideration. With CO_2 reduction agreements the company can avoid the CO_2 tax if it agrees to make an agreement on how to reduce the CO_2 emissions. This is only possible for the CO_2 intensive industries.

3. Results

The data on CO_2, SO_2 and energy taxes from the Nordic countries are analysed in this chapter. The first part deals with the relationship to the national economy (GDP and total taxes and contributions). The second part deals with the taxes broken down by industry to analyse who uses the energy and who pays the energy taxes. The third part deals more specifically with who emits CO_2 and who pays the CO_2 taxes. The fourth and last part deals with who emits sulphur and who pays the sulphur taxes. The focal points of the last three parts are whether or not the taxes follows the polluter pays principle as it was described in the previous chapter.

3.1 Analysis of total revenues in relation to GDP

The energy taxes as a percentage of GDP is interesting as an indicator of the significance of the energy taxes as it is related to a common production value from each country. In the following part, the energy taxes, CO_2-taxes and sulphur taxes are analysed in relation to GDP and the total taxes and social contributions in the countries in 1999 and a longer time series. Figures for the taxes as well as the GDP figures are in current prices.

Table 3.1 Taxes as per cent of GDP, 1999

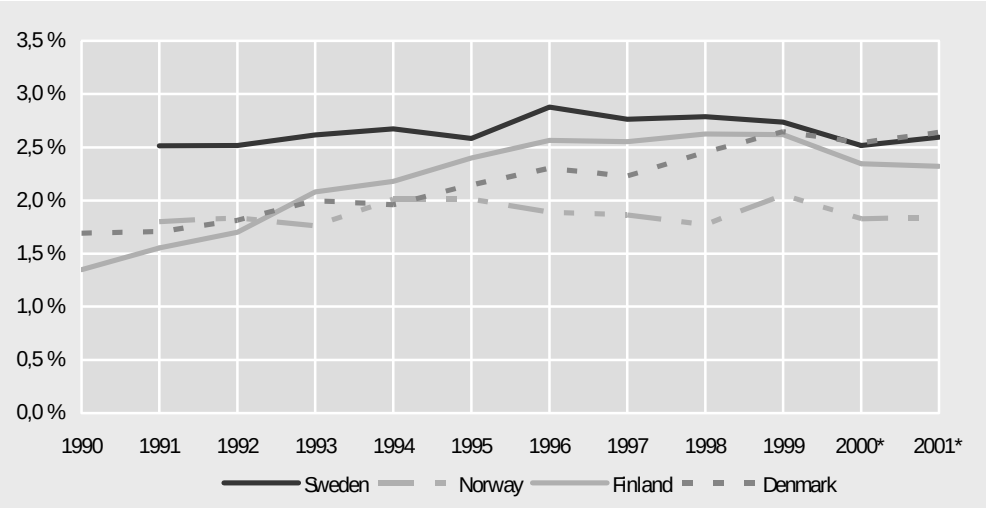
Per cent GDP	Sweden	Norway	Finland	Denmark
	per cent			
Energy taxes (excl. CO_2 taxes)	2.1	1.5	2.2	2.2
CO_2 taxes	0.7	0.6	0.4	0.4
SO_2 taxes	0.0	0.0	0.0	0.0
Total energy related taxes	**2.8**	**2.1**	**2.6**	**2.6**

The revenues from energy taxes (ex. CO_2 taxes) as a per cent of the GDP are very similar in Sweden, Finland and Denmark, a little over 2 per cent. Norway has a lower rate of 1.5 per cent. Finland and Denmark have the highest rates of 2.2 per cent. In Sweden, the rate is slightly lower with 2.1 per cent. The revenues from CO_2 taxes are lower and the range is more widespread. Sweden has the highest revenue at 0.67 per cent and Norway has the second highest revenue at 0.6 per cent of the GDP. Finland with 0.36 per cent and Denmark with 0.40 per cent follow closely. Revenues from sulphur taxes are also very different. Denmark has the highest revenue 0.04 per cent of GDP. In Norway the percentage is 0.02 and in Sweden it is 0.01. Finland does not have a tax on sulphur emissions. The significance of sulphur taxes in relation to GDP is low in the Nordic countries but the tax serves as a measure to lower sulphur emissions.

The total energy related taxes are highest in Sweden with 2.8 per cent of GDP. Finland and Denmark have rates around 2.6 per cent, whereas Norway has 2.1 percent.

Seen over a longer time perspective, the Nordic countries also show similar trends regarding energy taxes as a percentage of GDP. In general the Nordic countries increase the share of energy taxes in the period up to the mid-nineties, where stagnation is seen. From 1999 to 2000 all countries see a decline in the revenue but the trend is broken again as the revenue in Finland is unchanged in 2001, and the revenue is increasing in Sweden, Norway and Denmark. In the decade from 1990 to 2000, Finland has the highest increase in energy taxes as the percentage of GDP as the share almost doubles.

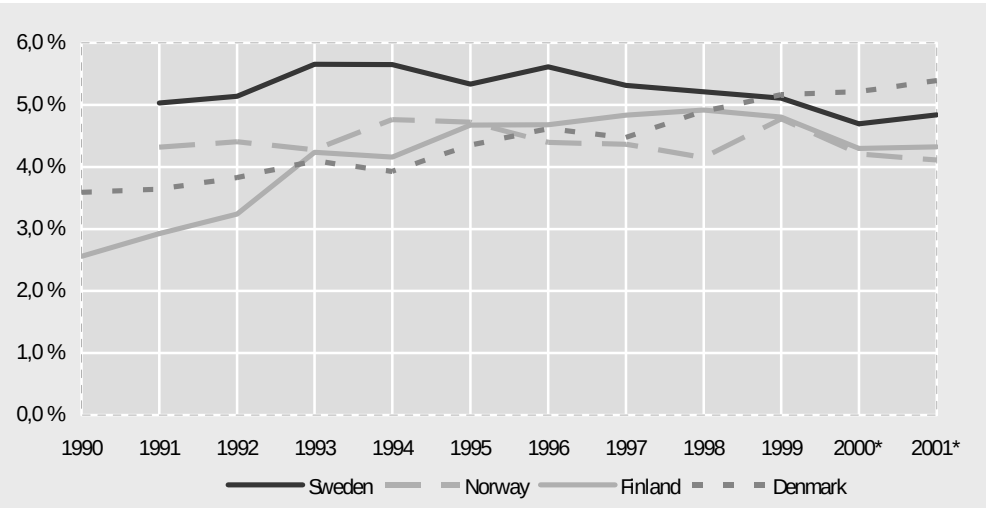
Figure 3.1 CO_2, SO_2 and energy taxes as a percentage of GDP



Energy taxes as a percentage of the total taxes and social contributions are interesting as it shows to which extent energy taxes are used as a tax revenue raising tool (see figure 3.2). The level of energy taxes does not reflect the efficiency as an environmental tool as the level of tax rates and exemption and reimbursement rules, not the total level, are determining for the efficiency.

This indicator shows different trends in the Nordic countries as it has increased from 3.6 to 5.2 per cent in Denmark from 1990 to 2001, which is the most significant increase during the period. A similar trend is seen in Finland with an increase from 2.6 to 4.3 per cent. In Sweden the significance of the energy taxes as a tax tool has decreased as the share in Sweden has decreased from 5.0 to 4.8 per cent. This development can be explained mainly due to the high yearly growth rate in the revenues from total taxes and contributions, in particular the high increase in the yearly growth rate in current taxes on income and wealth in 1999 (16.0 per cent) and 2000 (42.3 per cent). The revenues from the energy taxes show, with the exception of 1998, a positive annual growth rate through the 1990s, but the annual growth rates for the total taxes and social contributions are still higher, especially in 1999 and 2000.

Figure 3.2 CO_2, SO_2 and energy taxes as per cent of total taxes and social contribution

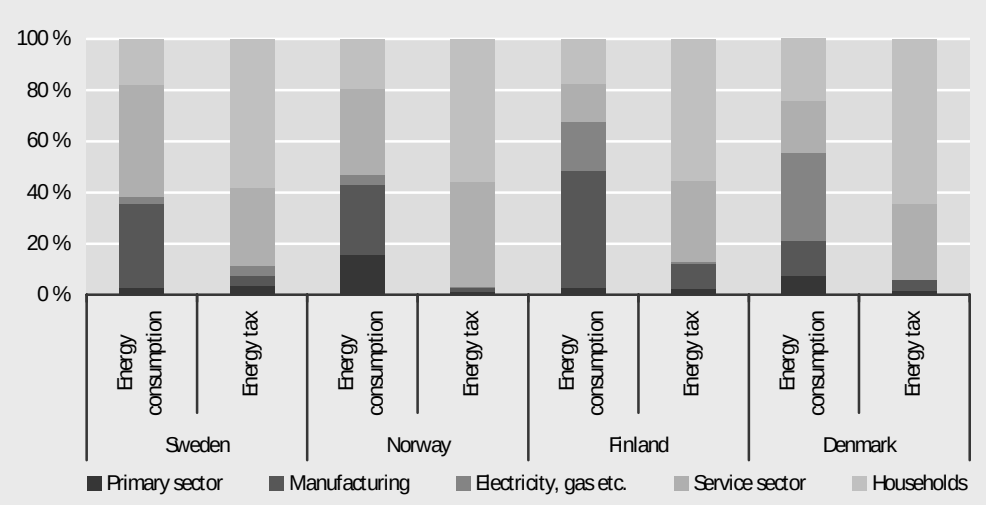


3.2.1 Energy taxes by industry

This section focuses on who actually pays the taxes levied on energy products and who uses the energy products. In this section, the distribution of energy use and energy taxes by industry will be analysed. CO_2 taxes are not included as they will be analysed separately in 3.3.1.

For the following analyses, the industries have been aggregated into 4 sectors plus households. The primary sector includes NACE 1-14, the manufacturing sector includes NACE 15-37, the energy sector includes NACE 40-41 and the service sector covers NACE 45-99.

Figure 3.3 Energy consumption and energy tax revenues, 1999



Who uses the energy?

Figure 3.3 shows for each country how much energy the sector uses (left column) and how much energy taxes it pays (right column). The tables with actual percentages are provided in Annex 7. The structures in energy use and who pays the energy taxes are similar in the Nordic countries.

The primary sector (forestry, hunting, fishing, agriculture, mining and quarrying) accounts for around 5 per cent of the total energy use in each country. The manufacturing sector has a rather high energy use, ranging from 36 per cent in Denmark to 47 per cent in Finland. The energy use in the electricity, gas and water supply sector shows a high level of variation as the consumption that is used to produce electricity and district heating is 3 per cent in Sweden, 4 per cent in Norway, 20 per cent in Finland and 28 per cent in Denmark (see figure 2.1 and comments for more information on the structure of this sector in the different countries). Energy use in the service sector is high in Norway (36 per cent) and Sweden (26 per cent) compared to Finland (12 per cent) and Denmark (19 per cent). Households consume around 20 per cent of the energy in all 4 Nordic countries, with the highest being in Sweden where 28 per cent of the energy is consumed in the households.

Who pays the energy taxes?

The burden of paying the energy taxes is not equally distributed to the consumers of the energy. This is due to the tax exemptions and extensive refund mechanisms connected to energy taxes for the energy that is used in the industries (see chapter 2).

Most significant is the manufacturing sector that pays about 5 per cent of the energy tax revenues but consumes around 50 per cent of the energy. The opposite is seen for households, which use around 20 per cent of the energy but account for half of the energy tax revenues or more in each country. The most significant difference is in Denmark where the households use 17 per cent of the energy but are responsible for paying 62 per cent of the energy tax revenues.

From this analysis we can conclude that the energy use and the energy tax revenues are not coordinated in a way that the polluter pays principle is followed. In relation to the polluter pays principle described in chapter 2, the exemptions and refund mechanisms distribute the

burden of the pollution cost unequally. This way the cost of the pollution is primarily placed on the households.

3.2.2 Electricity taxes

The electricity taxes have been chosen for a more thorough analysis of who uses the electricity and who actually pays the taxes. Electricity has been chosen because it is a homogenous product widely used in the Nordic countries.

Table 3.2 shows the actual tax rate (€-cents per kWh) for electricity broken down by different branches.

The Nordic countries are very different regarding taxes on electricity. Denmark has the highest average tax rate on electricity; where on average 3 cents are paid in tax, whereas in Norway and Finland it is as low as 0.3 and 0.6 cents per kWh respectively. In Sweden it is 1.2 cents. Denmark also shows the largest variations between branches. The branches with the most favourable exemption and refund rules pay almost no tax whereas households pay 6.2 cents per kWh. In Denmark some parts of the service sector pay more than households. This is due to the fact that electricity consumption in households with electric heating, to some extent, is exempted from the tax on electricity.

Table 3.2 Average annual actual tax rates on electricity, 1999

	Sweden	Norway	Finland	Denmark
	cents per kWh			
All industries	**1.2**	**0.3**	**0.6**	**3.0**
Households	**1.8**	**0.6**	**0.7**	**6.2**
Agriculture and fishing	1.7	0.6	0.7	0.0
Mining and quarring	0.2	0.2	0.4	0.1
Manufacturing	0.2	0.0	0.4	0.1
Electricity, gas and water supply	1.9	0.1	0.0	0.0
Construction	1.8	0.8	0.7	0.0
Wholesale and retail trade	1.8	0.7	0.0	0.3
Transport, storage and communication	0.8	0.6	0.7	2.3
Financial intermedation	1.8	1.3	0.0	8.5
Public administration and services	3.7	0.8	0.0	6.4

The variations in table 3.2 reflect that the tax burden is not distributed equally. This is also seen in figure 3.4. Figure 3.4 also shows big variations on the tax rates in the Nordic countries. Households in Denmark have the highest actual tax rate on electricity (more than 6 cents per kWh), followed by the service sector in Denmark and the service sectors in Finland and Sweden.

The differences in the actual tax rates show differences in exemption rules and refund mechanisms. These differences also reflect differences in the way the electricity is produced as is the case for Denmark where the rate is higher which reflects the fact that a large proportion of electricity production is based on fossil fuels.

Figure 3.4 Average actual tax rates on electricity, 1999

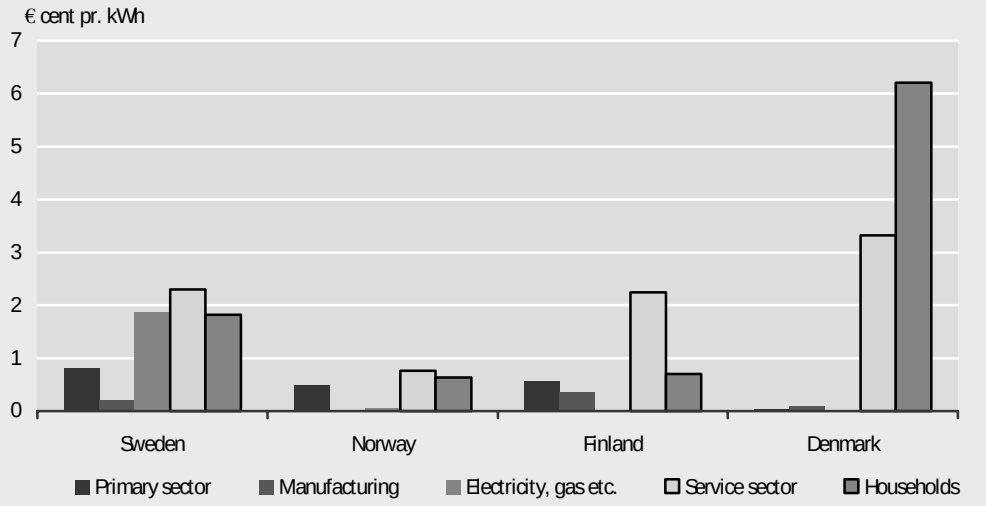
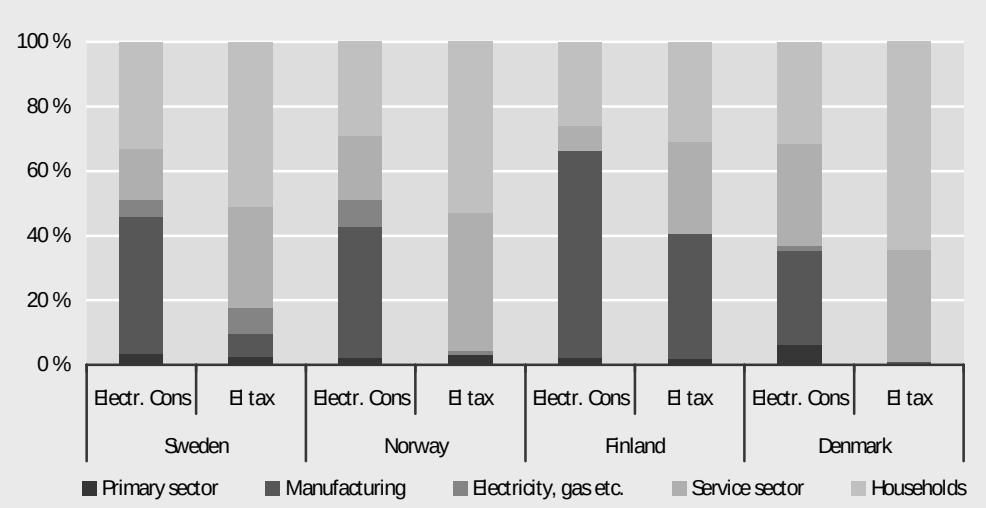


Figure 3.5 shows the distribution of who uses electricity and who pays the taxes. The general trend is that the primary sector and the manufacturing sector use a large part of the electricity but do not pay accordingly. The tax burden is mainly on the service sector and the households.

Figure 3.5 Electricity consumption and electricity tax revenues, 1999



3.2.3 Petrol tax

The tax on electricity showed great variance in the Nordic countries. This could be due to the different electricity production methods in the Nordic countries varying from hydro power to nuclear power to fossil-fuelled power plants. The different production methods give rise to different pollution levels and therefore it can be argued that the polluting costs also vary. It is different with the petrol tax as its polluting factor is the same in all the countries.

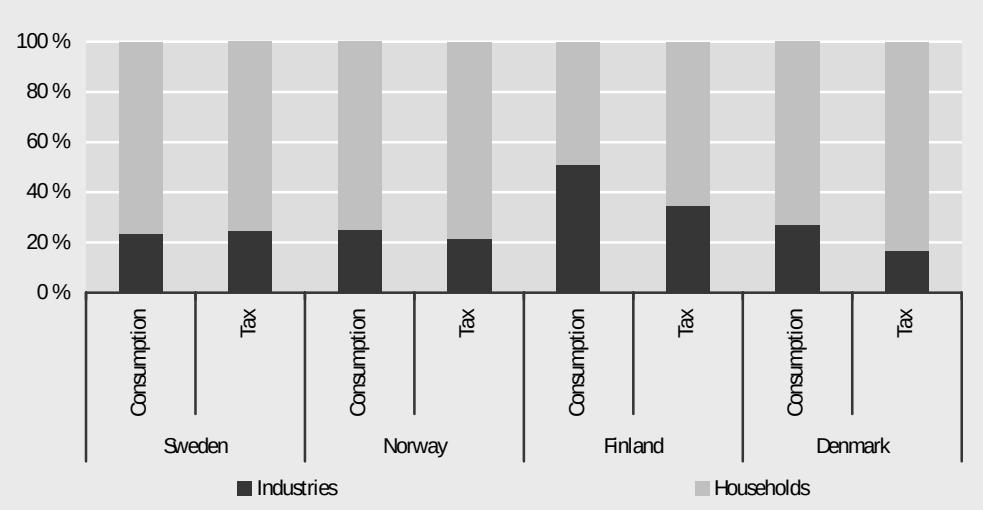
Who uses the petrol and who pays the tax is shown in figure 3.6. When analysing the petrol tax, only two categories are used: industries (NACE 01-99) and households. This is because only 2-3 per cent are used outside the service sector and households.

Sweden has the most equal distribution between who uses the petrol and who pays the petrol tax of the Nordic countries. In Sweden the industries use 24 per cent of the petrol and pay 25 per cent of the petrol taxes.[7] In Norway the distribution between consumption and

[7] This small difference may be due to uncertainty in the measuring method.

tax is also relatively equal between industries and households. Industries use 25 per cent of the petrol and pay 22 per cent of the tax revenues. In Denmark the distribution is less equal as the industries use 27 per cent of the petrol but only pay 17 per cent of the taxes. Finland has an even less balanced distribution as the industries use half of the petrol but only pay one third of the taxes.

Figure 3.6 Petrol consumption and petrol tax, 1999



The results of this analysis shows that the polluter pays principle is followed to a much higher degree regarding the petrol tax (although to a lesser extent in Finland) than are the other taxes examined thus far. This is primarily due to the fact that the exemptions and refund mechanisms are very limited for petrol as was seen in chapter 2.

3.3.1 CO_2 taxes total

In chapter 2 it was shown that the CO_2 taxes were introduced much later than the classic energy taxes and with a more specific environmental aim. This could lead us to hypothesize that the CO_2 taxes to a larger extent follow the polluter pays principle. This hypothesis will be tested in this section.

Table 3.3 CO_2 emissions and CO_2 taxes revenues, totals, per capita and € per tonne, 1999

	Sweden	Norway	Finland	Denmark
Total CO_2, mill. tons	66	52	58	65
CO_2 per capita, tonne/cap	7	12	11	12
Total revenues from CO_2 tax, mill. €	1508	818	454	652
CO_2 tax revenues per CO_2 emission, €/tonne CO_2	23.0	15.6	7.8	10.0

Table 3.3 shows the total emissions of CO_2 and the total CO_2 tax paid in the Nordic countries in 1999. All countries have around the same level of CO_2 emissions ranging from the lowest in Norway with only 52 million tonnes to Sweden with the highest emissions of 66 million tonnes. Denmark has almost as much with 65 million tonne whereas Finland emits 58 million tonnes.

The picture looks different when the emissions are related to the number of inhabitants as Denmark with 12 tonnes per capita has the highest relative emission of CO_2. Closely followed by Norway and Finland with 12 and 11 tonnes per capita. Sweden is significantly lower than the three other Nordic countries as the emissions are only 7 tonne per capita. This is because of the different structures in both the extraction of crude oil and natural gas as well as the different structures in the energy sector. Norway has a high emission of CO_2 due to the oil and natural gas extraction activities in the North Sea and due to ocean

transport. Sweden and Norway have a large production of hydro power, whereas Denmark is highly dependent on carbon intensive thermal power. Sweden also has a high level of electricity production from nuclear power plants.

The levels of CO_2 tax revenues show large differences. Sweden has the highest revenue of €1.508 million from the CO_2 tax. The second largest revenue of €818 million is in Norway. Denmark has a revenue of €652 million and Finland around €430 million. This difference in revenues from this type of tax is due primarily to the higher average rate of the tax in Sweden as the analysis of revenues per ton shows.

The average CO_2 tax revenue per tonne CO_2 emissions shows large variations between the countries. Finland has a revenue raising rate of around €8 per ton. Denmark is at €10, Norway at €16 while Sweden is the highest at €23 per tonne. In chapter 2.1 the polluter pays principle was discussed and the price range of a tonne of CO_2 emission in what is called an illustrative restricted area of costs was estimated to be between €18 and €46[8]. Only the average CO_2 tax rate in Sweden with €23 per tonne CO_2 has a level where the polluter pays for the damage according to this estimate from ExternE (ExternE, 2002, page 68).

3.3.2 CO_2 by industry: Who pollutes and who pays?

The polluter pays principle can also be analysed at the industry level. Following the principle from chapter 3.2, where the traditional energy taxes were analysed, the CO_2 tax is analysed with the same categories.

Figure 3.7 CO_2 emissions and CO_2 tax revenues, 1999

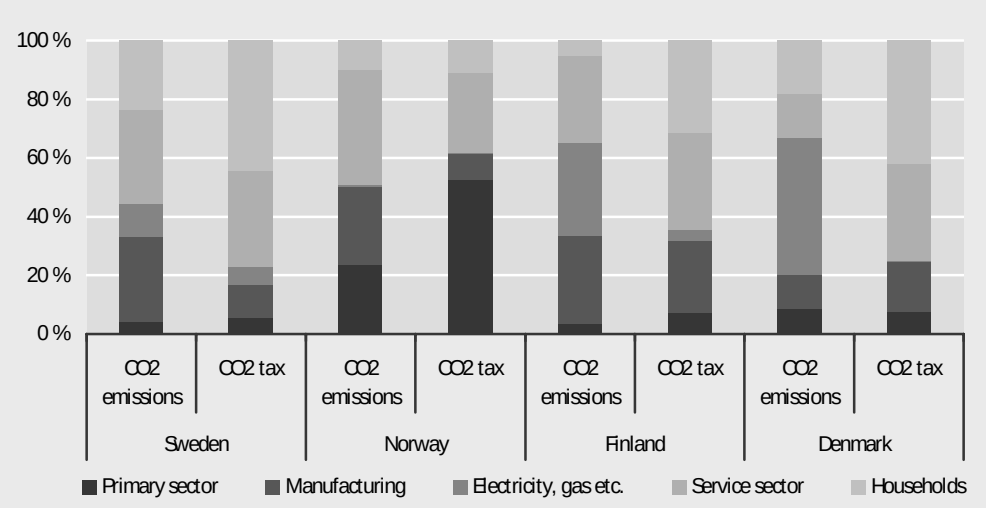


Figure 3.7 shows the shares of CO_2 emissions and the shares of CO_2 tax revenues in each of the four Nordic countries (the actual percentages can be found in Annex 7). The CO_2-emissions are different from the energy use. Most significant is the differrence in Norway where the primary sector has only 4 per cent of the energy use (see figure 3.3) but 24 per cent of the CO_2 emissions. This is due to the emissions connected to the large production of oil and natural gas in the Norwegian sector of the North Sea. The oil and gas producers are also paying for this large emission as the primary sector pays more than 50 per cent of the CO_2-taxes.

In general, the burden of the CO_2-tax is more closely connected to the CO_2 emissions than is the case with energy use and energy taxes. The CO_2 tax is in all countries based on the principle that the one who has the emissions also pays the CO_2 tax. Most significant is that the manufacturing sector pays a relative higher price for the emission of CO_2 than it pays for the energy. In Finland, the manufacturing industries pay as much as 25 per cent of the CO_2-taxes with a corresponding CO_2 emission of 30 per cent.

[8] This is only indirectly comparable as the ExternE estimates are fixed prices (1995).

CO_2 intensity

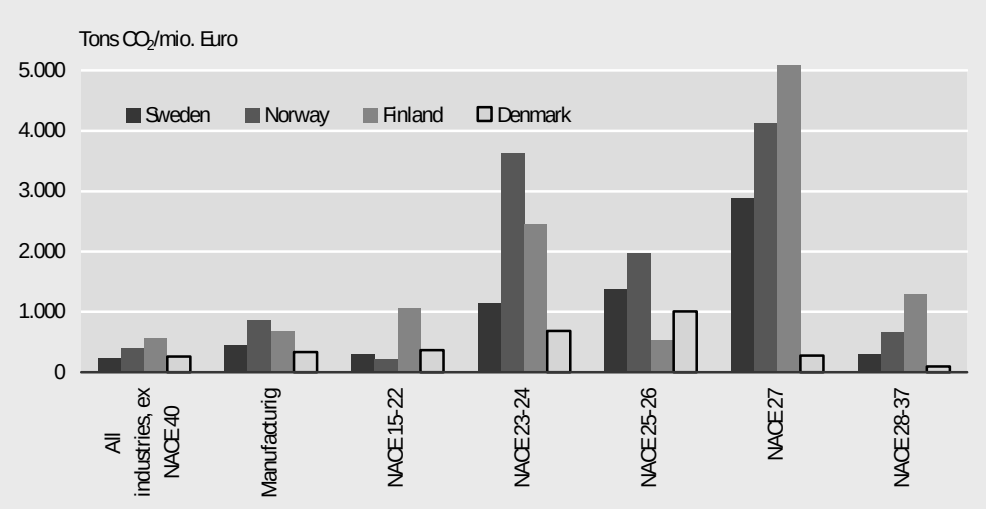
The CO_2 emissions and CO_2 tax revenues in the manufacturing sector have been chosen for a more in-depth analysis of who emits CO_2 and who is providing the revenues from the CO_2 tax. CO_2 in the manufacturing industry has been chosen because as it was seen above, the exemptions and reimbursements are not as widely spread for the CO_2 tax as they are for the energy taxes.

Figure 3.8 shows the CO_2 intensity in the manufacturing sector expressed as the amount of CO_2 emissions in relation to value added. This measure shows how much CO_2 an industry releases into the air to produce a certain value and the industries with the highest CO_2-emission are the most CO_2-intensive industries.

The CO_2 intensity is not surprisingly generally higher in the manufacturing industries compared to all industries. Some branches in the manufacturing sector, for example the CO_2 intensity in manufacture of basic metals in Sweden, Norway and Finland is 10 times higher than all industries.

The CO_2-intensity in Sweden for all industries (including NACE 15-37) is 366 tonne/million € and 443 tonne/million € in the manufacturing industry. Denmark is lower as the CO_2-intensity is 261 tonne/million € in all industries and 335 tonne/million € in the manufacturing sector. The pattern is similar in all 4 countries as some branches are very CO_2 intensive with an intensity of more than 1000 tonne/million €. This goes for NACE 23-24 (Manufacture of coke, refined petroleum products and nuclear fuel and Manufacture of chemicals and chemical products) in Finland, Sweden and Norway, NACE 25-26 (Manufacture of rubber and plastic products and Manufacture of non-metallic mineral products) in Sweden, Norway and Denmark and NACE 27 (Manufacture of basic metals) in Finland, Sweden and Norway.

Figure 3.8 CO_2-emissions in relation to value added, 1999



Effective tax rate

Table 3.4 shows the effective tax rate. This gives an approximation of how expensive CO_2 emissions are by branches of industry. It is calculated by dividing the CO_2-emissions with the CO_2 tax revenues and is expressed in € per tonne.

The tax revenue of a tonne of CO_2 emission is very different in the Nordic countries. It is most expensive in Sweden, where the average tax revenue is €23 per tonne and cheapest in Finland where the tax revenue is only €8 per tonne. This is a reflection of the level of the CO_2 tax rates and the level of exemptions and refund mechanisms.

One conclusion that can be made for all four countries is that households pay more than industries. In Norway the households only pay a little more than the industries. This is due to the fact that the Oil and gas sector pays a relative high tax on the emissions. In Sweden

the households pay 2.5 times more than the industries. In Denmark households pay more than 3 times more than industries. In Finland the households pay as much as 8 times more than the total.

Within the industries widespread variations are experienced. In general the more CO_2 intensive the industry is, the less it pays for the CO_2 emission. Put even more simply, the polluter does not pay. But compared to the traditional energy taxes the tax burden is more equally distributed.

Table 3.4 Effective CO_2 tax rate, 1999

	Sweden	Norway	Finland	Denmark
	€/tonne CO_2			
Total	**23**	**16**	**8**	**10**
Households	43	17	46	23
All industries	17	15	6	7
Agriculture and fishing	36	13	16	15
Mining and quarring	14	40	12	1
Manufacturing	9	5	6	14
Electricity, gas and water supply	13	7	1	0
Construction	44	21	17	13
Wholesale and retail trade	43	11	14	42
Transport, storage and communication	15	9	6	9
Financial intermediation	43	218	•	107
Public administration and services	39	25	•	59

3.4 Sulphur taxes

The revenues from sulphur taxes in the Nordic countries are not as big as the revenue from energy taxes and CO_2 taxes but it still plays an important role as it directly puts a higher price on fuels with higher sulphur content. The damages caused by sulphur, specifically acidification of large nature areas and bodies of water, are extensive in some parts of the Nordic countries and hence important.

3.4.1 Emissions and revenues

Sulphur dioxide (SO_2) emissions are on the same level in the four Nordic countries - highest in Finland with 97 million tonne. Sweden and Norway are on the same level with respectively 78 and 77 million tonnes. Denmark emits 68 million tonnes. It should be noted that for Norway almost 48.5 tons of SO_2 emissions (or 63 per cent) are arising from ocean transport and there is little to no taxes on fuels used by these types of ships since fuel is purchased outside of Norway.

Table 3.5 SO_2 emissions and SO_2 tax revenues, 1999

	Sweden	Norway	Finland	Denmark
Total SO_2, 1 000 tons	78	77	97	68
SO_2 per capita, tonne/cap	9	17	19	13
Total SO_2 tax, mill. €	14	35	•	67
SO_2 tax revenues per SO_2 emission, €/tonne SO_2	181	450	•	988

In relation to population, Finland is the country with the highest emission level as 19 tonnes of sulphur dioxide are emitted per capita. Second is Norway with 17 tonnes and Denmark third with 13 tonnes. The lowest emission per capita is Sweden with 9 tonnes.

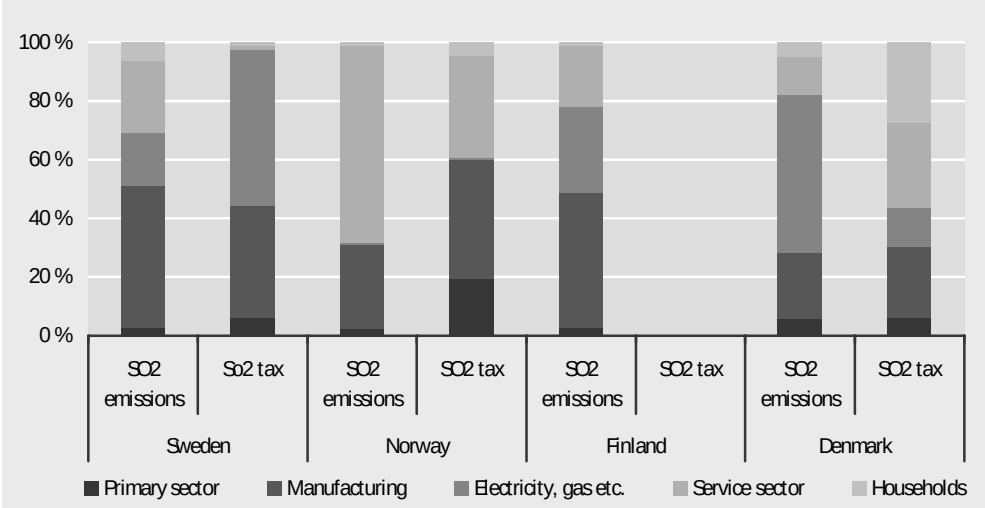
Only three countries have sulphur taxes – Finland with the largest emission has not introduced this kind of tax. Denmark has the highest revenue from sulphur taxes €67 million, Norway the second highest with €35 million, whereas the revenue from sulphur taxes in Sweden is only €14 million.

The actual tax revenue from sulphur dioxide emissions follows the same pattern – in Denmark it costs €988 per tonne of SO_2. In Norway it is 450 per tonne and in Sweden it is €181 per tonne. If the emissions from ocean transport are eliminated from the Norwegian totals then the tax revenues per ton SO_2 released by Norwegian economic activity in Norway increases to €814 per tonne.

3.4.2 Sulphur tax: who pollutes and who pays?

The following section will analyse whether the principle of the polluter pays principle is followed regarding the sulphur tax.

Figure 3.9 SO_2 emissions and SO_2 tax revenues, 1999



Patterns in who actually pollutes and who pays the tax on SO_2 emissions are very different in the Nordic countries. Differences occur due to the exemptions in transportation and energy production. Ocean transport also accounts for large amounts of emissions but since fuels for these types of ships are primarily purchased in other countries, there is no connection between fuel use and tax revenues in the Nordic countries.

In Sweden, fuels used for ship propulsion are exempted and hence the service sector that emits 25 per cent of the SO_2 in Sweden only pays 1 per cent of the sulphur taxes. The majority of the emissions in the service sector come from water transport. The manufacturing sector emits 48 per cent of the SO_2 but takes 38 per cent of the burden of the SO_2 taxes. Taxes are not paid on emissions that are not related to energy generation and hence the industry sector where sulphur-containing fuels are used in processes pays a smaller share of taxes than its emission. The other sectors; primary sector, energy production and households pay higher shares than the emissions suggest.

The service sector in Norway has the highest SO_2 emission abd again it is water transport that is the major source of emissions in this sector. The service sector emits 67 per cent but only pays 35 per cent of the taxes. The manufacturing industry emits 28 per cent but pays 41 per cent of the taxes. Also the primary sector and the households pay a larger portion of the SO_2 tax than their portion of the total sulphur emissions. The large emission and tax exemption in the transport sector causes an imbalance in share for the other sectors and hence the primary sector and the manufacturing sector pay a rather large share of the SO_2 taxes. Please note, however, that a different picture would emerge if the emissions from ocean transport were excluded from these calculations. It could be argued that this is appropriate since the shipping vessels in this sector do not purchase large quantities of fuels from within Norway.

In 1999 in Denmark, a sulphur tax was levied on electricity and not directly on the fuels used in the energy sector (this has later been changed in 2000). This means that in 1999 households paid a relatively high share of the tax. Households only have a direct emission of SO_2 of 5 per cent but pay 27 per cent of the tax revenues. The taxes paid in the service sector are also high which is due to sulphur tax on electricity. The emission of SO_2 is relatively high because of heavy emissions from water transport. The two different mechanisms outweigh each other to a certain extent and the service sector emits 13 per cent of the SO_2 and pays 29 per cent of the taxes. The energy sector emits 54 per cent of the SO_2 but is only paying 13 per cent of the taxes. This is due to the shift of the tax burden to the consumers of electricity.

The sulphur tax does not follow the polluter pays principle as transportation, especially water transport, contributes considerably to the sulphur emissions but does not pay accordingly. With respect to the other sectors, the burden of the taxes follows to a larger extent, which sector actually pollutes.

4. Conclusions and discussion

4.1 Methodology

The tax systems regarding energy products are very similar in the Nordic countries. As it was seen in chapter 2, exemptions and refund mechanisms are similar. Although the energy sectors are different in the Nordic countries, the tax systems are relatively similar. The tax rates vary but the exemption rules are similar. The general rule is that manufacturing industries are exempted for the energy taxes, whereas the mobile sources (shipping and aviation) are exempted for the CO_2 taxes and sulphur taxes or in the case of ocean transport, fuel purchases are made outside national borders and are therefore not subject to the national taxes levied on the various fuels.

The methodology used by the different Nordic countries to obtain energy tax information broken down by industry groups involves either a bottom-up methodology or top-down methodology. Both methods make sure that the sum of each tax is balanced to the actual revenue from the tax. None of the countries apply a 'real' bottom up methodology with actual records of who uses the energy and who pays the taxes (or exempted).

4.2 Does the polluter pay?

Energy related taxes/GDP

The data generally show the same trends. The level of energy taxes as a percentage of GDP is around 2 per cent in all countries. The level of CO_2 taxes as a percentage of GDP shows more differences within the countries, but is, in general, lower than the energy taxes. Sulphur taxes are only used in Sweden, Norway and Denmark and are insignificant when compared to GDP. But as a tool to fight acidification caused by sulphur emissions it is very important. Developments in the level of all three energy related taxes are not clear as different trends over the period from 1990 to 2001 and within countries are seen.

Table 4.1 Taxes as per cent of GDP, 1999

Per cent GDP	Sweden	Norway	Finland	Denmark
	per cent			
Energy taxes (excl. CO_2 taxes)	2.1	1.5	2.2	2.2
CO_2 taxes	0.7	0.6	0.4	0.4
SO_2 taxes	0.0	0.0	0.0	0.0
Total energy related taxes	2.8	2.1	2.6	2.6

Energy related taxes/total taxes

When it comes to the energy related taxes as a percentage of the total taxes and social contributions the trend is more clear-cut as these kind of taxes are used more as a tax tool as the rate is increasing.

Energy taxes by industry

The general trend in the Nordic countries is that the burden of the energy tax is not distributed equally to the consumers of the energy and hence does not follow the polluter pays principle. The households pay by far the most in energy taxes and the manufacturing industries are exempted or the taxes are refunded, due to competitive reasons as the OECD countries in general exempt these activities (OECD-database on environmental taxes, see chapter 2). The service sector pays relatively more than the manufacturing industries but less than the households.

Electricity taxes by industry

More specifically the electricity tax and the petrol tax were analysed on industry level. The electricity tax does not follow the polluter pays principle as the variations on who uses the electricity and who pays the taxes are too large. The electricity tax shows great variations within the Nordic countries regarding level and regarding equal distribution between polluter and payer. This reflects the fact that electricity is produced differently in the Nordic countries as Norway and Sweden to a large extent produce electricity from hydro power, whereas Finland and Denmark produce by burning fossil fuels.

Petrol taxes by industry

Petrol on the other hand, is a more homogenous product in the way that it gives the same polluting effect no matter where it is consumed, although externalities are larger in big

cities with for example smog. The petrol tax follows to a large extent the polluter pays principle as the tax burden follows the consumption of petrol.

CO_2-taxes by industry

The CO_2 tax is more equally distributed so the polluter who also pays for the emissions. But still, there are great differences between how much each industry pays in relation to the CO_2 emission.

SO_2 taxes by industry

The transportation sector especially water transport has large emissions of sulphur but are widely exempted from paying tax or do not pay the tax since fuels are purchased outside national borders. This distorts the distribution. No other sector is exempted from the tax burden and therefore the sulphur tax revenues can be seen as following the polluter pays principle for other sectors besides transport.

Conclusion

The hypothesis concerning the polluter pays principle is only followed for the taxes with an explicit environmental purpose is true to a certain extent. It is only to a certain extent as the petrol tax that was introduced very early and has a traditional fiscal motivation, follows the polluter pays principle as the tax burden and consumption is closely connected. The sulphur tax which was explicitly introduced with an environmental purpose on the other hand does not (or cannot due to purchases made outside national borders) tax emissions from water transport. The ocean going ships are actually coming under a new convention that will require reduced SO_2 emissions and this is through the use of cleaner fuels. In Norway all coastal transport is required to use low-sulphur fuels so coastal transport, which is under control of national pollution authorities, is different than ocean transport -- which needs to be under international conventions.

4.3 Recommendations

On the basis of the experiences in this project, it is recommended that energy taxes should be published annually for the Nordic countries. In addition, each country should plan to expand their calculation systems to include all environmental taxes and not just energy taxes. If all of the Nordic countries do this, then regular publication of environmental taxes should be evaluated.

It is worth considering that other externalities are also included in the taxes. For example the petrol tax does not only cover environmental externalities (global warming) but also includes traffic accidents and road damage.

How to make better statistics on energy taxes?

Part of this project was to collect the experiences on the statistical treatment of energy taxes gained from this project.

It should be considered to remove branches of industry with very irregular emission or tax patterns, like the SO_2 emissions from ocean transport. These branches blur the patterns and make it difficult to analyse the aggregated data.

Grouping data helps to maintain an overall picture of the development and minimize the effect of changes in tax laws. Not to distinguish between traditional energy taxes and CO_2 taxes and SO_2 taxes on the other hand makes the time series more consistent.

Statistics on energy related taxes should be net amounts as the refund mechanisms are extensive. Furthermore, it is important that energy consumption is net energy consumption and that the emissions follow the energy consumption, which makes direct comparisons between taxes, energy consumption and emissions.

We recommend that environmental taxes and total taxes should be published and compared with emissions and other externalities. It would be valuable to calculate and publish subsidies in a similar fashion. Statistics showing the gaps in the instruments for regulating environmental damages can hopefully spur the invention of new instruments or other means to overcome the difficulties.

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Annexes

Annex 1: Data on Denmark, 1999

			Energy taxes				Energy use				Emissions		Value added
Nace 2-digit	CO_2-tax	SO_2-tax	Electri-city	Petrol	Other fuels	Total	Electricitycity	Petrol	Other	Total	CO_2	SO_2	
	mill. €						TJ				1.000 tons		mill. €
Total	**652**	**67**	**988**	**1 333**	**1 277**	**3 598**	**117 355**	**103 922**	**847 352**	**951 274**	**65 034**	**68**	**136 096**
01-02, 05	**47**	**4**	**1**	**13**	**42**	**56**	**7 185**	**631**	**43 935**	**44 566**	**3 174**	**3**	**3 862**
10-14	**2**	**0**	**0**	**0**	**1**	**1**	**293**	**12**	**26 926**	**26 938**	**2 469**	**1**	**1 446**
15-37	**110**	**16**	**8**	**33**	**108**	**149**	**34 190**	**1 795**	**112 991**	**114 786**	**7 619**	**15**	**22 744**
15-16	31	4	2	5	25	31	7 818	275	27 999	**28 275**	1 841	4	3 734
17-19	3	0	0	2	3	5	733	103	2 016	**2 119**	113	0	686
20	4	1	0	1	3	4	1 211	48	5 760	**5 808**	555	0	687
21-22	6	1	1	5	4	10	2 586	256	6 128	**6 384**	268	0	2 527
23-24	10	2	1	2	6	9	5 265	133	28 185	**28 318**	1 633	3	2 398
25	9	1	1	1	4	7	2 432	80	2 266	**2 346**	140	0	1 106
26	12	1	0	1	13	15	3 132	69	24 686	**24 754**	2 057	8	1 078
27	3	1	0	0	2	3	2 800	26	2 423	**2 449**	139	0	505
28	8	1	1	4	15	20	1 930	209	3 977	**4 186**	257	0	1 995
29	10	1	1	5	16	22	2 307	248	3 918	**4 166**	235	0	3 453
30-33	5	1	1	3	6	10	1 448	168	1 693	**1 861**	94	0	2 377
34-35	4	1	0	1	4	6	854	49	1 261	**1 310**	74	0	793
36	5	1	0	3	6	8	1 614	128	2 636	**2 764**	210	0	1 381
37	0	0	0	0	0	0	60	3	43	**45**	3	0	24
40-41	**3**	**9**	**0**	**2**	**4**	**6**	**1 698**	**122**	**363 286**	**363 408**	**30 399**	**37**	**3 235**
40	1	9	0	2	4	6	1 030	114	363 238	**363 352**	30 396	37	3 075
41	2	0	0	0	0	0	668	8	48	**56**	3	0	161
45	**15**	**1**	**0**	**31**	**71**	**101**	**920**	**1 545**	**14 101**	**15 645**	**1 148**	**1**	**6 865**
50-52, 55	**60**	**6**	**11**	**74**	**108**	**192**	**14 284**	**4 338**	**26 018**	**30 355**	**1 425**	**0**	**19 821**
60-64	**46**	**4**	**35**	**20**	**239**	**294**	**5 497**	**987**	**73 889**	**74 877**	**5 425**	**7**	**10 269**
60-63	0	0	0	0	0	0	1 602	335	31 922	**0**	2 396	1	0
60	30	1	0	7	219	226	1 602	335	31 922	**32 256**	2 396	1	3 400
61	0	1	0	0	0	1	105	21	10 403	**10 424**	787	6	1 543
62	0	0	0	0	0	1	113	13	27 977	**27 990**	2 012	0	583
63	11	1	25	3	11	40	2 660	215	1 735	**1 951**	114	0	1 640
64	5	0	9	9	8	26	1 018	404	1 853	**2 257**	116	0	3 103
65-67	**5**	**0**	**20**	**2**	**4**	**27**	**856**	**130**	**1 456**	**1 587**	**45**	**0**	**6 938**
70-99	**89**	**8**	**276**	**50**	**127**	**453**	**15 546**	**18 427**	**38 256**	**56 683**	**1 497**	**0**	**60 916**
90	8	1	16	1	16	32	1 437	34	3 140	**3 173**	131	0	797
Households	275	18	636	1 109	573	2 318	36 885	75 936	146 495	**222 431**	11 832	3	0

Annex 2: Data on Finland, 1999

			Energy taxes				Energy use				Emissions		Value added
Nace 2-digit	CO_2-tax	SO_2-tax	Electricity	Petrol	Other fuels	Total	Electricity	Petrol	Other fuels	Total	CO_2	SO_2	
	mill. €						TJ				1.000 tons		mill. €
Total	**454**	**0**	**379**	**1 993**	**329**	**2 701**	**230 188**	**154 610**	**869 702**	**1 254 500**	**59 542**	**99**	**103 790**
01-02, 05	**32**	**0**	**6**	**10**	**45**	**61**	**2 988**	**607**	**30 290**	**33 886**	**1 982**	**2**	**3 941**
10-14	**1**	**0**	**2**	**0**	**1**	**3**	**1 951**	**0**	**829**	**2 780**	**63**	**0**	**287**
15-37	**112**	**0**	**146**	**0**	**117**	**263**	**148 082**	**5**	**422 554**	**570 642**	**17 547**	**44**	**26 096**
15-16	11	0	6	0	11	17	5 663	0	9 112	**14 775**	723	3	1 934
17-19	1	0	1	0	1	2	936	0	720	**1 656**	50	0	583
20	1	0	5	0	2	7	5 141	0	10 168	**15 309**	143	1	1 261
21-22	49	0	86	0	50	137	87 743	0	260 353	**348 096**	5 354	16	5 812
23-24	22	0	18	0	24	41	17 852	0	65 180	**83 033**	4 436	14	1 813
25	0	0	3	0	0	3	2 581	0	485	**3 067**	35	0	934
26	15	0	3	0	16	19	3 071	0	11 115	**14 186**	894	1	824
27	12	0	16	0	13	29	15 948	1	64 140	**80 089**	5 821	8	976
28	0	0	2	0	0	2	1 984	0	282	**2 265**	20	0	1 597
29	0	0	2	0	0	3	2 480	0	261	**2 741**	18	0	2 752
30-33	0	0	3	0	0	3	2 621	0	205	**2 826**	13	0	6 071
34-35	0	0	1	0	0	2	1 199	5	441	**1 644**	34	0	936
36	0	0	1	0	0	1	817	0	91	**908**	6	0	583
37	0	0	0	0	0	0	47	0	0	**47**	0	0	19
40-41	**17**	**0**	**0**	**0**	**18**	**18**	**0**	**2**	**243 921**	**243 923**	**18 208**	**29**	**2 197**
40	17	0	0	0	18	18	0	2	243 921	**0**	18 208	29	0
41							0			**0**			0
45	**16**	**0**	**2**	**2**	**24**	**27**	**799**	**109**	**12 678**	**13 586**	**938**	**1**	**5 774**
50-52, 55	**20**	**0**	**0**	**0**	**28**	**28**	**0**	**0**	**22 407**	**22 407**	**1 447**	**2**	**54 610**
60-64	**93**	**0**	**4**	**624**	**0**	**628**	**1 872**	**74 943**	**37 212**	**114 027**	**14 696**	**17**	**10 885**
60-63	93	0	4	624	0	628	0	74 943	37 212	**0**	14 696	17	0
60	93	0	4	624	0	628	1 872	74 943	2 968	**79 783**	11 081	0	3 909
61	0	0	0	0	0	0	0	0	4 291	**4 291**	322	2	726
62	0	0	0	0	0	0	0	0	6 561	**6 561**	465	0	636
63	0	0	0	0	0	0	0	0	84	**84**	6	0	2 438
64	0	0	0	0	0	0	0	0	23 308	**23 308**	2 822	14	3 176
65-67	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**23 308**	**0**	**2 822**	**14**	**0**
70-99							**0**			**0**			**0**
Other	20	0	103	59	23	184	14 735	3 406	18 729	**36 869**	1 535	2	0
Household	143	0	116	1 298	73	1 487	59 760	75 537	81 083	**216 380**	3 127	1	0

Annex 3: Data on Norway, 1999

			Energy taxes				Energy use				Emissions		Value added
Nace 2-digit	CO_2-tax	SO_2-tax	Electri-city	Petrol	Other fuels	Total	Electri-city	Petrol	Other fuels	Total	CO_2	SO_2	
	mill. €						TJ				1.000 tons		mill. €
							432		**582**	**1 088**			**131**
Total	**818**	**35**	**419**	**1 158**	**545**	**2 123**	**786**	**73 431**	**688**	**904**	**52 486**	**77**	**803**
01-02, 05	**28**	**5**	**12**	**8**	**4**	**24**	**7 070**	**350**	**27 636**	**35 057**	**2 210**	**1**	**3 150**
									134	**137**			
10-14	**401**	**2**	**1**	**0**	**5**	**6**	**2 698**	**6**	**409**	**113**	**10 155**	**1**	**19 959**
							175		**120**	**296**			
15-37	**74**	**14**	**0**	**7**	**18**	**25**	**938**	**383**	**066**	**387**	**13 983**	**22**	**16 332**
15-16	7	1	0	1	8	9	10 957	104	8 500	**19 561**	606	1	2 495
17-19	0	0	0	0	0	0	749	11	348	**1 107**	28	0	267
20	1	0	0	0	2	2	2 535	9	8 041	**10 585**	78	0	612
21-22	5	1	0	1	0	1	25 061	75	21 678	**46 815**	524	2	2 388
23-24	50	8	0	2	1	2	26 102	13	60 293	**86 408**	5 518	8	1 518
25	0	0	0	0	0	0	1 430	10	325	**1 765**	28	0	344
26	2	0	0	0	2	2	3 289	8	10 793	**14 089**	1 832	2	595
										101			
27	7	4	0	0	1	1	95 777	6	5 949	**732**	5 057	9	1 228
28	0	0	0	1	1	1	2 084	38	636	**2 758**	49	0	1 077
29	0	0	0	1	1	2	2 146	47	735	**2 928**	55	0	1 396
30-33	0	0	0	0	0	0	1 523	13	633	**2 170**	86	0	1 541
34-35	1	0	0	0	1	1	2 997	26	1 002	**4 026**	72	0	2 257
36	0	0	0	0	0	1	1 097	17	789	**1 902**	27	0	553
37	0	0	0	0	1	1	191	6	345	**542**	24	0	62
40-41	**2**	**0**	**6**	**7**	**2**	**14**	**36 506**	**60**	**5 120**	**41 686**	**378**	**1**	**3 099**
40	2	0	6	7	2	14	36 506	60	4 818	**41 385**	356	1	2 882
41	1	0	0	0	0	0	0	0	302	**302**	22	0	217
45	**14**	**1**	**5**	**12**	**57**	**73**	**2 034**	**625**	**8 704**	**11 363**	**701**	**0**	**6 153**
50-52, 55	**16**	**1**	**45**	**93**	**14**	**152**	**23 895**	**9 567**	**9 189**	**42 650**	**1 360**	**0**	**15 626**
									231	**243**			
60-64	**151**	**6**	**11**	**63**	**391**	**465**	**6 519**	**4 606**	**878**	**003**	**17 262**	**51**	**12 370**
60-63	0	0	0	0	0	0							0
60	71	0	4	27	341	372	2 124	2 841	49 896	**54 862**	3 428	1	4 007
									159	**159**			
61	10	2	0	0	0	0	33	0	389	**422**	12 043	50	2 655
62	39	0	1	0	0	1	262	106	20 951	**21 318**	1 542	0	785
63	26	4	3	8	40	51	1 954	208	1 366	**3 528**	125	0	1 981
64	4	0	4	27	10	41	2 146	1 452	276	**3 873**	124	0	2 942
65-67	**12**	**1**	**10**	**14**	**0**	**24**	**2 892**	**468**	**685**	**4 045**	**56**	**0**	**5 199**
70-99	**29**	**2**	**107**	**48**	**4**	**159**	**49 068**	**2 208**	**16 677**	**67 953**	**1 156**	**0**	**49 782**
90	1	0	0	2	2	4	31	15	1 209	**1 255**	63	0	834
							126			**209**			
Households	91	2	222	907	50	1 179	166	55 158	28 325	**648**	5 225	1	133

Annex 4: Data on Sweden, 1999

			Energy taxes				Energy use				Emissions		Value added
Nace 2-digit	CO_2-tax	SO_2-tax	Electricity	Petrol	Other fuels	Total	Electricity	Petrol	Other fuels	Total	CO_2	SO_2	
	mill. €						TJ				1.000 tons		mill. €
							325		**740**	**1 065**			**251**
Total	**1 508**	**14**	**1 477**	**2 363**	**857**	**4 697**	**019**	**0**	**495**	**514**	**65 593**	**78**	**135**
01-02, 05	**74**	**0**	**30**	**33**	**86**	**149**	**1 422**	**0**	**10 150**	**11 572**	**2 053**	**1**	**3 828**
10-14	**8**	**1**	**5**	**1**	**4**	**10**	**17 486**	**0**	**20 491**	**37 977**	**567**	**1**	**509**
							182		**380**	**563**			
15-37	**170**	**5**	**104**	**64**	**23**	**192**	**961**	**0**	**815**	**776**	**19 196**	**38**	**43 325**
15-16	20	1	5	4	5	14	1 373	0	1 456	**2 830**	945	1	3 716
17-19	2	0	1	1	0	2	10 383	0	37 299	**47 682**	104	0	569
									170	**246**			
20	8	0	5	2	8	15	76 101	0	769	**870**	264	2	1 900
21-22	51	2	43	8	3	54	5 350	0	58 782	**64 132**	2 511	14	6 509
23-24	9	0	11	3	1	15	22 099	0	9 930	**32 029**	4 911	10	4 290
25	3	0	2	2	0	4	4 358	0	19 013	**23 370**	113	0	1 330
26	20	0	2	1	2	6	28 914	0	62 437	**91 351**	3 083	2	993
27	25	0	16	1	1	18	7 567	0	4 681	**12 248**	5 906	7	2 052
28	7	0	4	9	1	14	8 204	0	4 376	**12 581**	292	0	3 905
29	7	0	4	9	1	15	205	0	200	**405**	267	0	5 584
30-33	4	0	3	7	0	10	13 535	0	8 179	**21 713**	126	0	5 635
34-35	10	0	5	13	1	20	3 356	0	2 004	**5 360**	482	1	5 761
36	2	0	1	2	0	3	824	0	1 494	**2 318**	59	0	1 020
37	2	1	0	0	0	1	692	0	196	**888**	133	0	62
40-41	**95**	**7**	**123**	**5**	**48**	**176**	**5 811**	**0**	**26 820**	**32 631**	**7 412**	**14**	**4 715**
40	95	7	106	3	48	157	3 296	0	332	**3 628**	7 397	14	4 065
41	1	0	17	2	0	19	2 515	0	26 488	**29 004**	15	0	650
45	**70**	**0**	**13**	**67**	**69**	**149**	**20 311**	**0**	**35 964**	**56 275**	**1 593**	**0**	**8 824**
50-52, 55	**81**	**0**	**127**	**165**	**59**	**351**	**16 503**	**0**	**67 106**	**83 609**	**1 865**	**0**	**24 689**
									131	**135**			
60-64	**211**	**0**	**36**	**94**	**286**	**416**	**4 427**	**0**	**196**	**622**	**14 087**	**18**	**16 373**
60-63	0	0	0	0	0	0	0	0	0	**0**	14 087	18	0
60	192	0	15	75	265	354	61	0	87 402	**87 462**	4 420	1	6 221
61	0	0	0	1	0	1	227	0	35 642	**35 869**	6 640	16	981
62	0	0	1	1	0	2	1 594	0	3 281	**4 875**	2 602	0	873
63	10	0	8	4	13	25	2 286	0	3 832	**6 118**	225	0	2 680
64	9	0	12	15	8	34	259	0	1 040	**1 299**	200	0	5 619
65-67	**3**	**0**	**10**	**8**	**1**	**19**	**9 421**	**0**	**11 612**	**21 032**	**63**	**0**	**7 502**
70-99	**128**	**0**	**276**	**145**	**94**	**515**	**38 783**	**0**	**32 929**	**71 712**	**3 299**	**1**	**97 719**
90	9	0	7	2	13	21	596	0	137	**733**	196	0	666
Households	669	0	754	1 782	186	2 722	27 894	0	23 412	**51 306**	15 459	5	43 651

Annex 5: Minutes from Oslo meeting

Minutes from meeting on the Nordic tax project

Participants

Virva Terho, Statistics Finland
Merja Saarnilehto, Statistics Finland
Mårten Sjölin, Statistics Sweden
Viveka Palm, Statistics Sweden
Kristine Erlandsen, Statistics Norway
Julie Hass, Statistics Norway
Tone Smith, Statistics Norway
Karin Blix, Statistics Denmark
Preben Etwil, Statistics Denmark
Klaus B. Pedersen, Statistics Denmark

Agenda

See programme

Country presentations

The first part of the meeting was a presentation of the energy tax systems in the Nordic countries. The systems are rather similar in their nature as the quiry from the OECD database suggests but the taxes are calculated in very different ways.

Denmark: The tax is calculated in the energy section as the quantity multiplied with the tax rate and adjusted for exceptions and reimbursements. The total of the calculated tax should add up to the revenue from Ministry of Finance.

Norway: The tax is calculated in the national account section. The total book values from the Government are adjusted for time periods, so it is on an accrual basis.

Finland: The actual calculation is not carried out yet, but it will be done by the national accounts and the actual method is not quite clear yet.

Sweden: The method used in Sweden is similar to the Danish method. The energy use is multiplied with the tax rate.

Currrency

It was discussed whether time series should be in national currencies or in Euros. It was decided to report national currencies as it is difficult or almost impossible to get a reasonable time series in Euros as the exchange rate will have big influence (eg. exchange rate SEK/ECU has changed dramatically because of devaluation of the Swedish krone).

Fixed or current prices

As we are not interested in developments caused by inflation, we would like to eliminate the price differences but is seems to be difficult (almost impossible) to compare taxes in fixed prices as taxes are not made in fixed prices.

Partly due to the currency problem and partly due to national problems in getting data, most focus is put on getting data for 1999. Time series will be shown as indexes as that will be the best way to show national developments.

Data

The data for 1999 should look like this table:

NACE 2-digit	CO_2-tax	SO_2-tax	Energy taxes				Energy use				CO_2-emissions	SO_2-emissions	Value added
			Electricity	Petrol	Other fuels	Total	Electricity	Petrol	Other	Total			
	€						tera Joules				tons		€
	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx

Explanations:

NACE 2-digit: The data should be delivered on a NACE 2-digit level. Countries should take care of confidentiality problems themselves before data are delivered. In addition to the NACE-categories there should also be one household category. Afterwards the branches can be grouped differently.

Energy use should be actual energy use as it is in NAMEA.
CO_2- and SO_2-emissions should be the emissions as it is presented in the NAMEA-system. That includes non-energy related emissions.

Which years?

It was decided to focus on 1999 and the time series ahead instead of making too many compromises about a long time series back in time. However, it would be good to have data back in time and therefore it was decided to give data for 1998 if possible.

It was also decided to have some total figures for taxes, energy taxes, CO_2-taxes, SO_2-taxes, energy use, CO_2-emissions and SO_2-emissions.

Documentation

Each country shall give an explanation to the figures and a precise documentation including description of sources, definitions, methods etc.).

Time schedule

Deadlines	
March-July	Data from Sweden in March
August 1st	Final data from Norway and Denmark
September 1st	Preliminary data from Finland
October 1st	First draft report
November 1st	Meeting in Copenhagen
December	2nd draft report
December	Final figures
December 31st	Final report

Next meeting

The next meeting in the group will be November 1st in Copenhagen. The provisional agenda will be discussion of the draft report and the analysis in particular and how the statistics should be treated and published in the future.

Annex 6: Industrial classification in full text

Nace 2-digit	Main group	
Total		
01-02, 05	**A+B**	Forestry, Hunting, fishing and Agricultural
10-14	**C**	Mining, quarring
11		
15-37	**D**	Manufacturing
15-16		Manufacture of food products and beverages. Manucacture of tobago plants
17-19		Manufacture of textiles, of wearing apparel; tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear.
20		Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials.
21-22		Manufacture of pulp, paper and paper products. Publishing, printing and reproduction of recorded media.
23-24		Manufacture of coce, refined petroleum products and nuclear fuel, manufacture of chemicals and chemical products.
25		Manufacture of plastic and rubber products
26		Manufacturing of other non- metallic mineral products
27		Manufacture of basic products
28		Manufacture of fabricated metal profucts, except machinery products.
29		Manufacture of machinery equipment
30-33		Manufacture of office mechinery and computers. Manufacture of electric machinery and apparatus .Manufacture of radio, television, and communication equipment and apparatus. Manufacture of medical, precision and optical instruments, watches and clocks.
34-35		Manufacture of motor vehicles, trailers and semitrailers. Manufacture of other transport equipment.
36		Manufacture of furninture
37		Recycling
40-41	**E**	Electricity, gas and water supply
40		Electricity, gas. steam and hot water supply
41		Collections, purification and distrubiution of water
45	**F**	Construction
	G+H	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods.
50-52, 55		Hotels restaurants
60-64	**I**	Transport, storage and communication
60-63		Landtransport;transport via pipelines. Water transport. Air transport. Supporting auxaliary transport activities of travel agents.
60		Land transport
61		Water transport
62		Air transport
63		Supporting and auxiliary transport activities; activities for travel agencies
64		Post and tele communications
65-67	**J**	Financial intermedation
70-99	**J-Q**	Real estate, renting, and business activities. Public administration, and defense; compulsory social security. Education. Health and social work. Other community, social and personal service activities. Private households with employed persons.
90		Sewage and refuse disposal sanitation and similar activities
Households		Households

Annex 7: Figures in the graphic

Figure 1.1

	Sweden		Norway		Finland		Denmark	
	Energy consumption	Energy tax	Energy consumption	Energy tax	Energy consumption	Energy tax	Energy consumption	Energy tax
Manufacturing	39%	11%	47%	3%	68%	13%	55%	6%
Service	44%	31%	34%	41%	15%	32%	20%	30%
Households	18%	58%	19%	56%	17%	55%	24%	64%
Total	100%	100%	100%	100%	100%	100%	100%	100%

Figure 2.1

	Sweden	Norway	Finland	Denmark
Energy consumption. PJ	32.63	41.69	243.92	363.41

Figure 3.1

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Sweden		2.5%	2.5%	2.6%	2.7%	2.6%	2.9%	2.8%	2.8%	2.7%	2.5%	2.6%
Norway	1.3%	1.8%	1.8%	1.8%	2.0%	2.0%	1.9%	1.9%	1.8%	2.1%	1.8%	1.8%
Finland	1.3%	1.6%	1.7%	2.1%	2.2%	2.4%	2.6%	2.6%	2.6%	2.6%	2.3%	2.3%
Denmark	1.7%	1.7%	1.8%	2.0%	2.0%	2.1%	2.3%	2.2%	2.5%	2.6%	2.5%	2.6%

Figure 3.2

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Sweden		5.0%	5.1%	5.7%	5.7%	5.3%	5.6%	5.3%	5.2%	5.1%	4.7%	4.8%
Finland	2.6%	2.9%	3.2%	4.2%	4.2%	4.7%	4.7%	4.8%	4.9%	4.8%	4.3%	4.3%
Denmark	3.6%	3.6%	3.8%	4.1%	3.9%	4.4%	4.6%	4.5%	4.9%	5.2%	5.2%	5.4%
Norway		4.3%	4.4%	4.3%	4.8%	4.7%	4.4%	4.4%	4.2%	4.8%	4.2%	4.1%

Figure 3.3

	Sweden		Norway		Finland		Denmark	
	Energy consumption	Energy tax	Energy consumption	Energy tax	Energy consumption	Energy tax	Energy consumption	Energy tax
Primary sector	3%	3%	16%	1%	3%	2%	7%	2%
Manufacturing	33%	4%	27%	1%	45%	10%	14%	4%
Electricity. gas etc.	3%	4%	4%	1%	19%	1%	34%	0%
Service sector	44%	31%	34%	41%	15%	32%	20%	30%
Households	18%	58%	19%	56%	17%	55%	24%	64%
Total	100%	100%	100%	100%	100%	100%	100%	100%

Figure 3.4

Euro cent per kWh	Sweden	Norway	Finland	Denmark
Primary sector	0.82	0.48	0.56	0.03
Manufacturing	0.20	0.00	0.35	0.09
Electricity. gas etc.	1.87	0.06	0.00	0.00
Service sector	2.30	0.76	2.25	3.33
Households	1.82	0.63	0.70	6.21

Figure 3.5

	Sweden		Norway		Finland		Denmark	
	Electr. Cons	El tax	Electr. Cons	El tax	Electr. Cons	El tax	Electr. Cons	El tax
Primary sector	3%	2%	2%	3%	2%	2%	6%	0%
Manufacturing	42%	7%	41%	0%	64%	39%	29%	1%
Electricity. gas etc.	5%	8%	8%	1%	0%	0%	1%	0%
Service sector	16%	31%	20%	42%	8%	29%	32%	35%
Households	33%	51%	29%	53%	26%	31%	31%	64%
Total	100%	100%	100%	100%	100%	100%	100%	100%

Figure 3.6

	Sweden		Norway		Finland		Denmark	
	Consumption	Tax	Consumption	Tax	Consumption	Tax	Consumption	Tax
Industries	24%	25%	25%	22%	51%	35%	27%	17%
Households	76%	75%	75%	78%	49%	65%	73%	83%
Total	100%	100%	100%	100%	100%	100%	100%	100%

Figure 3.7

	Sweden		Norway		Finland		Denmark	
	CO2 emissions	Co2 tax	CO2 emissions	Co2 tax	CO2 emissions	Co2 tax	CO2 emissions	Co2 tax
Primary sector	4%	5%	24%	52%	4%	7%	9%	7%
Manufacturing	29%	11%	27%	9%	30%	25%	12%	17%
Electricity. gas etc.	11%	6%	1%	0%	31%	4%	47%	0%
Service sector	32%	33%	39%	27%	29%	33%	15%	33%
Households	24%	44%	10%	11%	5%	31%	18%	42%
Total	100%	100%	100%	100%	100%	100%	100%	100%

Figure 3.8

	Sweden	Norway	Finland	Denmark
	Tonne CO2 per mill. €			
All industries. ex NACE 40	236	405	559	261
Manufacturig	443	856	672	335
NACE 15-22	301	214	1 054	364
NACE 23-24	1 145	3 636	2 446	681
NACE 25-26	1 376	1 980	528	1 006
NACE 27	2 879	4 119	5 964	276
NACE 28-37	302	662	1 293	96

Figure 3.9

	Sweden		Norway		Finland		Denmark	
	SO2 emissions	SO2 tax	SO2 emissions	SO2 tax	SO2 emissions	SO2 tax	SO2 emissions	SO2 tax
Primary sector	3%	6%	2%	19%	3%	•	6%	6%
Manufacturing	48%	38%	28%	41%	46%	•	22%	24%
Electricity. gas etc.	18%	53%	1%	1%	30%	•	54%	13%
Service sector	25%	1%	67%	35%	20%	•	13%	29%
Households	6%	1%	1%	5%	1%	•	5%	27%
Total	100%	100%	100%	100%	100%	•	100%	100%