



The Use of Economic Instruments in Nordic Environmental Policy 2006–2009

*Henrik Lindhjem, John Magne Skjelvik, Anna Eriksson,
Terhi Fitch and Lise-Lotte Pade Hansen*

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Nordic Council of Ministers

Store Strandstræde 18
DK-1255 Copenhagen K
Phone (+45) 3396 0200
Fax (+45) 3396 0202

Nordic Council

Store Strandstræde 18
DK-1255 Copenhagen K
Phone (+45) 3396 0400
Fax (+45) 3311 1870

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Preface

The Nordic Council of Ministers publishes regular overview reports on the use of economic instruments in Nordic environmental policy (previous editions: 1994, 1997, 1999, 2002 and 2006). In addition to an overview of the use of economic instruments in the Nordic countries (excluding the Baltic countries compared to the previous edition), this year's report contains a separate analytical part on the use of instrument mixes in environmental policy. This is the second report in the series with a separate analytical section. The report has been prepared by Econ Pöry Norway in cooperation with Econ Pöry offices in Sweden and Denmark, and Pöry Environment Oy, Finland. The core team consisted of John Magne Skjelvik (project leader), Henrik Lindhjem, Anna Eriksson, Lise-Lotte Pade Hansen, Terhi Fitch, and Karin Ibenholt as internal quality assurer. Inputs and comments to the report have been provided by many who deserve our thanks, but none of the blame for any remaining errors: especially Professors Jon Strand and Anni Huhtala, and the members of Working Group on Environment and Economics under the Nordic Council of Ministers.

October 2009,

Ulrika Lindstedt

Chairwoman

the Working Group on Environment and Economics (MEG)
under the Nordic Council of Ministers

Executive Summary

Abstract

This report consists of two parts. Part I presents an overview of the use of economic instruments in the environmental policies of the Nordic countries with the main focus on changes during the years 2006–2009. Part II gives a brief overview of the various policy instruments (i.e. also other than economic instruments) used in the countries towards the different environmental problems, and present two case studies assessing areas where a mix of instruments are used towards an environmental problem. There are generally few changes in the use of economic instruments since 2006. The introduction of the emissions trading system EU ETS and changes in most countries' vehicle registration tax systems to become more based on specific fuel use or CO₂ emissions are the most important changes. In general the tax systems could be made more effective and efficient by treating different sectors and fuels more equally. Since CO₂ emissions from power production now is covered by emissions trading the goals and policy instruments used to promote renewable electricity production should be reconsidered to see if they are still needed or should be redesigned. Also, the various policy instruments used towards waste handling should be reconsidered to avoid unnecessary overlap. The various policy instruments used to spur energy efficiency seems to supplement each other.

Background

The Environmental and Economy Group of the Nordic Council of Ministers every two or three years publishes a report on the use of economic instruments in environmental policies of the Nordic countries. This report is part of this series. The first part of the report presents an overview of the use of economic instruments with the main focus on changes in the use during the years 2006–2009. The other part of the report gives a brief overview of the various policy instruments (i.e. also other than economic instruments) used in the countries towards the different environmental problems, and present two case studies of areas where a mix (i.e. more than one) of instruments are used towards an environmental problem. The case studies are stationary energy production and use, and climate change policy in Norway, and the waste management policy in Sweden. Since there are many similarities in the policy instrument use between the Nordic countries, the case studies are made relevant for most of the countries.

Economic instruments are often called incentive-based instruments, and comprise the following:

- Emission taxes, i.e. taxes either put directly on emissions or on an input, produced good or service associated with pollution (e.g. tax on carbon content in a fuel).
- Taxes on products for other purposes than environmental protection, but which might also have positive environmental impacts (e.g. car sales tax, electricity consumption tax).
- Deposit-refund schemes where buyers pay a tax upon buying a product and then get a wholly or partly tax refund when delivering the product for treatment when it ends up as waste
- Subsidies for pollution reductions
- Subsidies for renewable energy production, energy efficiency measures etc. that might indirectly yield environmental benefits (including so-called green certificates for renewable electricity production)
- Emissions trading, where a cap is set on total emissions and allowances are distributed for free or auctioned among emitters.
- Charges put on sales of products to cover waste collection and treatment costs of products to ensure high collection and proper treatment.

Conclusion and recommendation

Few changes since 2006

In general there are few changes in the tax systems and rates since 2006. Most rates are adjusted according to the price level increase. The most substantial change affecting all Nordic countries has been the introduction of the EU Emissions Trading System (EU ETS), which was introduced as a trial system from 2005 but is permanent from 2008. Most allowances are allocated free of charge to the participating companies. To reduce “double taxation” Denmark, Norway and Sweden have adjusted their CO₂ tax regimes.

Denmark, Finland and Norway have adjusted their vehicle registration tax systems to become more based on specific fuel use or CO₂ emissions from the vehicle. The Norwegian system is the one that have been changed most in this direction. Also, some changes in the annual vehicle taxes towards environmental differentiation have been made. All Nordic countries will have environmentally differentiated annual vehicle taxes from 2010.

Furthermore, some producer responsibility schemes have been introduced, mostly to fulfil EU regulations. These comprise for instance end-of-life vehicles, and waste electric and electronic equipment.

Table A gives a broad overview of the use of economic instruments in the Nordic countries. It is hard to judge only from the table which country uses economic instruments most extensively in their environmental policy. Denmark, Norway and Sweden all have many instruments in use, with Denmark as the country with the broadest coverage. It is not always easy to compare the countries' use of economic instruments, since there are many different designs when it comes to tax base, exemptions, rates etc.

Table A Overview of the use of economic instruments in the Nordic countries in 2009

	DK	FIN	IS	N	S
<i>Energy and air pollution</i>					
Excise tax on electricity consumption	X	X		X	X
Excise tax on fuel oil products etc.	X	X		X	X
Excise tax on transportation fuels	X	X	X	X	X
CO ₂ tax on fuel oil	X	X		X	X
CO ₂ tax on transportation fuels	X	X		X	X
CO ₂ emission trading energy intensive industries	X	X		X	X
SO ₂ tax	X			X	X
NO _x tax				X	X
Subsidy schemes for renewable energy, energy efficiency etc.	X	X		X	X
<i>Water pollution</i>					
Water effluent tax	X				(X)
Water supply tax	X				
<i>Waste</i>					
Tax on waste put on landfill	X	X		X	X
Tax on incinerated waste	X			X	X
Taxes, deposit-refund systems or other collection systems on beverage containers/packaging	X	X	X	X	X
Taxes on other packaging	X				X
Charges to finance collection and treatment, or deposit-refund systems for products: ELVs batteries, tyres, lubrication oil or pesticides	X	X	X	X	X
Tax on GHGs (industrial gases)	X			X	
Tax on PVC, phthalates and chlorinated solvents	X				
<i>Transport</i>					
Vehicle registration or sales tax	X	X	X	X	
Annual circulation tax	X	X	X	X	X
Environmental related or noise charges on aviation		X		X	X
Road congestion tax					X
<i>Agriculture and natural resources</i>					
Tax on extraction of raw materials	X				
Tax on pesticides				X	X
Tax on fertilizer use	X				X
Tradable fishing quotas			X		

Source: Econ Pöyry

Denmark has had a tax freeze

Denmark imposed a tax freeze from 2001/2002, which has left most tax rates unchanged since then. But since 2008 rates have been regulated according to price level increases. Subsidies for wind power production and other renewable power production are increased for the period 2008–

2011. Denmark is still the only country with water pollution tax and tax on PVC, phthalates, chlorinated solvents and on extraction of various raw materials. From April 2007 some major changes were made in the car registration tax system, that favours small, fuel efficient cars at the expense of those with large fuel consumption. Electric and hydrogen driven cars are fully exempted from the tax. From 2010 a NO_x tax and several other taxes will be implemented.

Car tax changes in Finland

The Finnish basic energy and air pollution tax system have been more or less unchanged since 1997, only the tax rates have been adjusted somewhat. The car registration tax system was changed in 2008, and differentiated according to specified fuel consumption of the car. Tax rates were generally cut by 1/6. The annual car owner's tax will likely be changed from 2010 to be based on CO₂ emissions from the car.

Iceland has no taxes on stationary energy use or air pollution

In Iceland most electricity and heat production stems from hydro and geothermal sources. Hence the local air quality is good, and there are no reasons to tax stationary energy use from an environmental perspective. However, there are excise duties on fossil fuels for transportation, and the system has mainly been unchanged for several years. The country also has an excise duty on registration of private cars, differentiated on engine capacity, and a weight tax on all vehicles. Vehicles larger than 10 tons pay a special weight distance tax. Iceland has no taxes on waste handling, but some recycling fees and deposit-refund systems related to beverage containers, end-of-life vehicles etc. The individual fishing quota trading system for fishermen is rather unique for the country, and appears to have been working rather well.

Most tax system changes in Norway

The tax rate for the general mineral oil tax was increased in 2008 to come on par with the general electricity tax, to avoid substitution from electricity to fuel oil. However, industry pays the very low, EU minimum tax rate on electricity, which implies that the relative electricity prices has become even lower than before for these users. CO₂ tax rates have mostly been adjusted to price level increases, but almost halved for offshore installations from 2008 to reduce the level of "double taxation" because of the introduction of the EU ETS for this sector.

A NO_x tax on emissions from large sources was introduced in 2007 to contribute to reach the national goal for total NO_x emissions. An agreement was struck between government and industry, implying that when paying into a fund for abatement investments a tax relief could be obtained. Furthermore, a small amount for compensation to the installations most affected by the tax was set aside in the Government's budget.

In 2007 the car registration tax system was considerably changed. A CO₂ component was introduced, replacing the displacement part of the tax. The tax is now based on weight, engine effect and CO₂ emissions. The tax rates have been further changed since 2007 and the system now highly encourage purchase of low emission cars and punish the purchase of high emission cars. Electric and hydrogen driven cars are fully exempted from the tax. The annual excise duty on vehicles is from 2008 differentiated according to whether diesel vehicles have particle filter or not.

Sweden is the only Nordic country without vehicle registration tax

In Sweden the basic energy and air pollution tax system has been more or less unchanged since 2006, only tax rates have been adjusted. Because of domestic car production Sweden is the only Nordic country without vehicle registration tax. But there is an annual vehicle tax differentiated according to some environmental criteria. Sweden is also the only Nordic country with a Green certificate trading scheme for renewable electricity. Furthermore, Stockholm's congestion tax, made permanent from 2007, is a very interesting example of a new environmental tax that could be an example for other cities.

The tax systems could be made more effective and efficient

There is no doubt that the CO₂ and excise taxes have significantly contributed to emission reductions. But the tax systems could be more cost effective if the rates varied less among sectors. Furthermore, reduced tax rates for natural gas in some countries use weaken the position of emissions free alternatives.

Also the CO₂/fuel use differentiation of car sales taxes has had effect through a reduction in the specific emissions from new cars. But the effect depends heavily on the size of the differentiation, and the more country that differentiate their tax systems, the stronger signals will be passed on to the car manufacturers to develop low emission cars.

Various subsidy schemes for renewable energy sources are being evaluated in many countries, and the effectiveness of grants and tax reliefs for these sources are being questioned. Norway is considering introducing a green certificate scheme for renewable electricity linked to the Swedish system.

The instrument mix to promote renewable electricity production should be reconsidered in light of the introduction of emissions trading

There are several goals in the Norwegian environmental and energy policies, but the ultimate goals seem to be reduction of GHG emissions and reduced electricity supply costs. There have been several policy instruments like subsidies, information to promote renewable electricity production and more efficient use of electricity to reduce GHG emissions from electricity production in most Nordic countries. Also, there are taxes

on CO₂ emissions, electricity and fuel oil use, as well as GHG emissions trading. Emissions from power production are since 2005 covered by the EU ETS, implying that total emissions from the system have a cap. Thus, promoting renewable electricity production or efficient use of electricity would not any more lead to net emission reductions. Therefore, the goals and policy instruments used should be reconsidered to see if they are still needed or could be redesigned.

Also, changes in the use of policy instruments like taxes and emission permit trading directly towards the various GHG emission sources should be considered to ensure more cost effective emission reductions. The CO₂ taxes should be made more uniform among sources, and the tax rates could be set to mirror the allowance price in the emissions trading system or the trading system could be expanded to include some sectors that are currently covered by CO₂ tax.

The policy instruments used to spur energy efficiency supplement each other

More efficient electricity (and energy) use would reduce overall energy consumption. Since there are several low or no cost actions that could be taken both in industry and households to use energy more efficiently that could be cheaper for society than for instance investments in new power production capacity, energy efficiency measures should be promoted. For several reasons households and companies will not invest enough in such measures.

Promoting energy efficiency investments and –behaviour need to be addressed at various levels through different policy instruments. Technical and performance standards affect the design and construction of new buildings and some equipment, and contribute to reduced energy use. Subsidies for various energy saving measures (including fuel switch) addresses existing buildings and machinery, and promotes energy saving in the existing stock of houses and equipment. The various taxes (including emission permit costs) on electricity and fuel oil give users signals through energy prices of the real costs of energy use, and affects the amount of fuel used. Information activities could impact all these various decisions, and contribute to strengthen the impacts of the taxes, emission trading and subsidies.

Thus, the combination of policy instruments towards energy efficiency in households and industry used in Norway and most Nordic countries does not seem to act against each other or weaken the overall impacts. To the extent that the instruments spur low cost actions that would otherwise not be implemented, it could be said that they contribute to increased cost effectiveness in GHG emissions reductions and energy supply.

The various policy instruments used towards waste handling should be reconsidered to avoid overlap

Even though our case study shows that there are several goals in Sweden and most other Nordic countries for how waste should be sorted and handled for material and energy recovery in accordance with the so called “waste hierarchy”, the ultimate goals are related to reduce the environmental impacts from waste handling, in particular the reduction of GHG emissions. Some goals also seem to be related to promote more efficient (sustainable) resource use to save the use of natural resources like timber, metals and oil. Taxes on waste delivered for incineration and landfills are imposed in most countries. In Norway emissions from incineration are taxed directly and the tax on waste delivered on landfills is differentiated according to the environmental standard of the landfill. In addition there are in all countries several regulations to reduce emissions from incineration and landfills. Furthermore, measures are taken to reduce the generation of waste and to sort out various waste fractions for recycling or energy recovery.

Many of these instruments are overlapping and several seem unnecessary. The EU ban on putting biodegradable waste on landfills, which is followed up by all Nordic countries, implies that several of the current policy measures directed towards landfills will be unnecessary. But technical requirements for existing landfills will still be necessary to avoid future leakages to air and water, since they are hard to monitor and tax. Emissions from incineration plants could be taxed directly in combination with a tax on the fossil carbon content on the waste delivered as in Norway, to give long term incentives to reduce emissions. In addition, regulations of some substances that are eventually not taxed could be considered, whereas other regulations or technical requirements towards emissions from waste incineration seem unnecessary. Waste containing hazardous substances could still be sorted out and treated separately to avoid releases of these substances to air. Deposit refund systems for bottles and cans could be kept to avoid littering. Information measures to support the waste policy activities should be kept.

The various goals and measures for material and energy recovery should be carefully considered, since they do not seem necessary for neither environmental nor optimal natural resource use reasons. Given the right price signals, including environmental costs, the markets will themselves find the most profitable ways and amounts of material and energy recovery to the benefit of the whole society.

1. Introduction

1.1 Background

“Command-and-control is comforting to politicians and people: governments know what they are asking for, people know what they are getting, companies know what they are supposed to deliver; the only people who do not like it are economists” (The Economist, 2 September 1989)¹.

This view on the use of “command and control” (CAC) vs. economic or “market based” instruments (EI) in environmental policy has become more nuanced during the last two decades². While advocates of CAC and status quo have gradually come around to accept that EIs in many areas may offer both cost savings and environmentally effective outcomes, economists on the other hand, have realised that the use of EIs pose many challenges they did not originally foresee. This realisation has sharpened public debate and academic research and lead to a better understanding of the complex role of environmental regulation in the political economy. In no other area is this perhaps more true than in the Nordic countries, which adopted EIs, mostly taxes, at an early stage, but currently has rather complex regulation systems shaped by a multitude of considerations. The proposed assignment by the NCM is a welcome contribution to the analysis of EIs and the challenge to improve the efficiency and effectiveness of instrument mixes in environmental policy.

1.2 Objectives

The objective of this report is to present an overview of the use of EIs in environmental policy in the Nordic countries for the period 2006–2009. In line with previous reports, the last one from 2006³, the report will contain two main parts:

- Part 1: Overview of the use of economic instruments in the Nordic countries in the period 2006–2009.

¹ Quoted at <http://www.iisd.ca/consume/skou.html>

² The classification of instruments into CAC and (market based) EI is sometimes not very precise since markets involve both prices and quantities, regulations are often backed by economic sanctions, and even economic theory suggests that quantitative instruments such as standards, emission targets, or permits may be optimal in many cases (Stern 2003).

³ TemaNord (2006).

- Part 2: A special chapter giving an overview of areas where instrument mixes⁴ are used i.e. where more than one instrument (of any type) is used to reach an environmental target

⁴ We prefer his term over the alternative “double regulation” which has negative connotations.

PART I:

Overview of Economic Instruments 2006–2009

2. Introduction

2.1 Scope

The main content of part I is an update of the information of the previous report in the TemaNord series (TemaNord, 2006) regarding the use of Economic Instruments (EIs) in the Nordic countries (Sweden, Finland Norway, Denmark and Iceland). The overview does not comprise the Baltic countries (included in the previous report). The previous report focussed on the period up till 2005. The current report has the main focus on the period 2006–2009, and what changes there has been in the design and use of economic instruments in the countries since 2005. The report describes the instruments in use by 1. January 2009, but also briefly mentions changes that are made during the first 6 months of 2009 and will have effect from 2010. The report contains the same type of information as the previous one, and basically follows the same structure.

Part I of the report also compares the use of EIs between countries. This overview primarily focuses on environmental polices, rather than natural resource policies, i.e. instruments that aim to reduce concentrations of pollution, as opposed to those that regulate natural resources such as fisheries, biodiversity etc. However, the comparison is rather limited as this is not considered to be the main topic of the report.

Finally, part I also contains a brief evaluation of the environmental and cost effectiveness of the EIs, i.e. whether intended environmental improvements are achieved (goals are reached) and whether improvements are reached at least cost. This part also has the main focus on changes since 2005. The evaluation is based on existing studies, i.e. academic and government commissioned ex ante and ex post evaluations of EIs in the countries. As the main analytical contribution of the report is directed towards the second part, the evaluation of environmental and cost effectiveness in part I is more limited in scope and depth. The evaluation tries to emphasise any effectiveness concerns of particular relevance to the time period under investigation (i.e. 2006–2009). However, rather few evaluations have been available.

All numbers (e.g. tax rates) are presented in local currencies only, and in current prices. As in the previous report, this report goes through economic instruments in the areas of energy and air pollution, water pollution, waste generation and management, transport and agriculture and natural resources management. We present both economic instruments that are designed primarily to spur environmental improvement, and those designed primarily for fiscal or other reasons that might also have some environmental impacts. Thus, the report is not an exhaustive review

of all economic instruments used in these sectors. When possible the purpose of each instrument described is stated in the text.

2.2 Economic instruments considered

In this report we consider the following economic instruments:

- Emission taxes, i.e. taxes either put directly on emissions or on an input, produced good or service associated with pollution (e.g. tax on carbon content in a fuel).
- Taxes on products for other purposes than environmental protection, but which might also have positive environmental impacts (e.g. car sales tax, electricity consumption tax).
- Deposit-refund schemes where buyers pay a tax upon buying a product and then get a refund back when delivering the product for treatment when it ends up as waste
- Subsidies for pollution reductions
- Subsidies for renewable energy production, energy efficiency measures etc. that might indirectly yield environmental benefits
- Emissions trading, where a cap is set on total emissions and allowances are distributed for free or auctioned among emitters.
- Charges put on sales of products to cover waste collection and treatment costs of products to ensure high collection and proper treatment of the waste.

3. Denmark

For almost a decade the Danish politics have been characterised by the tax freeze introduced by the government in November 2001. The tax freeze is based on the following principles (Danish Ministry of Taxation 2002): no tax may be raised; if the tax is based on a percentage the percentage rate may not be raised; if the tax is based on a fixed amount of Danish kroner per unit, the amount of Danish kroner may not be raised; if there is a compelling necessity to introduce or increase a tax the yields may be used in full to reduce other taxes. It should be noted that especially in the area of environment and environmental levies the principles above open up to the possibility of deviating from the tax freeze. However, potential increased tax revenue must be used to lower other taxes (The Tax Commission's proposal, p. 31).

In May 2009 a new Danish tax reform was adopted by the Danish parliament. The Danish tax reform affects the environmental policy. However, the changes will be introduced no earlier than 2010 and some not until 2013. The main principle behind these changes is a more uniform taxation of the environmental impacts from different sources, so that the Danish goal on energy and climate can be reached in a cost effective way.

In the area of energy, the changes aim at lowering the consumption of energy. The increase in levies will help to reduce both the CO₂-emissions, increase the share of renewable energy and reduce the energy consumption.

In short, the Tax Commission's proposals contain: Energy levies for the business community; a general increase in the energy levies; a reduction of the lower-limit allowance of the CO₂-levy (reduction in the basic tax free allowance of the CO₂-tax, not implemented yet); increase in the levy on waste put on landfills; levies on hazardous waste; levies on methane in connection with energy use(not imposed yet); increase in the levies on GHG; a higher levy on wastewater; and lastly, several initiatives in the area of levies for vehicles.

Based on the principles in the tax freeze the Danish government has to some extent been reluctant to make any changes in the economic instruments in the Danish environmental policy, especially for taxes on transport, and most of the instruments introduced in TemaNord (2006) have remained unchanged. However, some levy changes in the energy and CO₂ area have been passed by the government.

3.1 Energy and air pollution

For two decades the environmental policy has strongly influenced the Danish energy policy, as focus turned to acid rain and global warming. Especially Denmark's ambitious Kyoto target has played an important role. However, constant consideration of the competitive power of the Danish enterprises has led to a large amount of exemptions in the environmental policy.

3.1.1 Energy tax on fossil fuels

As a response to the oil crises in the 1970's the energy tax on fossil fuels was introduced in 1977. The purpose was to provide incentives to decrease the energy consumption in order to reduce the balance of payments deficit resulting from the import of oil products and to some extent stimulate the use of natural gas. The tax depended on the energy content of the fuels. Initially, the tax was only levied on oil-products, but in 1982 the energy tax scheme was expanded so that coal was included in the tax umbrella. In 1996 the energy tax scheme was expanded further to include natural gas as well. Today the tax is dependent on the energy content of the fuel.

Due to the tax freeze, the energy taxes have remained constant in values since 2002. Thereby the energy taxes have been decreasing in real terms. In the end of 2007 it was decided to regulate the energy taxes according to the inflation (Danish Ministry of Taxation, 2009a). The energy tax burdens of different sources are illustrated in table 3.1.

Exemptions

Energy taxes on fossil fuel consumption are not levied uniformly across all Danish sectors. A large number of exemptions have been adopted in order to ensure that the competitive power of the Danish enterprises is not significantly weakened. Up until 1996 all VAT registered firms in Denmark were practically exempt from paying energy tax (TemaNord, 2006). From 1996 on the VAT registered companies were to pay the energy tax for energy used for space heating. Gas, oil and coal products used for light and heavy processes are 100 percent exempt from paying energy tax. Furthermore, oil, coal and gas used for electricity production are not levied any energy taxes (Danish Ministry of Taxation, 2009a).

3.1.2 CO₂-tax

In the beginning of the 1990's the attention to the connection between emissions of greenhouse gases and global warming increased. As response hereto the Danish parliament introduced the CO₂ tax in 1992 in order to increase the incentives to substitute towards less CO₂ intensive

fuels. The intention of the CO₂-tax was not to increase the price of fossil fuels, so the energy tax was lowered when the CO₂-tax was introduced to keep the overall tax burden constant (TemaNord, 2006). The tax levied on the fuels was dependent on the content of CO₂. The tax was introduced at the level of DKK 100 /tonne. Later the tax scheme was revised and the CO₂ tax was lowered to DKK 90 /tonne CO₂. A proposal for increasing the CO₂ tax again to DKK 150/tonne (which is the expected emissions quota price for 2008–2012), covering all sources that are not part of the emissions trading system EU ETS has been submitted to the EU and is expected to be approved within a year (Danish Energy Agency, 2008c). The main principle behind this increase is that all who release CO₂ should have the same incentives to reduce their emissions, whether included in the EU ETS or not. The CO₂ levy will therefore be adjusted if the price of the EU ETS quotas will differ substantially from DKK 150/tonne. In order to ensure equal treatment between free quota distribution and the CO₂ tax system, a basic (tax free) allowance has been introduced for certain industries' CO₂ tax.

Furthermore, a CO₂-tax is levied on electricity and is not directly linked to the CO₂-from the production, since it does not depend on how the electricity is produced. For different energy sources the CO₂-tax burden is illustrated in table 3.1.

Table 3.1 Energy tax and CO₂-tax burden of different energy sources. Current prices

		2006	2007	2008	2009
Light fuel oil (øre/l)	Energy tax	185.7	185.7	189	192.4
	CO ₂ -tax	24.3	24.3	24.7	25.2
Heavy fuel oil (øre/kg)	Energy tax	209.2	209.2	213	216.8
	CO ₂ -tax	28.8	28.8	29.3	29.8
Natural gas (øre/nm ³)	Energy tax	204.2	204.2	207.9	211.6
	CO ₂ -tax	19.8	19.8	20.2	20.5
Pit coal (øre/kg)	Energy tax	144.92	144.92	147.53	150.18
	CO ₂ -tax	217.8 (kr/ton)	217.8 (kr/ton)	221.7 (kr/ton)	225.7 (kr/ton)
Electricity (øre/kWh)	Energy tax	57.6	57.6	58.7	59.6
	CO ₂ -tax	9.0	9.0	8.8	8.9

Source: Danish Ministry of Taxation, 2008a, 2008b, 2008c, 2008d

Exemptions

The CO₂-taxation scheme is designed to fulfil two targets. First of all the tax scheme is designed to ensure the fulfilment of the Danish CO₂ reduction targets under the Kyoto protocol. Further, the tax scheme was designed not to increase substantially the taxes levied on the energy-intensive industries and thereby affect the competitive power of the Dan-

ish enterprises. Therefore, when the CO₂-tax scheme was introduced in 1992 the companies were fully exempt from paying CO₂ tax. Later, the tax reform was revised such that the largest CO₂ tax rebates were given to heavy industrial processes in energy-intensive industries, while energy consumption in light processes was given a smaller tax rebate.

Enterprises using energy for heavy processes are exempted 72.22 percent of the CO₂-tax, i.e. they only pay 17.78 percent of the regular tax. Enterprises using electricity for heavy processes are exempt of 70.9 percent of the CO₂-tax. Unlike the energy tax, the energy consumption used for light processes are not exempt from paying the CO₂-tax. Energy used for electricity production is not levied a CO₂-tax (Danish Ministry of Taxation, 2008a). As already mentioned the Danish authorities have passed changes in the CO₂ tax system in order to ensure equal treatment of emissions regulated by the EU ETS with those that are taxed. However, this is still not in effect.

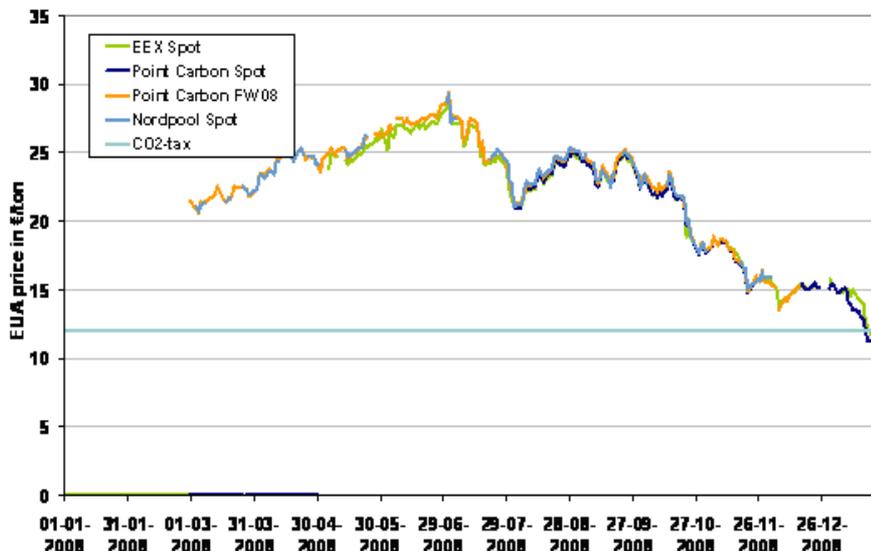
3.1.3 CO₂-emissions trading scheme

Denmark was one of the first countries to introduce tradable carbon emission allowances. In the period 2000–2003 the electricity generation sector was exposed to an emission trading scheme providing them with fewer and fewer allowances each year (Nordic Council, 2006).

Under the EU framework of the Kyoto protocol the period 2005–2007 was known as the first trading period and was prior to the commitment period which covers the years 2008–2012. In the first trading period the goal for the installations by the European Emission Trading System (EU ETS) was to reduce the CO₂ emissions by 15 percent compared to the “business as usual” projection of the EU ETS sectors. The installations in the EU ETS are approximately 375 units covering most of the electricity and heat producers and energy intensive industrial units. The approximately 375 units account for about half of the Danish CO₂-emissions (Danish Energy Agency, 2008b).

In the first trading period 5 percent of the total amount of allowances was auctioned off and the remaining 95 percent allocated free of charge, but in the commitment period all the allowances are allocated free of charge. A pool of emission allowances is set aside for new or expanded capacity. When introducing the EU ETS system the sectors covered by it were exempt from paying CO₂-tax (Danish Energy Agency, 2008b). Through 2008 the price on the EU ETS allowances varied between 11.25 €/ton and 29.38 €/ton (app. DKK 85–220/ton), i.e. the price of a tonne of CO₂ was significantly higher than the CO₂ tax (see figure 3.1). It should be mentioned here that these numbers are based on the current CO₂ tax. But as stated earlier a levy of 150 DKK/tonne has been approved; an amount that would have better matched the quota price before the financial crisis.

Figure 3.1 EU ETS allowance price, January 2008–January 2009



Source: EEX (2009), Point carbon (2009), Nordpool (2009)

A new levy on NO_x of DKK 5/kg will become effective from 2010 to help fulfil the Danish NO_x-commitment.

3.1.4 Excise duties on transportation fuels

Taxation of transportation fuels was introduced already in 1917. Until the late 1980s taxes on transportation fuel were mostly imposed for fiscal reasons and they were also seen as an instrument to limit oil imports. The excise duties on transportation fuels have, however, also been seen as a deliberate means to regulate the environmentally harmful effects from the fuel consumption. In the 1980s the fuel tax scheme was used as a means to reduce the use of petrol containing lead (Nordic Council, 2006).

The 2005 revision of the CO₂ tax legislation introduced a CO₂ tax on petrol in order to achieve consistency in the taxation of the different mineral oils. However, the introduction of the CO₂ tax was not intended to increase the overall tax burden on petrol, and therefore the basic excise charge was lowered to maintain the level of the overall rate (Nordic Council, 2002). The tax rates on transportation fuels for the period 2006–2009 are illustrated in table 3.2.

Table 3.2 Excise duties on transportation fuels. Øre/liter

	Petrol				Diesel			
	2006	2007	2008	2009	2006	2007	2008	2009
Basic excise charge (leaded ^a)	447.0	447.0	455	463.2	278.7	278.7	283.7	288.8
Basic excise charge (unleaded ^a)	382.0	382.0	388.9	395.6				
CO ₂ tax on gasoline	22.0	22.0	22.4	22.8	24.3	24.3	24.7	25.2
TOTAL TAX (unleaded ^a)	407.0	407.0	411.3	418.7	303.0	303.0	308.4	314

^a) Petrol only

Source: Danish Ministry of Taxation 2008b, 2008d

3.1.5 Excise duty on electricity consumption

Excise duty on electricity consumption was introduced in 1977. The tax was introduced as response to the first oil crises in order to give incentives to reduced electricity consumption. Since the introduction, the energy tax on electricity has increased except in 1986 when the tax for electricity used for space heating was reduced. The excise duties on electricity are levied on all electricity consumption in Denmark regardless of its origin (produced abroad, produced in combined heat and power plants, auto generated, produced by use of coal, fuel oil, wind turbines, etc.) (TemaNord, 2006).

The excise duty on electricity consumption was revised in 1999. That year the electricity market was opened to international trade and in response a distribution tax and an energy saving tax was added to the electricity tax. (Danish Energy Authorities, 1999). The electricity tax in 2009 is set at 59.6 øre/kWh (table 3.1), and consists of an energy tax of 55 øre/kWh, energy saving tax of 0.6 øre/kWh and a distribution tax of 4 øre/kWh.

Exemptions

Electricity used for space heating has a reduced energy tax rate. For the amount of electricity used above 4000 kWh/year in dwellings heated by electricity the energy tax is only 48.3 øre/kWh compared to 55 øre/kWh (see above) and the total energy tax is therefore 52.9 øre/kWh. Furthermore, electricity used for light and heavy processes are exempt from paying energy tax except for a 1 øre/kWh energy tax for the first 15 million kWh consumed each year (15 million kWh in each VAT registered enterprise). Electricity consumption above 15 million kWh per year is not levied any tax at all.

3.1.6 Sulphur tax on fossil fuels

The sulphur tax was introduced in 1996 and was gradually scaled up until 2000 and has remained stable since then (Nordic Council, 2006). The sulphur tax is levied on fossil fuels containing more than 0.05 percent sulphur and was introduced to increase the incentives to substitute towards energy products containing less sulphur. The tax paid is either based on the sulphur content of the energy product or the emissions of sulphur dioxide. If tax is based on the content of sulphur, it is DKK 20.80/kg sulphur. If the tax is based on the emissions of sulphur dioxide, it is DKK 10.40/kg sulphur dioxide emitted. The latter way of taxing sulphur gives an extra incentive to abate SO₂-emissions by installing smoke scrubbers (Nordic Council, 2006)

3.1.7 Renewable energy sources

In order to promote the use of renewable energy and reduce the CO₂-emissions from the electricity and heat production several support schemes have been introduced by the Danish authorities. The agreement on Danish energy policy for the years 2008–2011 from February 2008 (Danish Energy Agency, 2008c) put forward some changes in the subsidy schemes for renewable energy.

From May 1992 the Danish Parliament passed a subsidy granting DKK 0.1/kWh (the so-called CO₂-dime) to producers of electricity from natural gas, bio fuels and wind turbines, and additional DKK 0.17/kWh for electricity produced from bio fuels and wind turbines (Nordic Council, 2006). Since then the subsidy scheme has been revised several times and the subsidy granted is dependent on the year the windmill was built. Windmills built in 2005 and later are granted a flat rate of DKK 0.1/kWh for the entire 20 year subsidy period (Danish Energy Agency, 2008a). In the agreement on Danish energy policy for the years 2008–2011 the subsidy for windmills has been increased to 25 øre/kWh.

In order to achieve a replacement of old windmills with new ones a “trash scheme” has been put in place in the agreement of March 2004 (Danish Energy Agency, 2008c). With this scheme, the builder of a new windmill, replacing an old one, is rendered a subsidy equalling 12 øre/kWh in connection to the production of the new windmill during 12,000 full load hours, for double of the capacity of the trashed windmill. Recognising the low effectiveness of this scheme, the agreement on Danish energy policy for the years 2008–2011 contained certain changes. Subsequently, the subsidy was increased to 20 øre/kWh.

The support to other renewable energy sources used for heat and power production varies between fuels and when the plants have been installed. According to the agreement on Danish energy policy for the years 2008–2011 the subsidy to electricity production based on waste or biomass in central combined heat and power plants increase from 10 to 15 øre/kWh. All new and existing plants using biogas receive a fixed price of 74.5 øre/kWh for the electricity, or a supplement of 40.5 øre/kWh when biogas is used in combination with other fuels.

3.2 Water pollution

Municipal drinking water and wastewater services are charged by a fixed part and a part which varies according to consumption, including the taxation on drinking water and wastewater. On average 1000 l of water costs DKK 39.80 – i.e. an average litre of water cost a little less than 4 øre (Danva, 2009), and the average consumption of water is 119 litres per person per day.

The green tax on the supply of water was phased in from 1994 to 1998 and has remained stable on DKK 5/m³ since then. In response to the introduction of this tax the Danish household water consumption decreased by 21 percent from 1993 to 2002.

In addition to the green tax on water supply a wastewater tax was introduced in 1997 and fully implemented in 1998 (Nordic Council, 2002). The purpose of the tax was to give incentives to reduce the amount of waste water, to improve the cleaning technologies of the wastewater treatment plants and to reduce the amount of rain water in the waste water system (Danish Ministry of Taxation, 2009a). Waste water is charged according to the content of bioorganic material, nitrogen and phosphorus. The wastewater tax has been doubled in connection with the Danish Tax Reform adopted by the Danish parliament in May 2009.

Table 3.3 Wastewater tax dependent on contents of pollutants 2006–2009. DKK/kg

Bioorganic material	11
Nitrogen	20
Phosphorous	110

Source: Danish Ministry of Taxation 2009a

In cases where the treatment plant receives more than 15 percent household wastewater the plant can choose to pay the wastewater tax according to the method of cleaning the water, and the tax then varies between DKK 0.5/m³ and DKK 3.8/m³ (Danish Ministry of Taxation, 2009a). If the treatment plant receives more than 85 percent industrial wastewater the treatment plant can choose to pay a tax dependent on treatment type: either DKK 0.5/m³ if they have percolation permission; otherwise DKK 3.8/m³ (Danish Ministry of Taxation, 2009a). Reduced rates apply to certain volume consumers. The actual rates of the wastewater tax have remained constant since implementation of the full rates, i.e. from 1998 to 2005 (see, for more detailed discussions, Nordic Council (2002)). However, the tax rates will increase from 2010 according to a decision in the Danish Parliament in spring 2009.

3.3 Waste

The Government's current waste strategy (2005–2008) puts increased focus on the use of economic instruments in waste planning. Recycling has remained the most important treatment method, currently accounting for approximately two-thirds of the total of waste treated; while incineration has remained relatively stable (TemaNord, 2006).

3.3.1 Waste taxes

The municipalities are responsible for handling waste from households and firms, and for which they charge a fee. It is not necessarily dependent on the amount of waste treated or the type of it and is therefore not a waste tax. The government, on the other hand, charge taxes on waste for incineration and landfill. In 2008 and 2009 they charge DKK 375/tonne waste for landfill and DKK 330/tonne for incineration.

On February 4th 2009 the Minister of taxation put forth a proposal regarding a reorganization of the levy on waste incineration. This reorganization entails an elimination of the waste incineration tax, an increase the levy on heat from waste and introduction of a CO₂ tax in the area of waste incineration. As a result, the reorganization will make the waste incineration more cost efficient in order to achieve socio-economical profits (The Danish Ministry of Taxation, 2009g). The proposal was adopted by the Danish parliament in May 2009.

Hazardous waste is handled by special treatment plants, e.g. the inter-municipal hazardous waste treatment plant “Kommunekemi”. The producer of hazardous waste pays directly to the treatment plant dependent on the type of hazardous waste. Hazardous waste has been exempt from the waste tax (TemaNord, 2006). However, from 2010 there will be a tax on hazardous substances.

3.3.2 Deposit-refund schemes

Beverage containers

The deposit-refund system for refillable beer and carbonated drinks bottles dates back to the early 1900s. From September 2002, the system also extends to beer and soft drinks in non-refillable bottles, as well as cans, if they are registered with Dansk Retursystem A/S, the branch organisation responsible for operating the system since the year 2000. The sale of beverages in cans was permitted in Denmark for the first time in 2002 (Nordic Council, 2002). The deposit refund rates for 2009 are listed in table 3.4

Table 3.4 Deposit-refund rates for refillable and non-refillable beverage containers 2006–2009

		DKK
Glass – refillable	up to 0.5 l	1.00
	over 0.5 l	3.00
Plastic – refillable	under 1 l	1.00
	exactly 0.5 l	1.50
	over 1 l	3.00
Glass, plastic, cans – non-refillable	under 1 l	1.00
	exactly 0.5 (plastic) l	1.50
	over 1 l	3.00

Source: Dansk Retursystem – “Pantsatser” (2009)

Refund schemes for crates for beer and soft drinks are not regulated by the authorities and the shops are free to choose the value of the crates (Dansk Retursystem, 2009)

WEEE

As a response to the EU directive on waste electrical and electronic equipment (WEEE), a WEEE-system was established January 1st 2006 with the purpose of organising the collection and handling of waste from electrical and electronic equipment (WEEE-system, 2009). The waste treatment costs are therefore included in the fee the producers and importers have to pay to the WEEE-system.

End-of-life-vehicles and tyres

The refund schemes for end-of-life-vehicles and tyres have not changed since the previous report. The recycling is handled by Dækbranchens miljøfond and the fees remain at DKK 1,750 for vehicles de-registered after July 2002 and returned to an authorised car breaker. Prior to this, the rate was DKK 1,500 (from July 2000 to July 2002). For end-of-life-vehicles, “Miljøordning for biler” handles the administrative practise regarding scrapping of cars (for rates and tariffs see TemaNord, 2006).

3.3.3 Product taxes

Batteries

The tax on nickel-cadmium batteries was introduced in April 1996. The tax applies to loose batteries and those sealed inside products. Rates have remained stable at 6 DKK per single battery or 36 DKK per pack for round cells joined in a unit since 1996 (for a more detail, see Nordic Council, 2002).

Packaging

Packaging taxes have existed in various forms since 1978, while the current weight-based taxes were introduced in 1999. From 2001 the weight-based packaging tax was revised to take account of the relative environmental impact and weight of the packaging types rather than relative fiscal equality and has since remained stable (for a detailed discussion see Nordic Council, 2002)). Since February 2004, the volume-based packaging tax on beverage containers has been differentiated to distinguish between containers for wines and spirits and those for beer and carbonated drinks, with lower rates applying to the latter than previously (TemaNord, 2006).

Packaging taxes cover a broad spectre from beverage containers, plastic bags, paper, board, throw-away cutlery among other items. In table 3.6, table 3.7 and table 3.8 the tax rates for packaging taxes are shown. The levy only includes parts of the total amount of packaging. The levies on beverage containers containing spirits, wine or fruit wine was reduced

by 50 percent in connection with the Danish Tax Reform adopted by the Danish parliament in May 2009.

Table 3.5 Beverage containers containing spirits, wine or fruit wine 2006–2009

DKK/piece	Cardboard/laminate	Other materials (e.g. glass, plastic, metal)
< 10 cl.	0.15	0.25
10–40 cl.	0.30	0.50
40–60 cl.	0.50	0.80
60–110 cl.	1.00	1.60
110–160 cl.	1.50	2.40
> 160 cl.	2.00	3.20

Source: Danish Ministry of Taxation (2009b)

Table 3.6 Beverage containers containing beer, soft drinks, cider 2006–2009

DKK/piece	All materials, e.g. cardboard, glass, plastic or metal
< 10 cl.	0.05
10–40 cl.	0.10
40–60 cl.	0.16
60–110 cl.	0.32
110–160 cl.	0.48
> 160 cl.	0.64

Source: Danish Ministry of Taxation (2009b)

Table 3.7 Weight- and volume-based packaging taxes 2006–2009

Material	DKK/kg
Paper and Cardboard ²⁾ and textiles	0.95
Paper and Cardboard ³⁾	0.55
Plastic(except eps ⁶⁾ and PVC) ²⁾	12.95
Plastic(except eps ⁶⁾ and PVC) ³⁾	7.75
Plastic(except eps ⁶⁾ and PVC) ⁴⁾	7.75
Plastic(except eps ⁶⁾ and PVC) ⁵⁾	10.35
Eps ⁶⁾ and PVC	20.35
Aluminium	33.30
Tinplate and steel	9.25
Tinplate and steel ⁵⁾	7.40
Glass and ceramic	1.85
Woods	0.55

²⁾ Primary material: newly produced material (virgin)

³⁾ Secondary material: recycled material (documentation needed)

⁴⁾ The plastic materials are partly substituted by other materials (documentation needed).

⁵⁾ UN-approved.

⁶⁾ eps: "ekspanded polystyrene".

Source: Danish Ministry of Taxation (2009b)

Table 3.8 Taxes for plastic bags, disposable dishes and cutlery 2006–2009

Material	DKK/kg
Paper bags	10
Plastic bags	22
Disposable dishes and cutlery	19.20
PVC for food products	20.35

Source: Danish Ministry of Taxation (2009b)

Tax on PVC, phthalates and chlorinated solvents

The tax was introduced in July 2000 with tax rates based on a product's PVC or phthalate-content, at a rate of DKK 2 per kg PVC and DKK 7 per kg phthalates. On this basis, rates are calculated for a range of different products, e.g. DKK 0.05 per plastic wallet containing soft PVC (reduced to DKK 0.02 if phthalates have not been used), DKK 3.60 per kg for gloves containing soft PVC (reduced to DKK 1.08). The rates have remained unchanged to date (TemaNord, 2006).

In 2001, Denmark introduced a tax on perfluorocarbons (PFCs), sulphur hexafluoride (SF₆) and hydrofluorocarbons (HFCs) as an additional measure to curb GHG emissions, working alongside the CFC tax which has been in force since 1989 (TemaNord, 2006).

3.4 Transport

Economic instruments in the transport sector consist of energy and CO₂ tax levied on transportation fuels, a registration tax and a tax for possessing a vehicle (vehicle excise duties).

3.4.1 Registration tax

In the spring 2007 the parliament decided on a far-reaching reform on vehicle taxation to increase the sales of small fuel efficient cars at the expense of the sales of cars with large fuel consumption. The registration tax is 105 percent of the car's value up to DKK 74 000 and 180 percent for the rest of the value. This value is either deducted or increased dependent on the fuel efficiency of the car (see table 3.9). Before 2007 the registration tax was not dependent on the fuel efficiency.

Table 3.9 Registration tax deduction and extra charge for fuel (in)efficiency since April 2007

	Reduction for fuel efficiency	Increase for fuel inefficiency
Petrol cars	DKK 4000 per km/l above 16 km/l	DKK 1000 per km/l under 16 km/l
Diesel cars	DKK 4000 per km/l above 18 km/l	DKK 1000 per km/l under 18 km/l

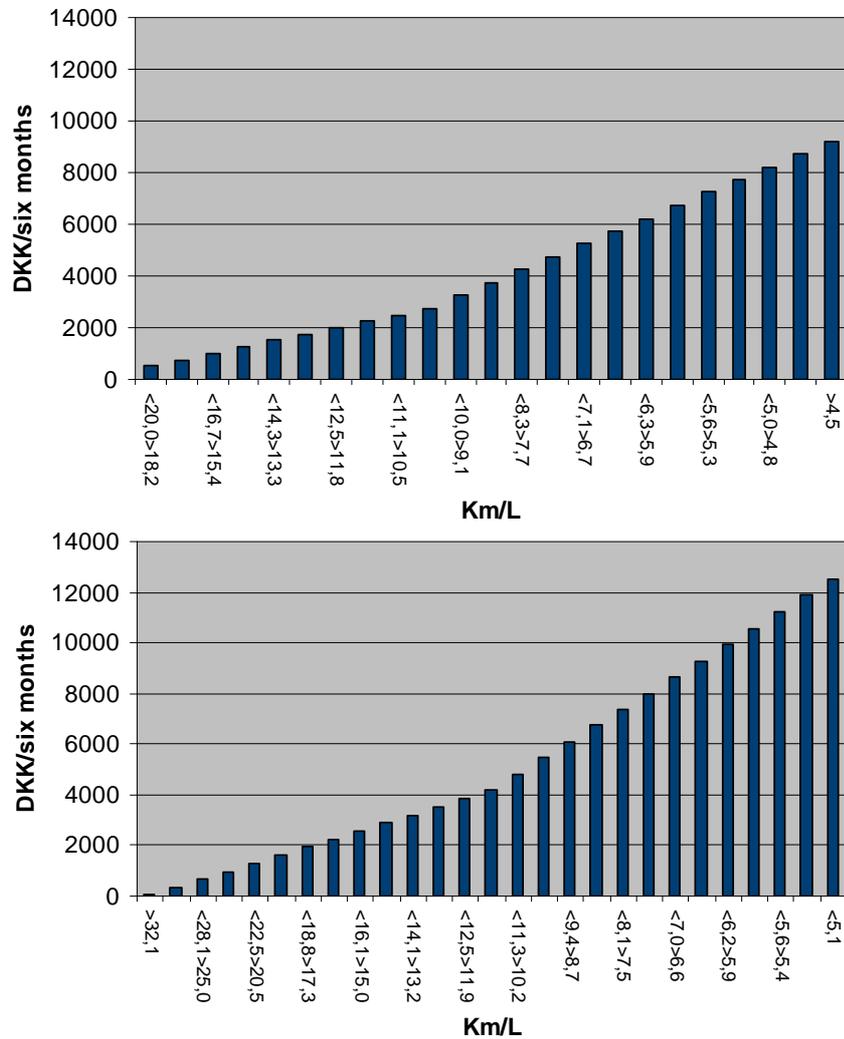
Source: Danish Ministry of Taxation (2007)

In addition to the reduced registration tax for fuel efficient vehicles the agreement on Danish energy policy for the years 2008–2011 assures that hydrogen cars as well as electricity driven cars are exempt from registration tax. For hydrogen cars this is permanent so far, and for electricity driven cars the exemption is prolonged until 2012 (Danish Energy Agency, 2008). From 2010 the registration tax will be changed.

3.4.2 Vehicle excise duty

The green distance-based levy replaced the former weight based levy that was based on the weight of the vehicle and hence the vehicle’s abrasion on roads and so forth. By July 1st 1997 the scheme changed, and vehicles registered after this date now pay the levy based on the vehicle’s fuel efficiency and whether it runs on diesel or petrol (see figure 3.2). It should be emphasized here that in contrast to the registration levy the vehicle excise duty is not a one-time levy. From 2010 the vehicle excise duty will be changed.

Figure 3.2 Distance based vehicle excise duty, petrol (left) diesel (right).



Source: Danish Ministry of Taxation (2008e)

Exemptions

Vehicles belonging to the state are exempt from paying registration tax and vehicle excise duty. Furthermore, the following types of vehicles are exempt from paying both registration tax and vehicle excise duty (Retsinformation, 2009; Danish Ministry of Taxation, 2009c):

- Tourist buses and buses in regular service (for minimum 10 persons)
- Vehicles above 4 tonnes used for goods transportation only
- Personnel carriers owned by companies strictly used for transporting material, tools and staff to and from workplaces.

3.5 Agriculture and natural resources

The use of fertilizer in the agriculture sector is both regulated by quotas and a levy (tax) on (nitrogen), and the use of pesticides is regulated by a levy. Danish farmers with a turnover of more than 20,000 DKK per year from agricultural production have the possibility or are obliged to keep an account of their use of fertilizer depending on their actual size of livestock (large farmers are obliged – small have the possibility). Furthermore, they have to report the amount used to the public authority. The account form the basis of farmers' fertilizer quotas, which are non tradable. If a farmer's use of fertilizer exceeds their quotas they are subject to a fine. The fine is proportional to the violation of the quota restriction (Retsinformation, 2009b).

In 1998 a tax on fertiliser was introduced in response to the second aquatic plan. The rate was set at DKK 5/kg and has remained constant since. Farmers who are regulated by fertilizer quotas are obliged to keep an account of their use of fertilizer are not charged with this tax (Danish Ministry of Taxation, 2009f).

Pesticides are regulated by a differentiated levy that is divided into three groups of taxes. The tax amounts to 34% of the wholesale price in the case of herbicides and fungicides and 54% in the case of insecticides and soil disinfectants. For certain products which are used in particular outside of the farming sector, a tax of 3 percent of the wholesale value was retained, as the environmental loading of these products differs from that of the other pesticides. There are some few cases where the companies can be freed of the levies, but the exemptions are not extensive (Danish Ministry of Taxation, 2009e).

Since 1990 a tax levied on the extraction of raw materials has been fixed at DKK 5 per m³ of raw material extracted, an amount that has remained fixed since its introduction. Other changes has been added though, which means that imported raw materials since 1. January 2006 have been included in the tax (Retinformation 2009c). A tax on phosphorous was adopted in 2005. The tax is imposed on mineral phosphorous when used in animal feed phosphates, with the exception of pet food. The tax rate is 4 DKK per kg mineral phosphorous.

4. Finland

In the beginning of the 1990s, a number of economic instruments were introduced for environmental purposes in Finland. Since then the emphasis of the taxation has gradually been shifted from taxation of labour to taxation of activities polluting the environment.

The most important taxes for environmental purposes are excise taxes on fossil fuels and electricity, the tax on waste and the registration tax on passenger cars.

4.1 Energy and air pollution

4.1.1 Introduction

The Finnish authorities make widespread use of various economic instruments in order to regulate energy consumption in Finland. However, the general structure of energy taxation in Finland has remained unchanged since 1997. The present energy tax system consists of taxes on traffic fuels and heating fuels, and on electricity. The major change as regards economic instruments has been the introduction of the European emissions trading scheme from the beginning of 2005. (IEA, 2008 & TemaNord, 2006)

4.1.2 Excise taxes on fossil fuels for energy purposes

The fuel taxes in Finland are divided into a basic tax and an additional tax. The basic tax is differentiated in order to promote environmental protection and, therefore, lower tax rates are applied to desulphurised reformulated petrol, as well as to desulphurised diesel oil. The additional, CO₂-based tax is determined on the basis of the carbon content of the fuel.

The carbon-based tax on energy consumption was introduced in Finland in 1990, as the first country in the world. The CO₂ tax was initially introduced as a tax with carbon dioxide as the sole base for calculating the tax rates. The tax rate and base has been increased several times since then. Table 4.1 illustrates how the tax rate per tonne CO₂ has developed since its introduction and between 2006 and 2009.

Table 4.1 Development of the CO₂ tax rate, EUR per tonne CO₂

1990	2006	2007	2008	2009
1.19	18.05	18.05	20.00	20.00

Source: Ministry of Employment and the Economy (2009a)

In order to create incentives for wider use of natural gas this fuel has been granted a 50 percent discount on the CO₂ tax. The CO₂ tax on peat was eliminated on 1 July 2005. (Ministry of Employment and the Economy, 2009a)

In addition to the basic tax and the CO₂ tax there are strategic stockpile fees and oil pollution fees levied on the use of fossil fuels and electricity in Finland. The fees were introduced in 1974 for fiscal and trade balance reasons only. Table 4.2 presents the taxes and fees levied on fossil fuels. Today, the CO₂ tax is the most dominant of the duties on fossil fuel consumption in Finland.

Table 4.2 Taxes and fees levied on fossil fuels

Product	Tax	2006	2007	2008	2009
Light oil, c/l	<i>Basic tax</i>	1.93	1.93	2.94	2.94
	CO ₂ tax	4.78	4.78	5.41	5.41
	Strategic stockpile fee	0.35	0.35	0.35	0.35
	Oil pollution fee	0.042	0.042	0.042	0.042
Heavy fuel, c/kg	<i>Basic tax</i>	-	-	-	-
	CO ₂ tax	5.68	5.68	6.42	6.42
	Strategic stockpile fee	0.28	0.28	0.28	0.28
	Oil pollution fee	0.050	0.050	0.050	0.050
Coal, €/t	<i>Basic tax</i>	-	-	-	-
	CO ₂ tax	43.52	43.52	49.32	49.32
	Strategic stockpile fee	1.18	1.18	1.18	1.18
	Oil pollution fee	-	-	-	-
Natural gas, €/MWh	<i>Basic tax</i>	-	-	-	-
	CO ₂ tax	1.82	1.82	2.016	2.016
	Strategic stockpile fee	0.084	0.084	0.084	0.084
	Oil pollution fee	-	-	-	-

Source: Ministry of Employment and the Economy (2009a), IEA (2008)

The revised energy tax legislation in 1998 introduced a refund scheme for special energy-intensive industries. The refund scheme is only applicable to companies when the total burden of excise duties on energy exceeds 3.7 percent of the value added of the given company. The company is then entitled to a refund of the taxes paid, and it can apply for a refund of up to 85 percent of the taxes paid exceeding 50,000 Euro. This means that a very limited number of industrial facilities can claim a tax refund. (TemaNord, 2006)

4.1.3 Excise taxes on electricity consumption

The electricity taxation in Finland is a rather complex combination of subsidies, different tax rates, exemptions and refunds. In 1997 the tax scheme relating to electricity was thoroughly revised. All production taxes were removed and a consumption tax on electricity was introduced to replace the production tax. One reason was the opening of the Nordic electricity market, and another reason was that the Finnish electricity tax

system was not in line with the EY legislation (Article 90 of the EC Treaty) containing tax discriminatory elements.

Since 1997 no taxes on fuels for electricity production have been applied; fuels used in the production of electricity are exempted from all taxes. The electricity tax on consumption has been divided into two taxation categories, the lower (category II tax), is paid by industry and professional greenhouses. Other consumers pay the higher category I tax. The tax is the same irrespective of the fuel used for electricity production. The differentiation of the electricity tax is similar to the differentiation of the taxation of fossil fuel. The differentiation was introduced to safeguard the competitiveness of the industrial sector (TemaNord, 2006). To improve the competitiveness of renewable energy sources and to partly compensate for the tax, subsidies are granted to electricity produced by for instance wind, small-scale hydropower, biogas, forest residue chips and recycled fuels. (IEA, 2008)

From the beginning of 2007 the electricity tax for industry (tax class II) was halved from 0.44 eurocents to 0.22 eurocents per kWh. Table 4.3 shows the development in the electricity tax between 2006 and 2009.

Table 4.3 Excise taxes on electricity consumption

Product	Tax	2006	2007	2008	2009
Electricity, c/kWh					
Tax category I	Basic tax	-	-	-	-
	CO ₂ tax	0.73	0.73	0.87	0.87
	Strategic stockpile fee	0.013	0.013	0.013	0.013
	Oil pollution fee	-	-	-	-
Tax category II	Basic tax	-	-	-	-
	CO ₂ tax	0.44	0.22	0.25	0.25
	Strategic stockpile fee	0.013	0.013	0.013	0.013
	Oil pollution fee	-	-	-	-

Source: Ministry of Employment and the Economy (2009a), IEA (2008)

4.1.4 Excise taxes on transportation fuels

Transportation fuels are charged with different energy related taxes. The taxation of transport fuels has a long tradition in Finland as in the other Nordic countries. In 1995 differentiated duties on diesel oil according to the sulphur content were introduced (sulphur-free = sulphur content < 10 ppm). Today the differentiation in excise tax rates according to the sulphur content of the fuel has also been extended to petrol (Ministry of Employment and the Economy, 2009a, TemaNord, 2006). Commercial aviation and navigation are exempt, whereas private pleasure aviation and navigation have been charged with energy related taxes since 2008. Tax rates on transportation fuels between 2006 and 2009 are presented in table 4.4.

Table 4.4 Tax rates on transportation fuels

Product	Tax	2006	2007	2008	2009
Motor petrol, c/l reformulated sulphur-free	<i>Basic tax</i>	53.85	53.85	57.24	57.24
	CO ₂ tax	4.23	4.23	4.78	4.78
	Strategic stockpile fee	0.68	0.68	0.68	0.68
	Oil pollution fee	0.038	0.038	0.038	0.038
other grade	<i>Basic tax</i>	56.50	56.50	59.89	59.89
	CO ₂ tax	4.23	4.23	4.78	4.78
	Strategic stockpile fee	0.68	0.68	0.68	0.68
	Oil pollution fee	0.038	0.038	0.038	0.038
Diesel, c/l sulphur-free	<i>Basic tax</i>	26.83	26.83	30.67	30.67
	CO ₂ tax	4.76	4.76	5.38	5.38
	Strategic stockpile fee	0.35	0.35	0.35	0.35
	Oil pollution fee	0.042	0.042	0.042	0.042
other grade	<i>Basic tax</i>	29.48	29.48	33.32	33.32
	CO ₂ tax	4.76	4.76	5.38	5.38
	Strategic stockpile fee	0.35	0.35	0.35	0.35
	Oil pollution fee	0.042	0.042	0.042	0.042
Jet fuel, c/l	<i>Basic tax</i>	-	-	33.32	33.32
	CO ₂ tax	-	-	5.38	5.38
	Strategic stockpile fee	-	-	0.35	0.35
	Oil pollution fee	-	-	0.04	0.04
Aviation gasoline, c/l	<i>Basic tax</i>	-	-	37.54	37.54
	CO ₂ tax	-	-	4.78	4.78
	Strategic stockpile fee	-	-	0.68	0.68
	Oil pollution fee	-	-	0.04	0.04

Source: Ministry of Employment and the Economy (2009a) IEA (2008)

4.1.5 Economic instruments towards renewable energy sources

Finnish renewable energy policy is a result of a conscious strategy outlined in the “Action Plan for Renewable Energy Sources 2003–2006” published by the Ministry of Trade and Industry in 2002. The Finnish energy taxation system entails various kinds of subsidies, the most important of these from the energy policy perspective being the tax support paid for power generation based on renewable sources of energy. The Finnish renewable energy strategy can, basically, be divided according to three separate regulatory instruments; a tax instrument, investment subsidies and research subsidies (IEA, 2008, TemaNord, 2006)

Energy taxation is emphasised as an important regulatory instrument in the action plan for renewable energy sources. From the beginning of 2007, the electricity tax for industry (tax class II) was cut in half. Together with this tax, subsidies for electricity production from wood fuels (industrial residues such as bark, saw dust and black liquor) and also from waste gases and waste heat from industry were repealed. Other tax subsidies for renewable energy were continued in their previous form. For example, electricity produced from forest residue chips still receives subsidies along with wind power, small hydro, biogas and recycled fuel (IEA, 2008). Refund amounts to 0.69 cents/kWh for wind and chips, 0.25

cents/kWh for recycled fuel and 0.42 cents/kWh for other⁵. The refund rates have been the same since 2003. In addition, bio fuel oil used in working machines (diesel) or in heating is tax-exempted since 1.1.2008 (Ministry of the Environment, 2008).

The support scheme for renewable energy sources provided by the Finnish Government also includes investment aid, subsidies for capital costs and funds for research and development (R&D) into renewable energy technologies. In 2007, 30.7 million EUR was granted for energy technologies (386 approved applications), of which 85 percent was granted for technologies supporting renewable sources of energy. The main part of these grants was given to investments in wood-fired energy generation plants (46 percent of total) and investments in wind power facilities (14 percent of total)⁶ (Ministry of Employment and the Economy, 2008). However, there has been a discussion about the need for additional support to improve the incentives for investing in onshore wind power in Finland. The measures being discussed are feed-in tariffs. A system based on feed-in tariffs is already in place for certain power plants using peat as fuel.

4.1.6 Emissions trading

A main instrument to be used in carrying out energy and climate policy actions in Finland is the European Union's Emissions Trading Scheme (EU ETS) (Finland's Environmental Administration, 2009a)

The Finnish Government agreed on the emission allowances allocated to energy production and industry for the 2005–2007 emission trading period on 19 August 2004. The total volume of emission allowances issued for the period amounted approximately to 136.5 million tonnes, whereas, total volume of verified emissions for the period 2005–2007 amounted to 120.28 million tonnes. Allowances equal to 2.5 million tonnes of the total volume of allowances were reserved for new entrants. The allowances were allocated free of charge.

On 14 February 2008, the Finnish Government decided of the emission allowances to be allocated to energy production and industry for the 2008–2012 emission trading period. The decision covers the emission allowances to be allocated to each installation. The allowances are allocated free of charge.

During the second emissions trading period the scope of the Emissions Trading Directive is broader compared to the first emissions trading period (2005–2007). The amount of emission allowances to be allocated annually during the second period would decrease by 17 per cent com-

⁵ Minimum amount eligible for refund is 100 MWh / six months (*Ministry of the Environment 2008*).

⁶ Ministry of Employment and the Economy also grants subsidies for energy efficiency related research work and information dissemination. Subsidies are estimated to be amounted to 15–20 million EUR in 2010. (*Ministry of Employment and the Economy 2009*).

pared to the first trading period. Installations and parts of their production included in the emissions trading are divided into similar sub-categories as during the first emissions trading period, based on their activities and the product produced.⁷ Heat generating installations that are mainly intended for district heating, form a part of a district heating network and have a maximum input of 20 MW (opt-in installations) are included in the Emissions Trading Scheme whenever at least one of the installations forming the heat distribution network and mainly intended for district heat generation has an input of more than 20 MW.

The total volume of allowances for the period 2008–2012 amounts approximately to 187.8 million tonnes, corresponding to 37.6 million tonnes per year. A total of 566 installations will be allocated emission allowances. Allowances equal to 7 million tonnes of the total volume of allowances are reserved for new entrants for the entire emissions trading period. This equals about 3.7 per cent of the total amount. The emission allowances will be allocated to new entrants based on specific criteria and according to the type of installation and fuels used.

The allocation of emission allowances is based on the calculation principles laid down in the Emissions Trading Act. Sub-category-specific efficiency and reduction coefficients have been applied to the calculations. The applied coefficients are:

- 0.91 in industrial processes⁸
- 0.86 in industrial energy production
- 0.77 in district heating and combined production of electricity
- 0.31 in condensing generation of electricity
- 0.86 in reserve and peak-load power plants.

The allocation criteria would be centrally based on the actual emissions of installations during the period chosen as the reference period. The general reference period used in the proposal is the period 1998–2002, but for the subcategory including condensing power production the period covers the years 2000–2003. The reference periods used are the same as during the first emissions trading period 2005–2007, so that the emission reduction measures by the operators in the first emissions trading period will not be invalidated. (Ministry of Employment and Economy, 2009b).

The introduction of emissions trading has not lead to any major changes in the CO₂ tax system for those emissions that are part of the trading system. However, the tax on electricity paid by industry has been lowered and tax on peat has been abolished.

⁷ The installations in the emissions trading sector have been divided into sub-categories such as industrial processes (A), industrial energy production on site (B), district heating and combined production of electricity and district heating (C), condensing generation of electricity (D) and peak-load power plants and reserve power plants (E). (*Ministry of Employment and the Economy 2009*).

⁸ For instance, 91 percent of the actual emissions (based on the reference period 1998–2002) of installations in industrial processes are allocated emission allowances free of charge.

4.2 Water pollution

Water supply and sewerage policies in Finland are designed to guarantee the availability of good quality drinking water, and to ensure that waste water is efficiently collected and suitably treated to acceptable standards. Municipalities have the primary responsibility for providing water supply and wastewater treatment. These services are financed by charges to the user based on a full-cost principle, which means that the total cost of providing the water services should be paid by the users. However, the situation may differ to some extent due to state subsidies for water management⁹. In addition, water and waste water tariffs are decided by each municipality.

In addition to volume charges, there are also fixed components, for instance a connection charge designed to cover the investment costs by the municipality in water service management. Industry often abstracts its water directly from surface water or groundwater sources, and is also responsible for the treatment of the wastewater produced.

4.2.1 User charges for water supply and wastewater services

The charges for water supply and wastewater service both vary from one municipality to another, however, the average total price for blocks, including the volume component and fixed components in 2008 was 1.27 EUR per m³ for water supply and 1.90 EUR per m³ for wastewater treatment (Finland's Environmental Administration, 2009b). Table 4.5 presents the development in average municipal water charges in 2000 and from 2006 to 2008. Municipal water supply charges have increased since 2000.

Table 4.5 Average municipal water charges in 2000–2008

	2000	2006	2007	2008
Water supply charge (EUR / m ³)	1.02	1.19	1.25	1.27
Wastewater charges (EUR / m ³)	1.37	1.73	1.79	1.90

Source: Finnish Ministry of the Environment (2008)

4.3 Waste

The 2003 Government Programme announced an ecological tax reform aimed at reducing use of non-renewable natural resources and preventing damage to the environment. Recycling, improved ecological efficiency of

⁹ Finland's 13 regional environment centres supervise the water supply and sewerage systems in their respective regions, while also controlling the planning of improvements and allocating financial subsidies for such purposes.

products, consumption, energy use and the cutting of subsidies detrimental to the environment were emphasized in the programme¹⁰.

The Finnish Government in 2008 approved the new national waste plan until 2016. The plan is aimed at developing the Finnish waste management system and promoting waste prevention. The plan emphasizes the relationship between waste issues and other sectors of environmental policy. The national waste plan also includes a separate national waste prevention programme (Finland's Environmental Administration, 2009b)

4.3.1 Municipal waste charges

Municipalities are responsible for the collection, treatment and reuse of household waste. Municipal waste charges cover costs related to the establishment, maintenance, decommissioning and clean-up of waste treatment facilities, and the transportation of wastes. Waste charges are also intended to reduce the amounts of waste generated and the consequent risks, and to encourage waste recovery. Many municipalities set lower charges for sorted wastes and for wastes that can be recovered than for unrecoverable mixed wastes.

Waste charges are payable by waste holders. Rates containing detailed specifications are set by municipalities. The development of municipal waste charges based on weight is presented in table 4.6.

Table 4.6 Municipal waste charges based on weight

Waste type €/t	2006	2007	2008
Municipal waste I ¹⁾	80.61	83.50	86.83
Municipal waste II ²⁾	76.06	82.98	85.46
Biowaste	52.55	55.99	63.67
Energy waste	58.70	60.35	64.46
Special waste	119.57	121.69	133.67

¹⁾ Municipal waste, unrecoverable mixed waste, transportation excluded

²⁾ Municipal waste, which is transported in a vehicle provided with a compressor device, or in a waste container

Source: Association of Finnish Local and Regional Authorities (2008)

In addition to waste charges levied per tonne of waste, in 2008 approximately 188 municipalities out of approximately 450 had introduced an “eco-charge” which applies to households at an average of 30 EUR per year per household. The purpose of the charge is to promote waste sorting by covering costs associated with a network of recycling and collection stations where households can deliver card and paper, glass, metal, untreated wood and electronic waste and batteries free of charge (Association of Finnish Local and Regional Authorities, 2008).

¹⁰ Further aims included use of economic and technical incentives to reduce the volume of waste, increased use of waste as a raw material and as a source of energy, an environmental guidance system based on excise tax for beverage packaging, minimisation of the adverse effects on the environment of the final disposal of non-recyclable waste and extension of the polluter-pays principle to further product groups, and the responsibility of the trade sector for packaging waste (Nordic Council, 2006).

4.3.2 Waste tax

Finland's Waste Tax Act came into force in 1996. Waste taxes aim to promote waste recovery and reduce the amounts of waste ending up in landfills. Waste taxes are paid by the owner of the landfill, who passes on the cost through fees charged for the reception of waste.

Waste taxes are paid on waste left at public landfill sites, but are not applied to private or industrial landfills where waste produced elsewhere are not received routinely. In order to promote recovery of waste, the tax does not apply to waste which is recycled, composted or incinerated.

Since 2005 the waste tax has been set at 30 euros per tonne of waste sent to landfill, which was a doubling from the 2002 level. The aim with the increase was to improve the incentive effect of the tax, in response to pressures within the field of waste policy.

Hazardous waste from households can be delivered at collection points and waste treatment centres free of charge. Companies are charged a fee at the waste treatment centres according to a type and weight of the waste. Charges are based on decisions made by municipalities. Hazardous waste is, since 1984, largely processed by Ekokem Oy Ab, which also receives the revenues from the hazardous waste charge. The company is jointly owned by the Finnish State, municipalities and industrial companies (Ministry of the Environment, 2008).

4.3.3 Oil waste charges

An oil waste duty was introduced 1.1.1987. The prices of lubrication oil include an oil waste charge of 5.75 cents per kilo. The income from this charge is used to cover the costs of managing oil wastes and cleaning up soils and groundwater contaminated with oil. In 2007 fiscal income from oil waste charges was 4.25 million euros (Ministry of the Environment, 2008).

4.3.4 Beverage packaging tax

Beverage packaging taxes are currently paid on packages for alcoholic beverages, soft drinks, bottled water and certain other drinking packages. The objective of the taxation system is to further encourage the reuse of drinking packages, to reduce the quantities of such materials ending up in landfills and to prevent littering. It also complements the deposit-refund system for refillable and non-refillable beverage containers.

Since 1 January 2005, the tax level has been 0.51 euros per litre. Since 2008, the tax does not apply to packages covered by approved returnable deposit systems that involve the collection of packages for refilling or material recycling.¹¹

¹¹ The Government budget of 2007 included 41 million euros of fiscal revenue from drinking packaging taxation. In 2008 this revenue from taxation declined to around 11 million euros (Finland's Environmental Administration, 2009).

Finland's beverage packaging taxation system has effectively encouraged consumers to return used drinks packages. The current deposit-refund scheme applies to both refillable and non-refillable beverage containers for reuse and recycling, respectively. There are several different types of beverage packages with a deposit; glass (bottles introduced in 1950's) or plastic bottles that are refilled, disposable plastic bottles that are not refilled (introduced 1.1.2008) but the plastic is recycled, and the aluminium cans (introduced 1.3.1996) that are recycled or re-used. The current rate of return of glass bottles for beer and soft drinks is 97 percent (Ekopullo Association, 2009). The rates for refund on aluminium beverage cans, glass and plastic containers are presented in table 4.7.

Table 4.7 Refund rates for glass, plastic and aluminium can beverage containers and crates in 2009

Containers	EUR per unit
Glass (0.33, 0.35, 0.5 litre)	0.10
Glass (1.0 litre)	0.40
Plastic (0.5 litre)	0.20
Plastic (1.0, 1.5 litre)	0.40
Crates (24 * 0.33 litre)	2.20
Aluminium can	0.15

Source: Ekopullo Association (2009), PALPA (2009)

4.3.5 *Producer responsibility in waste management*

Producer responsibility obliges producers to organise the reuse, recovery or suitable treatment or disposal of their products and the wastes derived from them, and to cover the related costs. The producer means the manufacturers and importers of the products; or where packaging is concerned, packagers and the importers of packaged products.

Producer responsibility covers electronic and electrical appliances, batteries and accumulators¹², tyres from motor vehicles, other vehicles and equipment, cars, vans and comparable vehicles, newspapers, magazines, copy paper, and other comparable paper products¹³ and packaging (Finland's Environmental Administration, 2009).

Tyres

The Finnish Tyre Recycling Ltd is responsible for recycling of used vehicle tyres. The company is owned by major Finnish tyre manufacturers and importers and has started tyre recycling in 1996. At the moment over 90 percent of all used vehicle tyres are recycled in Finland.

The scheme is financed by a recycling charge paid by the consumer on purchase of a new tyre. The proceeds are transferred by the retailer to the

¹² Since 26.9.2008 consumers have been allowed to return used portable accumulators and batteries to retail trader free of charge.

¹³ In case of paper collection from a real estate, the property is responsible for covering a waste container with its collection point, whereas, producer's responsibility is to cover waste management onwards.

producer or the importer, who, in turn, passes the funds on to the Finnish Tyre Recycling Ltd to cover the associated treatment and disposal costs. Some examples of the charges for different types of tyre in 2004 and in 2009 are presented below.

Table 4.8 Examples of tyre recycling charges for different types of tyre

Products (EUR per unit inclusive 22 percent VAT)	2004	2009
Moped and motorcycle tyres	1.85	1.85
Car tyres	1.85	1.85
Delivery van tyres	1.85	1.85
Lorry and coach tyres	8.30	8.65
Industrial and tractor tyres	2.45	2.45
Retreated lorry tyres	2.45	5.00

Source: Finnish Tyre Recycling Ltd (2009), TemaNord (2006)

In 2008, of the 48,394 tonnes of tyres collected, the vast majority underwent material recovery, a small proportion were retreaded. No tyres were incinerated with energy recovery (Finnish Tyre Recycling Ltd, 2009).

End-of-life vehicles (ELV)

The national legislation implementing producer responsibility and the EU ELV Directive came into force on 1 September 2004. It covers passenger cars, vans and special-purpose vehicles, such as recreational vehicles.

Finnish Car Recycling Ltd co-ordinates the collection, treatment and recycling of end-of life vehicles according to the requirements laid down in the ELV Directive. Finnish Car Recycling is owned by the Association of Automobile Importers in Finland. Owners can return ELVs without charge to authorised collection points (Finnish Car Recycling Ltd, 2009). Electrical and Electronic Equipment (WEEE)

National legislation implementing producer responsibility and the EU WEEE Directive came into force in August 2005 in amendments to the 1994 Waste Act.

The main requirements of the Finnish WEEE legislation are that producers must organise the collection, transport and treatment in an approved facility of separately collected equipments, finance the recovery and other waste management, ensure proper marking, provide the necessary information for users, register with the corresponding regional environment centre, submit annual reports and provide a guarantee (either a financial guarantee or by joining a collective scheme). (Finland's Environmental Administration, 2009).

4.4 Transport

4.4.1 Registration tax

Motor vehicles in Finland are charged with both a one-time registration tax and an annual tax. The registration tax (also called car tax) is levied on passenger cars, delivery vans and motorcycles when the vehicles are registered for the first time in Finland. This tax was introduced in the 1950s to raise state revenue.

The registration tax was changed from 1 January 2008 to guide consumers towards choosing car models which use less fuel while speeding up the renewal of the vehicle stock to introduce cars with the latest technology. The car tax levied on passenger cars upon registration is differentiated now in proportion to the carbon dioxide emissions resulting from the vehicle's specific consumption of fuel. At the same time, the car tax was generally cut by an average of one sixth.

The new taxation applies to all passenger cars. The tax rate is based on the carbon dioxide emissions declared by the car manufacturer for a combination of city and road driving. Where emissions data are not available, the tax rate is based on the weight of the vehicle. In practice, the latter applies to passenger cars which have entered into service before 2001. The registration tax is at the minimum 10 percent (max. 40 percent) of the taxable value. This means that the taxable value of the passenger car is still based on the common retail value but in the new taxation system the differentiation is enforced in such a way that each gram of carbon affects a level of the tax rate ¹⁴.

Vans are included in the new tax system from the beginning of April 2009. At the same time the registration tax on cars and vans will be raised by 22 percent, since VAT on registration tax is no longer levied. Passenger cars imported from a non-EU country are charged with an additional 10 percent toll (vans depending on motor type: 10 percent or 22 percent, motorcycles: 6 percent or 8 percent) (Customs Authority, 2009).

4.4.2 Annual car taxes

Besides the registration tax motor vehicles in Finland are also subject to an annual tax (i.e. the motor vehicle tax). Passenger cars and vans using methane fuel, including biogas, are exempted from the annual tax. Since 2004 passenger cars and delivery vans weighing below 3,500 kg are subject to a basic tax amounting to EUR 0.35 per day or EUR 127.75 per year. Vehicles registered before 1994 are charged with a lower tax rate. Diesel powered vehicles are charged with a driving power tax to compen-

¹⁴ The car tax rate as percentage of common retail value: 0.1 times CO₂ g/km + 4, min. 10 percent (CO₂ emissions 60 g/km or lower) and max. 40 percent (CO₂ emissions 360 g/km or higher).

sate for the lower tax rate on diesel fuel. The annual tax rates are presented in table 4.9. The rates have been valid as of 1.1.2004.

Table 4.9 Annual tax rates on motor vehicles since 2004

Basic tax: Passenger cars and delivery vans, and special-purpose cars < 3 500 kg	Vehicles registered on or after January 1 1994	Vehicles registered before January 1 1994
	0.35 EUR per day or 127.75 EUR per year	0.26 EUR per day or 94.9 EUR per year
Driving power tax: Motor vehicles using other than petrol (diesel tax)	Passenger cars and pas- senger vans	Vans and camper vans
	0.067 EUR per day for each 100 kg weight of the car	0.009 EUR per day for each 100 kg weight of the car

Source: Finnish Vehicle Administration (2009)

The annual tax rates (per unit of weight) are lower for heavy goods vehicles (HGV) than the rates for diesel powered passenger cars. However, the tax is charged per day for each 100 kg weight of the HGV also. The tax rate depends on the number of axles and the bogie structure (EUR 0.01–0.031/ 100 kg per day).

The Finnish Government has proposed that the annual taxation system (basic tax) will be changed into a differentiated system based on the carbon dioxide emissions resulting from the car's and van's specific consumption of fuel. The new system for the annual taxation is estimated to come into force in 2010 (Finnish Vehicle Administration, 2009, TemaNord, 2006).

4.4.3 Aviation noise charge

A noise charge is applied to departures at Helsinki–Vantaa Airport between 23.00–06.00 LMT with turbojet aircrafts. The noise charge for an aircraft is calculated according to the aircraft's noise certificate in accordance with the International Civil Association Organisation (ICAO). Aircrafts which are unable to show certificated noise levels will be charged at the highest noise rate of the same aircraft type. Charges less than 6.93 EUR will not be charged. There is no limit for the maximum charge¹⁵ (Finavia, 2008).

4.5 Agriculture and natural resources

Support payments to Finnish agriculture and horticulture are founded on the support schemes of the EU's common agricultural policy (CAP). The largest form of environmentally based aid is granted under environmental aid for agriculture, some 300 million every year. The aid can be used for

¹⁵ E.g. for the aircraft B737-600 the noise charge is 7.96 EUR.

financing general or supplementary environment protection schemes on farms. Environmental support is paid to promote the biological diversity and management of agricultural landscapes and it is partly funded by the EU. Environmental support consists of basic and additional measures and special support contracts. The main focus has been on water protection. Support may also be granted for enhancing biodiversity and landscape management (Ministry of Agriculture and Forestry, 2009).

The Act on the Funding of Sustainable Forestry came into effect at the beginning of 1997. Under it, the State can use direct aid or loans to finance measures intended to protect the sustainability of wood production, maintain the biological diversity of the forests, and carry out projects for managing the forest nature and other supportive measures. Financing can be obtained by private, or in some instances, other landowners. Private forest owners are granted environmental support for all but minor losses involved in preserving important habitats referred to in the Forest Act. Between 1997 and the end of 2006, the amount paid in environmental support amounted to a total of almost EUR 17 million. In 2006, more than EUR 1.2 million of the entire country's EUR 4.2 million in environmental support was paid to forest owners in Northern Ostrobothnia (Finnish Forest Research Institute, 2007).

In October 2002, the Finnish Government introduced the Forest Biodiversity Programme for Southern Finland 2003–2007 (the METSO Programme). The Government's decision of a new Forest Biodiversity Programme for the period of 2008–2016 was made in March 2008. The programme has been designed to benefit biodiversity by improving Finland's network of protected areas and by enhancing the forestry methods used in commercially managed forests. Conservation schemes will largely be based on the voluntary participation of landowners and is realised through temporary or permanent agreements. In this procedure the landowners commit to a voluntary contract concerning the maintenance or enhancing of natural values in their forests for a fixed term and receive a premium for this. Price and terms of contract were negotiated on a case by case basis, and when the term (10–13 years) ends the forest owner is free to manage the area according to his own wishes. Some areas may also be purchased by the State for designation as permanently protected areas. Compensation will be paid to landowners according to legislation in the Nature Conservation Act or the Act on the Financing of Sustainable Forestry. The METSO Programme will largely be financed through the annual framework budgets allocated to the Ministry of the Environment and the Ministry of Agriculture and Forestry. Previous Government resolutions have already guaranteed funding for the programme amounting to 182 million euros by 2012 (Finland's Environmental Administration, 2009b).

The pesticide charge that had to be paid by manufacturers and importers when pesticides were traded was repealed from 01.01.2007.

5. Iceland

Since the early 1990s, the Ministry for the Environment of Iceland has extended the scope of its responsibilities, among which are now: pollution prevention and control, nature protection, physical planning and meteorology. Environmental legislation and land-related legislation has been substantially enhanced, largely as a result of Iceland's participation in the European Economic Area (EEA), also providing a framework for managing land resources and the central highlands. The National Environmental Strategy, "Towards Sustainable Development" was published in 1993, followed by the National Sustainable Development Action Plan in 1997. Economic instruments have been introduced e.g. in fisheries and in hazardous waste management.

5.1 Energy and air pollution

The environmental tax scheme which relates to energy consumption and air pollution in Iceland differs significantly from those implemented in other Nordic countries. In Iceland, there are no excise duties charged on energy consumption, either in the household sector or the industrial sector. This rather unusual situation can be explained with reference to the special energy supply situation in Iceland. Electricity and heat supply from hydropower and geothermal energy sources dominate the energy supply to both the household sector and the industrial sector (TemaNord, 2006). This special energy supply situation has led to a low level of consumption of fossil fuels. As a result, the CO₂ abatement debate has not attracted as much attention in Iceland as in the other Nordic countries. That being said, Iceland has set forth a long-term vision for the reduction of their GHG-emissions in order to meet the demands of the Kyoto protocol. This implicates that Iceland should reduce their emissions by 50–75 percent within the year 2050¹⁶. (Umhverfisraduneyti, 2007).

Regarding air pollution Iceland finds itself in a fortunate place. Due to an oceanic climate and steady winds the outdoor air quality in Iceland is generally quite good. Therefore, local emission of air pollution is mainly due to road traffic and fishing boats. (Umhverfisstofnun, 2002).

As the transport sector is the only sector that has not been able to draw benefit from the availability of renewable resources, it has solemnly been subject to taxation schemes levied on both transport fuels as well as on vehicles. These schemes have been revised regularly, and serve both fis-

¹⁶ Calculated with the 1990 emission figures as baseline.

cal aims as well as having a positive outcome on the emission levels of a number of pollutants (see section 5.1.2).

5.1.1 Excise duties on fossil fuels for transport purposes

The excise tax on petroleum has since 2006 been calculated in two steps: the general excise tax is ISK 9.28 pr. liter, while the special excise tax is ISK 32.95/liter (ISK 34.92 if the petroleum contains lead). Therefore the overall excise tax on petroleum is ISK 42.23 (ISK 44.20 should the petroleum contain lead), while motor vehicles that run on diesel are imposed with a tax of ISK 45 pr. liter (Fjarmalaraduneyti, 2006; OECD, 2009)

The differentiation in the tax scheme is worth noting, as it clearly characterizes the tax as a regulatory instrument with an environmental focus.

5.2 Water pollution

Freshwater resources in Iceland are abundant and of high quality. However there are some problems regarding water pollution from fertilizer runoff and inadequate wastewater treatment.

The municipal charges for water services should not exceed the costs associated with their supply. The calculation of municipal water charges varies from municipality to municipality and is based on a fixed charge according to the area of the property (per m²) or a percentage of the rateable value of the property. In the majority of municipalities the charge is also made up of part which varies according to the actual volume of water used (per m³). In the capital city, Reykjavik, where the majority of the population live, the charges for water services in 2008 amounted to 134/m² of area of property (Samband, 2008)

Other economic instruments, such as water abstraction taxes; trade effluent taxes or sewage taxes, are not implemented in Iceland. In other words the consumer only pays for the service provided by the waterworks

5.3 Waste

5.3.1 Introduction

Compared to the relatively low population figures, Iceland produces a substantial amount of waste and the amounts are increasing. Statistics show that the total amount of waste managed in the years 2004, 2005 and 2006 amounted to respectively 493.000, 518.000 and lastly 546 000 tons. In 2003 Iceland's first general waste legislation (Waste Management Law 55/2003) became effective, and it has resulted in the first National Waste Management Plan running from 2004–2016. The plan focuses on the

most cost-effective conditions possible with regards to recycling and an obligation on local authorities to produce waste statistics. Furthermore the national and regional plans will be reviewed every third year.

Some of the overall goal of the plan includes:

- No later than 31 December 2011 between 55 percent as a minimum and 80 percent as a maximum by weight of packaging waste will be recycled,
- No later than 31 December 2011 the following minimum recycling targets for materials contained in packaging waste will be attained:
- 60 percent by weight for glass; 60 percent by weight for paper & cardboard; 50 percent by weight for metals; 22.5 percent by weight for plastics, counting exclusively material that is recycled back into plastics; 15 percent by weight for wood (Umhverfisstofnun 2005).

5.3.2 Municipal waste fees at recycling or waste treatment facilities

The 2003 regulation on the treatment of waste makes municipalities responsible for collection, handling and treatment of municipal waste, which makes charges vary considerably from one local authority area to another.

In the capital area (serving 62 percent of the population), for example, households and smaller enterprises can bring materials covered by recycling schemes free-of-charge to recycling centres, however, other items, e.g. garden waste, building waste, etc. are accepted against payment. Larger operators can take bulky waste directly to the waste sorting facilities against a gate fee, however, waste which has been separated and is subject to the recycling fee is accepted without payment. These gate fees vary according to site, however, for the Reykjavik area, the rates that are shown below are considered as regulating consumption as they are assessed in kilograms (TemaNord, 2006).

Table 5.1 Gate fees for industrial waste for the Reykjavik area

Waste products, ISK/kg	from July 2005
Sorted corrugated cardboard	5.80
Newspapers and magazines	5.80
Graphic paper	4.66
Mixed waste	8.48

(Source: Umhverfisstofnun 2006)

5.3.3 Recycling fees

The Icelandic Government has opted not to introduce taxes on landfill and incineration at present and has instead implemented a system of recycling fees through legislation passed in 2002. The underlying rationale for this decision is the position that landfill and incineration taxes may increase overall costs in the management of waste without achieving the

targets of improved waste reduction, re-use, recycling and recovery in Iceland (TemaNord, 2006).

The recycling fees are levied on the products itemised in the law in order to finance their collection, transport, recycling, recovery or disposal. The Recycling Fund of Iceland was set up in 2003 to collect and administer the recycling fees.

Table 5.2 Recycling fees on various products in 2009. ISK

Cartons	10.00/kg
Paper	10.00/kg
Plastic wrapping for hey	25.00/kg
One-way beverage containers made of coloured plastic material	1.80/container
One-way beverage containers made of non-coloured plastic material	0.76/container
One-way beverage containers made of glass, larger than 500 ml	2.50/container
One-way beverage containers made of glass, smaller than 500 ml	1.80/container
One-way beverage containers made of steel	3.40/container
One-way beverage containers made of steel, aluminium, glass and plastic material	7.23/container

Source: OECD (2009)

5.3.4 Hazardous waste fees

A system of hazardous waste fees on the sales of various products was introduced in 1997 to finance the collection, recycling and treatment of toxic waste.

Table 5.3 Hazardous waste fees for various products in 2009. ISK

Alkaline button batteries	2.50 each
Batteries containing acid	19/kg
Batteries containing mercury, nickel or cadmium	101.0/kg
Batteries in instruments	104.50 – 1,672.00/battery
Batteries in voltage transformers	19.00/kg
Batteries without acid	26.60/kg
Halogen chemical compounds	130.00/kg
Isocyanides	1.50/kg
Mercury compounds	900.00/kg
Oil compounds other than fuels	14.50/kg
Oil paints	20.00/kg
Organic chemical solvents	3.00/kg
Other photography chemical production	408.00/kg
Photography and printing chemicals	51 – 408/kg
Printing colours	34.00/kg
Refrigeration fluids	2.50/kg
Rot prevention chemicals	3.00/kg
Wood-treatment chemicals	3.00/kg

Source: OECD (2009)

5.3.5 End-of-life vehicles

Apart from a recycling fee, a deposit system for end-of-life vehicles also came into force in 2003 with the implementation of law 162/2002. The vehicle must be formally de-registered at a testing station or vehicle registration office before the fee is no longer charged. For vehicles exempt from the vehicle registration fee this fee has not to be paid (Umhverfisstofnun 2006).

5.4 Transport

Automobile traffic is one of the main causes of urban pollution in Iceland. There has been a substantial increase in the number of automobiles in the country in recent years, and now the number of motor vehicles per capita in Iceland is among the highest in the world. Therefore, increased use of private vehicles, and not increased population, is the primary explanation for the increase in traffic. At the same time, the number of people who use public transportation is diminishing. In Iceland, private automobiles are used in over 70 percent of the kilometres driven, while public transportation is used in less than 5 percent of instances. It is worth mentioning that over 60 percent of trips taken in private vehicles are shorter than 3 km, and roughly one-third are shorter than 1 km (Umhverfisraduneyti, 2006)

5.4.1 Taxes and duties on motor vehicles

Most motor vehicles are subject to excise duty on import and the base is the customs value of an imported vehicle. The following sections provide a comprehensive overview of the taxes and duties levied on various categories of vehicles in Iceland since 2006.

Private Cars

Table 5.4 Excise duty on private cars. Percent of customs value

Engine capacity (cm ³)	Excise duty. Percent
0–2000	30
> 2000	45

Source: Umhverfisraduneyti (2006), OECD (2009)

The excise duty can be waived or lowered in the following cases, sometimes under certain terms as shown below:

Table 5.5 Lowering/waiver of the excise duty

Taxis and rental cars	From 30 to 10 percent or from 45 to 13 percent
Cars which are partially fuelled with electricity or methane	The duty is lowered by ISK 240.000

Source: Umhverfisraduneyti (2006), OECD (2009)

Other motor vehicles

For motor vehicles other than private automobiles, there are four slabs of excise duties and various categories of non-private vehicles fall under these slabs as shown below.

Table 5.6 Excise Duty Slabs

Exempt from excise duty	<p>A. Motor vehicles for the transport of eighteen or more persons, including the driver</p> <p>B. Cars exclusively used for rescue operations</p> <p>C. Cars exclusively fuelled with electricity or hydrogen</p> <p>D. Rally cars and other cars exclusively used for motor sport</p> <p>E. Dumpers designed for off-highway use, of a gross weight 4 tons or more.</p> <p>F. Snow-ploughs</p> <p>G. Self-loading or self-unloading trailers and semi-trailers for agricultural purposes</p> <p>H. Snow-mobiles, weighing 700 kg. or more</p> <p>I. Navigable vehicles on wheels designed to travel over both land and water</p> <p>J. The following motor vehicles, provided that they are of a gross weight exceeding 5 tonnes:</p> <ul style="list-style-type: none"> - Tractors principally designed for semi-trailers or for hauling another vehicle <ul style="list-style-type: none"> - Motor vehicles for the transport of goods - Trailers and semi-trailers for the transport of goods - Motor vehicles for special purposes; breakdown lorries, crane lorries and more, not principally designed for the transport of persons or goods
10 percent excise duty	Tractors
13 percent excise duty	<p>A. Chassis fitted with engines for motor vehicles.</p> <p>B. Bodies for motor vehicles.</p> <p>C. Trailers and semi-trailers, other than for transport of goods.</p> <p>D. The following motor vehicles, provided that they are of a gross weight not exceeding 5 tons:</p> <ul style="list-style-type: none"> - Crane Lorries and mobile drilling derricks. - Trailers and semi-trailers, for transport of goods. - Tractors principally designed for semi-trailers or for hauling another vehicle. <ul style="list-style-type: none"> - Motor vehicles for the transport of goods. - Motor vehicles for special purposes, breakdown lorries and more, not principally designed for the transport of persons or goods.
30 percent excise duty	<p>A. Motor vehicles for the transport of 10–17 persons, including the driver.</p> <p>B. Motorcycles.</p> <p>C. Snowmobiles.</p>

Source: Umhverfissraduneyti (2006), OECD (2009)

Weight tax and disposal charge on motor vehicles

Weight tax is levied on all motor vehicles, regardless of fuel source. The tax for every taxation period (6 months) is calculated as follows:

- ISK 6.83 for each kg up to 1,000 kg,
- ISK 9.21 for each kg up to 3,000 kg, and
- ISK 2,277 for each additional tonne after that.

However, the lower limit for the total tax is ISK 3,416 and upper limit ISK 41,193 for each taxation period. A disposal charge of ISK 350 is also levied on each vehicle for each six-month period. This charge is payable for fifteen years from the date of the first registration of the vehicle in this country, except when the vehicle is already 25 years old at the beginning of the payment year. The charge is an environmental tax that is intended

to finance the disposal of the vehicle at the end of its useful life. Once the vehicle is delivered for scrap, ISK 15,000 refund is paid to the owner. VAT is not added to the weight tax or the disposal charge.

Weight distance tax

Motor vehicles over 10 tonnes of weight are subject to a special weight distance tax, calculated on the basis of the weight of the vehicle and the number of kilometres driven, as follows (these rates apply since July 1st 2005):

Table 5.7 Weight distance tax for motor vehicles in excess of 10 tonnes. ISK

Weight in kg.	Tax per km.	Weight in kg.	Tax per km.
10,000–10,999	0.29	21,000–21,999	6.89
11,000–11,999	0.89	22,000–22,999	7.49
12,000–12,999	1.49	23,000–23,999	8.09
13,000–13,999	2.09	24,000–24,999	8.69
14,000–14,999	2.69	25,000–25,999	9.29
15,000–15,999	3.29	26,000–26,999	9.89
16,000–16,999	3.89	27,000–27,999	10.49
17,000–17,999	4.49	28,000–28,999	11.09
18,000–18,999	5.09	29,000–29,999	11.69
19,000–19,999	5.69	30,000–30,999	12.29
20,000–20,999	6.29	31,000 and over	12.89

Source: Umhverfisraduneyti (2006), OECD (2009)

Owners of vehicles that weigh less than 10 tonnes do not pay a weight-distance tax.

The owner of a vehicle registered after 1980 has to pay a fee of ISK 520 per quarter, i.e. ISK 2,080 per annum. This fee is levied from the time the car is first registered until it is officially de-registered.

5.4.2 Airport charges

Keflavík airport is situated some 50 km south-west of Reykjavik, which might explain why noise has not been considered as a problem. Regarding the airport fees, Keflavík operates with two different. Each international landing is charged a fee, and a security fee has been set per adult and child down to 2 year (Keflavík, 2009).

5.5 Agriculture and natural resources

Tradable fishing quota system

The individual trading quota system (ITQ) in the fishery sector was first implemented in Iceland in 1979 for herring and was supported by the fishing industry. In later years, the ITQ was introduced for other fish species as well. Central to this policy are the individual transferable quotas given to each fishing boat for each species on the basis of its average

catch of that fish over a three-year period. This settles the boat's share of the total allowable catch of that fish for the entire country. The size of this total is announced each year on the basis of scientific advice from the independent Marine Research Institute (The Economist, 2009).

Subject to certain conditions, quotas can be traded among boats. If the boat owner has exhausted its quota, the owner must buy one from another boat. 20 percent of a quota may be carried forward a year, and 5 percent of the next year's quota can be claimed in advance. Equipment carried on all vessels send electronic signals to make satellite monitoring possible at all times, and each boat is likely to go to sea with an inspector aboard twice a year. All catches are rigorously recorded as soon as they are landed. The Marine Research Institute knows exactly how much each boat is catching and where. It claims that 95 percent of the total is well reported.

By looking at the Directorate of Fisheries' website fishers can see all landings by date and species and thus work out whether to sell their catch fresh or frozen, and whether to buy, sell or carry forward quotas. All quota changes, catches and landings are posted on the internet, enabling everybody to see what is going on. The idea is to let fishermen be guided by the market.

The owners of a quota are charged a fee of ISK 1530.00 per tonne of catch to finance a fund to facilitate rationalization in the fishery sector. The operations of the fund have stopped and the financing is linked to down payment of loans that the fund incurred when it was in operation (OECD, 2009).

This system was seen as a necessary and temporary remedy to overcome the deep crisis of over-fishing of herring prevailing at the time. There has been some discussion about this quota right, which one may sell, lease out or use oneself like any other possession. Debate has arisen about some of the effect of this management system on fishing practice. Recently, many have made enormous profits by selling fishing quotas which were allocated to them free of charge. Newcomers to the industry find it hard to buy the licences and quotas they need to start fishing. As a result, the number of boats is falling. Yet Iceland no longer suffers from overcapacity, and the catch per boat is increasing. Ownership, however, is growing more concentrated (The Economist, 2009).

Also, there has been discussions about that the rights of fishing have been transferred to specific individuals free of charge on a long term basis, thereby excluding others from fishing, which many people still find morally wrong. (http://www.arnastofnun.is/page/the_quota_system) / http://www.upei.ca/iis/art_oh_1

Fee on hunting

A charge of ISK 1900.00 per year is imposed on persons with a hunting permit. The revenue from the fee is earmarked for biodiversity and wild-life management.

6. Norway

Since the 1990s, economic instruments have been a central part of the “green taxation” system. The rates increased somewhat towards 2000, and some few new taxes were introduced. Since that time most tax rates have only been adjusted from one year to another based on the expected increase in the general price level. In 2005 a national emission trading system was established. From 2008 the system was expanded and integrated in the EU ETS, and the CO₂ tax system has been somewhat adjusted to avoid use of “double taxation. However, CO₂ emissions from the offshore installation both pay (reduced) CO₂ taxes and have to buy all allowances they need to cover their emissions. Furthermore, a NO_x charge has been introduced together with a NO_x abatement fund that companies alternatively can pay into if they commit themselves to undertake emission reductions instead of paying the tax. Finally, from 2007 the registration tax for passenger cars has been adjusted to favour low- CO₂ emission cars. In 2008 and 2009 the registration tax system has been further changed in favour of these cars.

6.1 Energy and air pollution

6.1.1 Electricity tax

The tax on consumption of electrical power was introduced in 1951 to finance investments in electricity supply in Norway, but is now imposed mostly for fiscal reasons. The general rate encompasses power to households and all commercial activities except industry. The tax also includes power to administration buildings in industry. In 2006 the general electrical power tax rate was 10.05 øre/kWh, increasing to 10.82 øre/kWh in 2009.

The industry and mining sector as well as district heating pay a reduced electricity tax amounting to 0.45 øre/kWh, the equivalent to the minimum rate given by the EU Directive 2003/96/EF concerning restructuring of EU regulation for taxation on energy products and electricity. According to the EFTA Surveillance Authority (ESA) ‘s approval under the guidelines for environmental support the reduced tax rate can not be set lower than 0.5 euro pr. MWh. At the same time EUs directive exempts power intensive industries from the tax. This means that the production processes in the metal industry, the cement industry and parts of the chemical raw material industry are exempt from paying tax on electricity.

In addition, energy intensive firms in the pulp and paper industry that implement approved energy-saving measures corresponding to the effect

of the tax rate are also exempt from paying the reduced electricity tax. Such an energy savings program has been approved by the authorities and the participants in this program cover about 95 percent of the electricity consumption in the pulp and paper industry.

Business activities in the north of Norway, Nord-Troms and Finnmark, are subject to a reduced electricity tax. However, in practice they have been exempted from paying this through government subsidy regulation since 2003. According to new EEA regulations from April 2007, government subsidies are no longer allowed and therefore business activities in the north of Norway have paid the reduced electricity tax of 0.45 øre/kWh in full from the 1st of January 2008. Public administration and households in the area are exempted from the electricity tax. Almost 40 percent of total net electricity consumption is exempted from the electricity tax.

Table 6.1 Electricity tax development. Øre/kWh

	2006	2007	2008	2009
General rate	10.05	10.23	10.5	10.82
Reduced rate	0.45	0.45	0.45	0.45

Source: Government tax proposals 2006–2009 (St. prp. nr. 1 Skatte-, avgifts- og tollvedtak)

6.1.2 General mineral oil tax

The general mineral oil tax was introduced in 1970 and removed in 1993. It was re-introduced in 2000, based on the argument that the increase in the tax rate on electricity in 2000 should not contribute to an environmentally harmful transfer of consumption of electricity to consumption of oil for heating purposes. The tax includes the consumption of mineral oil, meaning kerosene, gas oil, diesel oil and heating oil for heating purposes (i.e. purposes not subject to the auto diesel tax). This implies that oil used in vessels in international transport, domestic cargo and passenger transportation, fishing and catching in domestic and international seas, installations for petroleum production on the continental shelf and herring and fish flour industries are exempt from the tax.

The tax rate was in 2000 set at the same level as the then increase in the electricity tax, compared on øre/kWh basis. In 2007 the general mineral oil tax rate corresponded to a tax rate of 5,3 øre/kwh for light fuel oil, which was far less than the general tax rate on electricity of 10,23 øre/kWh. According to the Government tax proposal for 2008 equal treatment of different energy carriers means that electricity and mineral oil should have an energy tax at the same level. Therefore, the tax rate on heating oil for 2008 increased by 40.5 øre/liter in addition to normal price adjustments, see table 6.2. However, the proposal does not mention that this comparison only is valid for other sectors than the industry, since industry only pays 0.45 øre/kWh (see table 6.1).

Table 6.2 General mineral oil tax development. Øre/liter

	2006	2007	2008	2009
General rate	0.421	0.429	0.845	0.870
Pulp and paper	0	0	0.120	0.124
Prod. of pigments	0.421	0.429	0.845	0.124

Source: Government tax proposals 2006–2009 (St. prp. nr. 1 Skatte-, avgifts- og tollvedtak)

Until 2008 there were tax exemptions for the pulp and paper industry and mineral oil used as feedstock in industrial use if the total amount of the oil is tied to the final product. From September 2008 a general tax for the pulp and paper industry at the level of 12 øre/l, the same as the minimum rates in the EU Directive 2003/96/EF, has been imposed to fulfil the EEA agreement.

The exemptions from the general mineral oil tax are less comprehensive than those for the electricity tax. With the exception of the pulp and paper and the herring and fish flour industries the whole onshore industry sector pays the general mineral oil tax. Also, all users in Finnmark and northern Troms pay the general mineral oil tax, while they are exempted from the electricity tax. Thus, these sectors have a considerable tax incentive to substitute heating oil with electricity.

6.1.3 CO₂ tax

CO₂ tax on mineral oil products

The CO₂ tax on mineral oil products was introduced in 1991. The objective of the tax is to contribute to cost effective reductions of CO₂ emissions. The tax includes mineral oil, petrol, natural gas and LPG for energy purposes (i.e. not for transportation use). From January 1st 2003, all use of coal and coke became exempted from the CO₂ tax as part of the adaptation process to new regulations set out by the EFTA Surveillance Authority (ESA). From this moment on the CO₂ tax has only been levied on mineral oil products.

Among other activities mineral oil products used in vessels in international transport, fishing and catching in domestic and international seas and international aviation are exempted from the CO₂ tax. From 1st September 2008 mineral oil products supplied for use in activities subject to emissions trading are also exempted.

Both light and heavy fuel oil have a general tax rate of 57 øre/liter in 2009, increasing only through general price level adjustments since 2003 when the tax rate was at 50 øre/liter. Mineral oil used in domestic aviation has a tax rate of 0.67 øre/liter, while mineral oil used in the pulp and paper industry, herring and fish flour industry is levied a rate of 28 øre/liter.

From the 1st of July 2007 the government introduced a CO₂ tax also on gas for heating purposes in buildings with an exemption for gas used for other purposes. The CO₂ tax rate on natural gas was set to 47 øre/Sm³, while the CO₂ tax rate on LPG was set at 60 øre/kg. The tax rates were

price adjusted for 2008 and 2009. However the exemption has to be approved by EFTA Surveillance Authority ESA as legal support scheme, and the obligation to pay has been delayed until further notice.

The expanded emissions trading system for 2008–2012 compared to 2005–2007 implies that some emissions sources facing CO₂ tax until end 2007 will be subject to emissions trading. This comprises use of mineral oil in pulp and paper industry, energy installations larger than 20 MW in petrochemicals, chemical industries, herring and fish flour industries and in district heating among others. Some of these industries using natural gas in energy installations over 20 MW (pulp and paper among others) were also subject to emissions trading during 2005–2007.

Tax on CO₂ emissions from the continental shelf

The tax on CO₂ emissions from the petroleum activities on the continental shelf was introduced in 1991. The tax rate was 80 øre/liter/Sm³/kg in 2007. From 2008 CO₂ emissions from these activities were included in the emissions trading system, and the installations would have to buy all their allowances (i.e. no allocation of allowances free of charge). To keep the incentives to reduce emissions at about the same level as before and avoid increased costs for the installations, the CO₂ tax rate was reduced by 35 øre from 2008, based on an expected allowance price of NOK 160 kr/ton CO₂.

Tax rate developments

The development in the various CO₂ tax rates since 2006 is shown in table 6.3.

Table 6.3 CO₂ tax rates development. NOK per liter/Sm³/kg or ton CO₂

	2006	2007	2008	2009	NOK/ton CO ₂ in 2009
Gasoline	0.79	0.80	0.82	0.84	363
Jet fuel	0.53	0.54	0.65	0.67	263
Mineral oil					
- Light fuel oil diesel	0.53	0.54	0.55	0.57	214
- Heavy fuel oil	0.53	0.54	0.55	0.57	182
Mineral oil reduced rate					
- Light fuel oil, diesel	0.27	0.27	0.28	0.29	109
- Heavy fuel oil	0.27	0.27	0.28	0.29	92
Domestic use of gas					
- Natural gas	0	0.47	0.48	0.49	209
- LPG	0	0.60	0.62	0.64	213
Continental shelf					
- Light fuel oil, diesel	0.79	0.80	0.45	0.46	173
- Heavy fuel oil	0.79	0.80	0.45	0.46	147
- Natural gas	0.79	0.80	0.45	0.46	197

Source: Government tax proposals 2006–2009 (St. prp. nr. 1 Skatte-, avgifts- og tollvedtak)

6.1.4 The CO₂ emissions trading system

2005–2007 period

In order to reduce greenhouse gas emissions and get some experience from the use of a new policy instrument, a national emissions trading

system for CO₂ allowances was introduced for the period 2005–2007 in addition to the tax on CO₂. An emission allowance is defined as a portion or share of total allowable emissions assigned to a country or group of countries within the framework of maximum total emissions and mandatory allocations of resources. One allowance equals one ton of CO₂. The participating installations were allowed to trade the allowances among each other. The following industries were allocated allowances for free:

Energy installations larger than 20 MW (36 installations):

- District heating
- Gas fired power plants
- Pulp and paper
- Herring and fish flour industries
- Petrochemicals
- Natural gas processing and terminals
- Other industries
- Other sectors (15 installations):
- Refining of mineral oil
- Steel production
- Mineral products (cement, lime, glass, ceramics etc.)

Only emissions not subject to CO₂ tax were included in the trading system, implying that only emissions from the use of natural gas in these installations were included. This implies that for some installations some emissions were included, others not. The main reason for this design of the trading system was the requirements in the EU Emissions trading directive.

The installations were allocated allowances for free based on average emissions for the years 1998–2001 with some adjustments. Existing installations were allocated some 95 percent of the average emissions (with some adjustments), new activities were allocated 85 percent.

The economic consequences for the installations included are considered to have been minor, mainly because most of the allowances were allocated for free. Few installations traded allowances because of relatively generous allocations, and there is no information available about the allowance prices. However, on the margin natural gas had a slight decrease in its competitive position since those who needed to buy allowances would face a price on the CO₂ emissions from natural gas which they did not face earlier.

2008–2012 period

For the period 2008–2012 the national emissions trading system is expanded and connected to the European Union emission trading system (EU ETS). About 40 percent of Norway's total greenhouse gas emissions are included in the emissions trading system.

The following sectors are included during 2008–2012:

- Energy installations over 20 MW
- Refining of mineral oil
- Calcining/sintring of iron ore
- Production of cast iron and steel
- Production of cement and lime
- Products of glass, fiberglass and ceramics
- Pulp and paper industry
- Production of fertilizer
- Offshore petroleum installations

The pulp and paper industry, production of fertilizer and offshore petroleum installations are sectors that were not fully included in the emission trading system in the first trading period of 2005–2007. However, if they had energy installations larger than 20 MW using natural gas they were included. With the changes made to the system for the current period, more than 120 companies are now included in the system. In contrast to the previous trading period 2005–2007, the current emission trading system comprises all CO₂ emissions from these installations. However, emissions from burning of biomass, hazardous waste and waste subject to waste treatment tax are exempted. As mentioned above, the CO₂ tax for those industries covered by the emissions trading system is removed.

In the period 2008–2012 land based industries with an obligation to hold allowances will be allocated allowances for free amounting to 87 percent of the average emissions from their energy use during 1998–2001. Emissions from industrial processes will be allocated allowances for free amounting to 100 percent of the average emissions during 1998–2001. Petroleum installations offshore will have to buy allowances for their total emissions. Allowances for free allocation will be reserved for new gas fired power stations based on CO₂ handling, and for highly efficient heat and power plants with permit to operate.

6.1.5 Sulphur tax

The tax on sulphur in mineral oil was introduced in 1970. It was the first tax in Norway that had an explicit environmental purpose. The objective of the tax has been to reduce emissions of sulphur, and to fulfil the various international protocols on sulphur emission reductions that Norway has signed over the years. Oil with less than 0.05 percent sulphur content (by weight) today have a zero tax rate. Mineral oil used in vessels in international shipping, fishing and catching in domestic and international seas and international aviation are exempted from the sulphur tax.

The tax rate was nominally unchanged between 1991 and 2007 at 7 øre/liter for each 0.25 percent (by weight) sulphur content (equals NOK

17/kg sulphur). The rate was price adjusted for 2008 to 7.2 øre/liter and to 7.4 øre/liter for 2009. The sulphur content of the mineral oil has been considerably reduced over the years, and today mainly heavy fuel oil has sulphur content above 0.05 percent and thus subject to the sulphur tax.

The total or part of the tax is refunded if the emissions of sulphur are less than the sulphur content in the products, i.e. because of cleaning of the emissions or when the sulphur is tied in the final product.

6.1.6 Tax on NO_x emissions

The tax on NO_x emissions was introduced in 2007. The purpose of the tax is to contribute to cost efficient reductions in NO_x emissions and together with other policy measures contribute to fulfil Norway's obligations according to the Gothenburg protocol. The tax comprises:

- Propulsion machinery with total installed engine effect of more than 750 kW
- Engines, boilers and turbines with a total heating effect of more than 10 MW
- Flaring at offshore and onshore installations.

The tax duty arises when NO_x is emitted. There is tax exemption for emissions from vessels in direct traffic between Norwegian and foreign harbours, aircrafts in direct routes between Norway and foreign airports, vessels used for fishing and catchment in foreign seas and emission sources comprised by environmental agreement with the government about implementation of NO_x reducing interventions in accordance with a fixed goal. The Ministry of Environment and 14 trade organisations entered into such an agreement 14. May 2008. EFTA Surveillance Authority (ESA) approved the agreement shortly afterwards. The affected industries and the authorities have agreed to establish a fund to finance emission reductions where abatement costs are lowest, implying that those installations investing in abatement measures will be relieved from the NO_x tax. The tax rate for 2007 was NOK 15/kg NO_x emitted, and increased to NOK 15.39/kg and NOK 15.85/kg for 2008 and 2009, respectively.

When the tax was introduced it was emphasised that emissions should be reduced without harming the economy of the affected industries too much. Therefore, some NOK 400 million was set aside for compensation to the affected installations. When the environmental agreement was signed the background for much of this was removed, and the compensation for 2008 was reduced to about NOK 130 million. The compensation is further reduced to some NOK 60 million in 2009.

6.1.7 Petrol and auto diesel tax

A tax on petroleum consumption was introduced as early as in 1931 to finance road construction, and was the first energy related tax to be introduced in Norway (NOU, 2007:8). The present tax on diesel oil for transportation purposes was introduced in 1993 in connection with the phasing-out of an excise duty scheme on distance travelled. Today the purpose of these taxes is to have the users face the external costs connected to accidents, congestion, road wear and tear and harmful local emissions to air (Government tax proposal, (2009), St. prp. nr. 1 Skatte-, avgifts- og tollvedtak). There have only been modest changes in the tax rates since 2005.

Table 6.4 Petrol and auto diesel tax development. NOK/liter

	2006	2007	2008 ¹	2009
<i>Petrol</i>				
Sulphur free (<10 ppm)	4.10	4.17	4.33	4.46
Low sulphur (between 10 and 50 ppm)	4.14	4.21	4.37	4.50
Other petrol	4.14	4.21	4.37	4.50
<i>Auto diesel</i>				
Sulphur free (<10 ppm)	2.97	3.02	3.40	3.50
Low sulphur (between 10 and 50 ppm)	3.02	3.07	3.45	3.55
Other diesel	3.02	3.07	3.45	3.55

Source: Government tax proposals 2006–2009 (St. prp. nr. 1 Skatte-, avgifts- og tollvedtak)

Petrol and auto diesel are also levied a CO₂ tax as described in previous section. Petrol with a blend of ethanol and auto diesel with a blend of biodiesel are granted reduction according to the percentage of ethanol and biodiesel blended. Pure biodiesel, compressed natural gas (CNG), biogas, LPG and hydrogen used for transportation purposes are fully exempt from petrol, auto diesel and CO₂ taxes.

6.1.8 Subsidies for energy efficiency and renewable energy

The public agency Enova, which has been in operation since June 2001, is the most important tool to promote energy efficiency and more heat and electricity production from renewable sources. Enova's activities are financed through a charge of 1 øre/kWh on the grid tariff paid by all electricity users, annual grants from the government budget and yields from the Basic Energy Fund. The Fund was established in 2007 with a deposit from the government on NOK 10 billion. Another NOK 10 billion deposit is made in 2009, and additional NOK 10 billion is promised to be deposited by 2012

Enova should promote:

- More efficient energy use
- Increased use of other energy sources than electricity, natural gas and fuel oil for heating
- Increased production from renewable energy sources
- Introduction and development of new technologies and solutions in the energy market

- Well-functioning markets for efficient and environmental friendly energy solutions
- Increased knowledge about options to use efficient and environmental friendly energy solutions

In some easily quantifiable areas particular goals are agreed for the activities. Enova should release projects yielding new, environmental friendly energy production and energy saving of 18 TWh/year within end 2011 compared to 2001. By the end of 2010 Enova should contribute to minimum 4 TWh/year increased supply of water borne heat based on new, renewable energy sources, waste heat and heating pumps, and at least 3 TWh/year increased production of wind power (all compared to 2001 level).

The Norwegian Government has also started new negotiations with the Swedish authorities on a common market for green certificates. This idea was discarded early 2006 as the scheme was characterised as 'too expensive for Norwegian consumers and industry' by the Government.

The Norwegian government also grants funds for research and development concerning energy and oil production and consumption. The government also provides large subsidies to research and establishment of a test facility for carbon capture and storage.

6.2 Water pollution

There are no environmental taxes or charges on water pollution or water use in Norway. Municipalities and other suppliers of drinking water and wastewater treatment are not permitted to charge more for water related services than required to cover the associated costs.

Consumers pay a charge to the local municipality or other supplier of freshwater. The charge includes costs for water treatment to ensure supply of safe drinking water and good water quality. Consumers can often choose to pay fixed rates, according to actual metered usage or a mixture of the two systems. In case of payment using the consumption-based method, a minimum payment often applies which also varies according to municipality (TemaNord, 2006).

The average fee in 2008 was NOK 2,352, including the price for use of 150 m³ for those paying according to actual use (SSB, 2008). The fixed charge in 2006 was some NOK 2,076 (TemaNord, 2006).

Consumers mostly pay a fixed, annual charge to municipalities for wastewater treatment services. The average charge in 2008 was NOK 2,722 on average (SSB, 2008).

6.3 Waste

6.3.1 Waste end treatment tax

The tax on waste treatment was introduced in 1999. It consists of a tax on waste put on landfills and a tax on emissions from waste incineration. The purpose of these taxes is to set a price on the environmental costs of waste end treatment, stimulate recycling and reduce the amount of waste generated. The tax on emissions from waste incineration should in addition contribute to abatement of emissions and to sort out emission intensive waste fractions.

The tax on waste put on landfills is differentiated according to the environmental standard of the landfill. The tax has been about constant in real terms over the last years

Table 6.5 Landfill tax development. NOK/ton waste

	2006	2007	2008	2009
Landfills with high environmental standard	416	423	434	447
Landfills with low environmental standard	542	552	566	583

Source: Government tax proposals 2006–2009 (St. prp. nr. 1 Skatte-, avgifts- og tollvedtak)

Landfills with high environmental standards should fulfil the specified requirements for double bottom and side sealing, or these requirements have been reduced based on a risk assessment. All other landfills are classified as low standard landfills. The landfill tax is exempted for hazardous waste, waste delivered for recycling, recovery or sorting out for these uses, inorganic waste etc. From 1. July 2009 it is prohibited to put biological degradable waste on landfills. Thus, the composition of the waste put on landfills will change, implying that emissions of greenhouse gases and toxic substances will be reduced. The Government will eventually reduce the landfill tax to reflect this.

The tax on waste incineration comprises the emissions of the following substances:

Table 6.6 Tax on emissions from waste incineration 2009. NOK/gram

	2006	2007	2008	2009
Dust	0.611	0.622	0.638	0.657
Hydrogen fluoride	21.60	21.98	22.56	23.23
Hydrogen chloride	0.108	0.110	0.113	0.116
Nitrogen oxides	0.0159	0.0162	0.0166	0.0171
Sulphur dioxide	0.018	0.0183	0.0188	0.0194
Mercury	29.22	29.74	30.52	31.43
Cadmium	56.21	57.22	58.71	60.47
Lead	67.12	68.32	70.10	72.20
Chrome	604.46	40.07	41.11	42.35
Copper	0.325	0.331	0.339	0.350
Manganese	100.57	102.38	105.04	108.19
Arsenic	10.28	10.46	10.74	11.06
Nickel	9.85	10.02	10.28	10.59
Dioxins	2 487 700	2 532 500	2 598 300	2 676 300

Source: Government tax proposals 2006–2009 (St. prp. nr. 1 Skatte-, avgifts- og tollvedtak)

It can be seen from table 6.6 that the tax rates have mostly been adjusted according to the price level since 2006. One exception is the chrome tax rate, which was substantially reduced from 2006 till 2007 because most of the chrome emissions from incineration plants are in the form of chrome (III), and not the far more damaging chrome (IV) as previously assumed.

The emission tax is based on actual emissions monitored either continuously based on 24 hour average concentrations, or through manual monitoring or analysis every 6th month by an independent third party. There are detailed requirements about how the various monitoring or analysis activities should be carried out.

The CO₂ tax is levied on waste delivered for incineration.

Table 6.7 CO₂ tax on incinerated waste. NOK/ton waste

2006	2007	2008	2009
41.28	59.00	60.53	62.35

Source: Government tax proposals 2006–2009 (St. prp. nr. 1 Skatte-, avgifts- og tollvedtak)

Table 6.7 shows that the CO₂ tax rate has been adjusted according to the price level, except for in 2007 when the rate was increased to come on par with the CO₂ tax on mineral oil.

6.3.2 Tax and refund system on hazardous substances

A tax on the use of trichloroethylene (TRI) and tetrachloroethylene (PER) was introduced in 2000 to reduce the use of these toxic substances. The tax also includes use of recovered TRI and PER and when they are included as parts in other products with more than 1 and 0.1 percent respectively. TRI and PER that are recovered for own use are exempted from the tax. The tax rate has been adjusted according to the price level since 2006. For products that only partly contains TRI and PER a tax is calculated according to the content.

Table 6.8 Tax on TRI and PER. NOK/kg

2006	2007	2008	2009
56.67	57.69	59.19	60.96

Source: Government tax proposals 2006–2009 (St. prp. nr. 1 Skatte-, avgifts- og tollvedtak)

Parallel with the tax a refund scheme for waste containing TRI that is delivered to a certified waste collector has been in operation. The refund rate has been NOK 25/kg since the scheme was introduced in 2000.

6.3.3 Tax and refund system for some greenhouse gases

From 2003 a tax has been levied on the import and production of hydro-fluorocarbons (HFC) and perfluorocarbons (PFC). The purpose of the tax has been to reduce emissions of the substances through stimulating the use of alternative gases and developing new technology and products that does not use HFC and PFC. The tax also comprise all mixtures of HFC and PFC and products containing the substances. Recovered HFC and PFC are exempted from the tax.

Table 6.9 Tax on HFC and PFC. NOK/ton CO₂-equivalent

2006	2007	2008	2009
190.55	193.98	199	204.99

Source: Government tax proposals 2006–2009 (St. prp. nr. 1 Skatte-, avgifts- og tollvedtak)

From July 2004 an associated refund scheme for waste containing these substances and is delivered for waste treatment has been in operation. The current tax rates have been fully refunded.

6.3.4 Tax and refund system for lubricating oil

The tax on lubricating oil was introduced in 1988. The purpose of the tax is to reduce unfavourable disposal/incineration of waste oil (used lubricating oil) and thus reduce damages on human health and environment.

Table 6.10 Tax on lubricating oil and refund rate for waste oil collection. NOK/liter

	2006	2007	2008	2009
Tax	1.65	1.68	1.72	1.77
Refund rate	1.86	1.89	1.93	2.00

Source: SFT, Econ Pöyry (2008a)

The nominal rate for the lubricating oil tax has increased approximately according to the general price level increase since 1988, except for in 2000 when it increased by 44 percent compared to the previous year. The nominal refund rate increased by 50 percent from 1994 to 1995, and was the constant for some years before increasing up till 2000 when it was reduced compared to the previous year. After 2000 both the tax and the refund rate has increased at about the same rate as the increase of the general price level.

6.3.5 Taxes on beverage containers

The tax system on beverage containers consists of an environmental tax and a general tax on each container unit. The general tax is imposed on all beverage containers that cannot be reused in its original form. This tax was introduced in 1994. EFTA Surveillance Authority (ESA) opened a case against the Norwegian government in June 2007, claiming that this

tax violates the EEA agreement, since it is mainly imposed on imported beverage containers. Domestic producers can avoid the tax by using reusable containers, while foreign producers for practical reasons mostly cannot do this. This case is not yet settled.

Table 6.11 Taxes on beverage containers. NOK/unit

	2006	2007	2008	2009
Environmental tax:				
- Glass and metal containers	4.54	4.62	4.74	4.88
- Plastic containers	2.74	2.79	2.86	2.95
- Carton and cardboard	1.13	1.15	1.18	1.22
General tax on all units	0.93	0.95	0.97	1.00

Source: Government tax proposals 2006–2009 (St. prp. nr. 1 Skatte-, avgifts- og tollvedtak)

The purpose of the environmental tax is to put a price on the costs of littering the nature with the empty containers. The different tax rates on containers of various materials are justified by the fact that their damage on nature is different. The environmental tax is differentiated according to their recycling level, implying that containers that are part of a certified recycling system have their tax reduced according to the recycling rate. Containers with a recycling rate of more than 95 percent are fully exempted from the tax.

6.3.6 Deposit-refund and other systems for refillable and non-refillable beverage containers

The system of taxation on beverage containers is supported by producer responsibility in the form of a deposit-refund system (TemaNord, 2006). Norsk Resirk (www.resirk.no) is a trade and industry organisation with whom manufacturers and importers of beverages in cans or non-refillable PET bottles can register their products, enabling them to benefit from reduced rates of the environmental tax (see table 6.11) by participating in the deposit-refund system. The deposit/refund rates have for many years been NOK 1.0 for PET bottles and cans up to 0.5 litres and NOK 2.5 if over 0.5 litres. These rates are charged the consumers when buying the products, and refunded upon returning the empty containers. In 2008, 81 percent of PET bottles and 90 percent of cans were collected and of these 100 percent were recycled (www.resirk.no).

In addition to Norsk Resirk's refundable deposit scheme, three other return systems operate for one-way drinks cartons (Grønt Punkt Norge AS), non-refillable glass bottles (Norsk Glassgjenvinning) and refillable glass and plastic bottles. The latter are collected through a system operated by the Norwegian Brewers and Soft Drinks Producers. For refillable beverage containers the same deposit/refund rates apply as to non-refillable bottles and cans described above. However, the retailer receives a slightly higher refund than the consumers, at NOK 1.20 for refillable containers up to 0.5 litres and NOK 3.0 if over 0.5 litres (TemaNord,

2006). For one-way cartons and non-refillable glass, no deposit-refund system applies, and the system is financed through fees on the products. Municipal collection schemes are in place in the majority of the municipalities, covering almost 100 percent of the Norwegian population.

6.3.7 Deposit-refund system and producer responsibility for end of life vehicles (ELV)

The refund system for ELVs weighing less than 3.5 tonnes was established in 1978 to motivate car owners to return their hulks to a certified treatment plant. Today the system also covers camping-cars, snow scooters and mini-buses. A charge of NOK 1,300 is paid on purchase of a new car, and a refund of NOK 1,500 is given when a vehicle is returned. Until 2007 the system was operated by the Norwegian Pollution Control Authority (SFT), and the car dismantlers themselves received a fee per car for removing the environmentally hazardous elements. Further funding was also provided for costs associated with compressing and transporting the scrapped cars.

As a follow up of the requirements of the EU Commission's amendment to End of Life Vehicle Directive 2000/53, car importers and producers from 2007 took over the responsibility for collection and recycling of scrap cars from SFT. A subsidy to cover costs for those vehicles not part of the producer responsibility system has been paid car dismantlers since 2008, and will be operated also through 2009. Despite the producer responsibility the public deposit-refund system will still be operated for some years.

In 2008 the refund for the most polluting cars (i.e. older, heavier diesel vehicles with a total weight of less than 7.5 tonnes that have high NO_x and particle emissions) was increased to NOK 5,000. According to the tax proposition for 2009 there has only been a slight increase in the deposit of these older cars compared to 2007, and the increased refund is not continued in 2009.

6.3.8 Other waste handling systems

As a follow up of the various EU directives on waste handling producer responsibility for handling of various waste categories have been introduced. Collection and recycling systems for plastic, metals, glass, cardboard packaging, tyres, drinking cartons, batteries, electrical and electronic equipment have been established. These systems are run by several material handling companies, and financed through fees on importers and producers of the materials. Households and companies in possession of the waste in question can deliver the waste for free to shops selling the products and/or to special collection points.

6.4 Transport

6.4.1 Registration tax

The purchase tax on passenger cars and other motor vehicles was introduced in 1955 to reduce the increasing problems with the trade balance through increasing purchase prices on new vehicles and thus reduce demand (Te-maNord, 2006). The tax scheme has been changed several times, the last major change took place in 2007. Today this tax is primarily a fiscal tax.

Table 6.12 Various components in the registration tax for passenger cars*

	2006	2007	2008	2009
Specific weight (NOK/kg)				
First 1,150 kg	35.36	33.16	34.02	35.04
Next 250 kg	70.72	72.27	74.15	76.37
Next 100 kg	141.43	144.55	148.31	152.76
Rest	164.49	168.11	172.48	177.65
Displacement (NOK/kg)				
First 1,150 kg	35.36	-	-	-
Next 250 kg	70.72	-	-	-
Next 100 kg	141.43	-	-	-
Rest	164.49	-	-	-
Engine effect (NOK/kW)				
First 65 kW	136.57	120.59	123.73	127.44
Next 25 kW	498.11	502.47	515.53	531.00
Next 40 kW	996.52	1,205.92	1,237.27	1,274.39
Rest	1,686.36	2,512.33	2,577.65	2,654.98
CO ₂ -emissions (NOK per g/km)				
First 120 g/km	-	40.20	41.25	0
Next 20 g/km	-	190.94	195.90	526.00
Next 40 g/km	-	502.47	515.53	531.00
Next 70 g/km	-	-	1,443.48	1,486.78
Rest	-	1,406.90	1,443.48	2,500.00
Deduction per gram emissions under 120 g/km (only for vehicles with emissions < 120g/km)	-	-	-	-500
Deductions in percent of passenger car tax				
Delivery vans	20	22	22	22
Camping cars	13	22	22	22
Combined cars	55	-	-	-
Weasels	36	36	36	36
Taxis	40	40	40	40
Minibuses	35	35	40	40

* Cars under 6 meters and not more than 17 seats

Source: Government tax proposals 2006–2009 (St. prp. nr. 1 Skatte-, avgifts- og tollvedtak)

As can be seen from table 6.12 there was a major change in the registration tax for passenger cars in 2007 when a CO₂ component was introduced, replacing the tax on engine displacement. Today the registration tax consists of a vehicle weight, engine effect and CO₂ emissions component. All the elements are progressive. From 2009 the progression has been further developed with a deduction for low emission cars (less than 120 g/km), but total registration tax cannot become negative. Furthermore, high emissions vehicles (more than 250 g/km) have been rather heavily penalised by the tax system. The registration tax change from 2007 has led to a considerable increase in the share of diesel vehicles of the

total number of new passenger cars sold. The Government tax proposal for 2009 (St. prp. nr. 1 Skatte- avgifts og tollvedtak) indicates that the tax rates will be further differentiated in the coming years to stimulate purchase of low CO₂ emission cars and increase the costs of cars with high CO₂ emissions.

The registration tax system in 2006 indirectly taxed CO₂ emissions through the weight, displacement and engine effect components. However, the transformation of the tax system made from 2007 facilitates a more overall treatment of for example hybrid and electric vehicles. All cars will have engine effect and weight, but in the future there will be an increased supply of cars without displacement, like electric cars.

Electric cars powered from a battery only or through fuel cells pay no registration tax. Also hydrogen fuelled cars are fully exempt from the tax, also if the hydrogen engine is combined with an electric engine. Vehicles that can run on a concentration of at least 85 percent ethanol could deduct NOK 10,000 from the vehicle tax.

The registration taxes for motor cycles and snow scooters have similar, progressive tax systems based on displacement and engine effect as well as a general tax per unit (motorcycles), and on weight, displacement and engine effect (snow scooters).

6.4.2 Tax on boat engines

The tax on boat engines was introduced in 1978. The purpose of the tax is among other things to reduce the inconveniences related to noise and high speed through changing the demand towards smaller engines. The tax is levied on engines with at least nine horse powers or more when imported or taken out from a warehouse. Engines used in fishing vessels and shipping are exempt from the tax. The tax was NOK 137.50/horse power in 2006, and has gradually increased to NOK 147.81/horse power in 2009.

6.4.3 Annual excise duty on motor vehicles

The predecessor of this tax was introduced in 1917 as part of a taxation regime on luxury goods. The tax is a fiscal tax and is today paid annually by the owners of vehicles with a total weight of less than 7,500 kg.

Table 6.13 Annual excise duty tax development. NOK/vehicle

	2006	2007	2008	2009
Diesel vehicles without particle filter originally from the factory	2,865	2,915	3,090	3,185
Petrol and diesel vehicles with particle filter originally from the factory	2,865	2,915	2,660	2,740
Motor cycles	1,615	1,645	1,690	1,675
Camping trailers	955	970	995	1,025
Tractors, mopeds etc. (included electric driven cars)	365	370	380	390

Source: Government tax proposals 2006–2009 (St. prp. nr. 1 Skatte-, avgifts- og tollvedtak)

From 2008 the annual tax is differentiated according to whether the diesel vehicle has originally installed particle filter or not. This change was made to price the external costs connected to local emissions and to stimulate buying of diesel cars with particle filters. The change should be seen in the light of the change of the registration tax in 2007 that led to the purchase of more diesel cars.

6.4.4 Annual weight excise duty

This tax consists of a weight and an environmental component. Before 2006 this tax applied to all vehicles and combinations of vehicles with an allowed total weight of more than 12 tons, but from 2006 it was broadened to comprise all vehicles with total weight of 7,500 kg and more.

The weight-related tax component is dependent on the total weight of the vehicle, suspension system and number of axles. The component is designed to cover wear and tear of the roads. The environmental component is differentiated according to weight and emission standards that the vehicle fulfils. The emission standards follow the EURO-classification, which has emission limits for nitrogen oxides and particles.

The tax rates are very differentiated and detailed, and the rates have only been adjusted for the general price level increase since 2006.

6.4.5 Road tolls

To finance road construction and bridges, tunnels etc. there are several toll roads around the country where vehicles have to pay to use the road, bridge or tunnel. Several larger Norwegian cities also have toll rings where all vehicles entering the city centres have to pay a fee. In most cases the fees are differentiated between small (less than 3.5 tonnes) and large vehicles, but hardly anyone has fees differentiated during the day or the week (www.vegvesen.no). Thus, the environmental effect of the tolls may be limited.

6.4.6 Landing charges

Flights to and from Norwegian airports are levied a start charge, passenger charge, en route charge, security charge and de-icing charge to finance operation costs and investments at Norwegian airports. All these charges contribute to increased travel costs and might thus reduce passenger air travel demand which could have environmental consequences. Since 1990 there has been a noise-differentiated surcharge on the start charge at Bodø Airport, differentiated by airplane noise and time of the day. The purpose with this charge has been to stimulate airlines use low-noise airplanes on this airport.

6.4.7 Transport subsidies

Public transport is subsidised to make it more competitive and to achieve the aims of the national transport policy, including reducing emissions to air. Subsidies vary on an annual basis.

6.5 Agriculture and natural resources

6.5.1 Tax on use of pesticides

This tax is levied by the Ministry of Agriculture on farmer's use of pesticides. The pesticides are grouped in seven tax classes depending on their health and environmental risk, and the tax is paid according to this and the size of the land used. The tax has led to the use of pesticides with lower health and environmental risk (Ministry of Agriculture, 2008). The proceeds (NOK 65–70 million/year during the last years) are used to finance measures to reduce the use of pesticides and damages from the use of it.

6.5.2 Funding for conservation of land

Public funding for conservation and protection of forest land, national parks and other protected areas and to make coastal areas available for the public are provided by the Ministry of Environment. Funds are mainly spent for establishing conservation areas on private land according to the Nature Conservation Act through purchase of private land, and/or to compensate for inconvenience connected to restriction of use of private land areas. The amount of funding provided varies considerably from one year to another, depending on the establishing of new protected land areas.

Management of national parks and other protected areas has been strengthened partly as a result of recommendations from a peer review of Norway's sustainable development work. The Ministry of Environment's budget on protected areas management is increased by NOK 300 million in 2009.

7. Sweden

Sweden has a long tradition of making use of economic instruments in the environmental policy. Since the 1990s, economic instruments have been a central part of the “green taxation” system where higher environmental taxes have been shifted against increased personal allowances and lower social security contributions. Under the green taxation, the government has increased the carbon dioxide (CO₂) tax, the energy tax on electricity, the diesel tax, the waste tax, the tax on natural gravel, the pesticide tax, the road vehicle tax and the petrol tax, as well as introduced a SEK 0.005 electricity tax for industry. The taxes that have been lowered are the general salary charge, the energy tax and the diesel tax for agriculture and forestry. The personal allowance for income tax has also been raised. The aspiration is to achieve a SEK 30 billion green tax shift between 2001 and 2010 (Swedish Environmental Protection Agency, 2007).

7.1 Energy and air pollution

The Swedish Energy Tax Act (1994:1776) governs three taxes; 1) the carbon dioxide tax, 2) the sulphur tax and 3) the energy tax. Within the Swedish energy field, there are also a tax on NO_x emissions (SFS 1990:613), a nuclear power output tax (Act 2005:963) and several charges, grants and support programmes. Energy taxes are also governed by EC directives since Community law contains provisions governing mandatory minimum tax rates.

7.1.1 Carbon dioxide tax

The CO₂ tax constitutes the most significant part of the excise duties levied on energy in Sweden and has been successively increased since its introduction in 1991. The objective of the tax is to contribute to cost effective reductions of CO₂ emissions. The tax covers mineral oils, petrol and diesel, natural gas and LPG, coal and coke, as well as crude pine oil for energy purposes¹⁷. (Swedish Environmental Protection Agency, 2007).

Traditionally, the industry has only paid 21 percent of the CO₂ taxes. However, since the Swedish participation in the EU ETS on January 1 2005 there have been some changes. As of July 2008, exemptions from the CO₂ tax have been granted to industries included in the EU ETS with 85 percent, for the use of other fuels than petrol and highly taxed oil dur-

¹⁷ Peat is considered to be a biofuel and is, therefore, not charged with the CO₂ tax.

ing the production process. CO₂ tax exemptions are also granted with 85 percent for fuel which is used in production of heat from combined heat and power (CHP) plants.

Furthermore, CO₂ tax exemptions of 6 percent for fuel that are used for other heat production than the one mentioned above. This applies to heat production where the heat is not used in the industrial production process. CO₂ tax rates and developments are shown in Error! Reference source not found.

7.1.2 Sulphur dioxide tax

The Swedish sulphur dioxide tax was introduced on mineral products in 1991. The objective of the sulphur dioxide tax has been to shift the oil consumption towards low-sulphur oil. It is only levied on the fuel categories with the highest sulphur content; heavy fuel oil, coal and peat. Oil with less than 0.05 percent sulphur content is exempt from the tax, and the tax is capped at a maximum tax rate equivalent to 0.2 percent sulphur content. For coal, the sulphur tax is based on the weight of the sulphur in the fuel. The environmental classes of fuel oil are:

- MK 1¹⁸: <0.001 percent sulphur by weight
- MK 2: <0.005 percent sulphur by weight
- MK 3: <0.02 percent sulphur by weight

Since the introduction of the sulphur tax in 1991, the tax rate has remained constant at 30 SEK/kg sulphur for solid fuels and 27 SEK/kg for each thousandth of sulphur content by weight in oils (Skatteverket, 2008).

Fuels used for manufacturing lime, stone and cement, and in soda boilers in the pulp and paper industry are wholly exempt from the tax. Diesel and heating oils used for shipping, trams and railways, and aviation fuel are also exempt from the tax. It is possible to receive a refund of the tax if sulphur emissions are limited by treatment or if the sulphur is to some extent fixed (Swedish Environmental Protection Agency, 2007).

7.1.3 Nitrogen oxides charge

Sweden introduced a charge on nitrogen oxide emission in energy production at stationary combustion facilities in 1992 (Law 1990:613). The NO_x charge is a complement to emission limits set in operating permits. The main aim of the charge was to combat acidification and reduce emissions beyond the emission limits.

As of 1997, the charge covers combustion plants generating more than 25 GWh/year. A further criterion for liability to the charge is that the energy produced is used to heat buildings, to generate electricity or in

¹⁸ MK = Miljöklass, English translation = Environmental Classification,

industrial processes. The initial charge introduced in 1992 was SEK 40 per kilo of nitrogen oxides emitted, calculated as nitrogen dioxide. On January 1, 2009 this charge was raised to 50 SEK/kg (Proposition 2007/08:153).

All proceeds from the tax are paid back to the plants based on the amount of energy utilized. This means that plants with low emissions compared to the energy production are net receivers of funds, while plants with high emissions in relation to energy production are net payers.

7.1.4 Energy tax

The Swedish energy tax comprises in turn two kinds of taxes; (1) Selective sales taxes on fuels and (2) Taxes on electric power. Both kinds of taxes have been designed to take account of energy and environmental policy and fiscal considerations.

Sales taxes on fuels

The sales tax on mineral oil (including Heavy Fuel Oil (HFO), Light Fuel Oil (LFO) and kerosene) and coal was introduced in 1957. The scheme was extended in 1964 by extending the tax to LPG and in 1985 by inclusion of natural gas (Swedish Environmental Protection Agency, 2007). Fuel tax is levied according to volume. However, there are exceptions for LPG, coal-based fuels and petroleum coke, which are taxed by weight. The fuel tax rate is differentiated by dividing products into environmental classes, and by taking account of the use of the fuel.

In 1991 the energy taxation scheme was restructured and the energy tax was lowered, principally as a consequence of the introduction of the CO₂ tax (TemaNord, 2006). Since then, the energy tax has successively increased due to growing attention to the damaging effects of fossil fuel consumption to the environment.

Fuel sales and CO₂ tax rates

Table 7.1 shows the development of Energy and CO₂ taxes during 2006–2009.

Table 7.1 – Fuel sales and CO₂ tax rates for different energy sources 2006–2009

	Tax	2006	2007	2008	2009
Light fuel oil SEK/litre	Energy	0.739	0.75	0.764	0.797
	CO ₂	2.623	2.663	2.883	3.007
	Total	3.362	3.413	3.647	3.804
Heavy fuel oil (MK1) SEK/litre	Energy	1.042	1.057	1.277	1.332
	CO ₂	2.623	2.663	2.883	3.007
	Total	3.665	3.72	4.16	4.339
Heavy fuel oil (MK2) SEK/litre	Energy	1.286	1.306	1.53	1.596
	CO ₂	2.623	2.663	2.883	3.007
	Total	3.909	3.969	4.413	4.603
Heavy fuel oil (MK3) SEK/litre	Energy	1.609	1.633	1.663	1.735
	CO ₂	2.623	2.663	2.883	3.007
	Total	4.232	4.296	4.546	4.742
Natural Gas for transportation SEK/litre	Energy	0	0	0	0
	CO ₂	1.116	1.133	1.282	1.337
	Total	1.116	1.133	1.282	1.337
Natural Gas for other use SEK/litre	Energy	0.239	0.243	0.247	0.258
	CO ₂	1.965	1.994	2.159	2.252
	Total	2.204	2.237	2.406	2.51
LPG for transportation SEK/kilo	Energy	0	0	0	0
	CO ₂	1.357	1.378	1.584	1.652
	Total	1.357	1.378	1.584	1.652
LPG for other use SEK/kilo	Energy	0.145	0.147	0.15	0.156
	CO ₂	2.759	2.801	3.033	3.164
	Total	2.904	2.948	3.183	3.32
Coal SEK/kilo	Energy	0.315	0.319	0.325	0.339
	CO ₂	2.282	2.317	2.509	2.617
	Total	2.597	2.636	2.834	2.956

Source: Skatteverket 2008 and Skatteverket, 2009

The following tax exemptions exist for the tax on fuels:

Table 7.2 Fuel tax exemptions

Purpose	Non-exempt fuels	Degree of exemption from	
		Fuel tax	CO ₂ tax
Use for purposes other than as motor fuel or for heating or in process where the fuel is essentially used as motor fuel or for heating		100%	100%
Use for the manufacture of mineral oil products, coal-based fuels, petroleum coke or other products for which the manufacturer is liable to tax		100%	100%
Use in the manufacture of taxable electric power, subject to certain limitations	High-taxed oil	100%	100%
Use in metallurgical processes	Fuels except for coal-based fuels and petroleum coke	100%	100%
Use for purposes other than operation of motor vehicles in a manufacturing process in industrial operations	Petrol, raw tall oil, high-taxed oils	100%	79%
Use in a manufacturing process in mining operations for operation of motor vehicles other than automobiles, trucks and buses	Fuels except for high-taxed oils	100%	79%

Note: High-taxed fuels are heating oil, diesel fuel oil, paraffin etc without added marking agents and producing at least 85% distillate by volume at 350°C

Source: Swedish Environmental Protection Agency, 2007

Excise duties on transportation fuels have been used in Sweden since 1924 when a tax on petrol consumption was introduced. Two different tax rates for leaded and unleaded petrol have been introduced in order to offer an economic incentive to choose the least harmful type of petrol. When the CO₂ tax scheme entered into force in 1991, transportation fuels were also included in this tax scheme. Companies are not given a rebate on the CO₂ tax when the fuel is used for transportation purposes.

Table 7.3 Energy tax and carbon dioxide tax on transportation fuels (SEK per litre)

		2006	2007	2008	2009
Petrol (MK 1) SEK/litre	Energy	2,86	2,9	2,95	3,08
	CO ₂	2,13	2,16	2,34	2,44
	Total	4,99	5,06	5,29	5,52
Petrol (acrylate) SEK/litre	Energy	1,28	1,3	1,32	1,38
	CO ₂	2,13	2,16	2,34	2,44
	Total	3,41	3,46	3,66	3,82
Petrol (MK 2) SEK/litre	Energy	2,89	2,93	2,98	3,11
	CO ₂	2,13	2,16	2,34	2,44
	Total	5,02	5,09	5,32	5,55
Diesel (MK 1) SEK/litre	Energy	1,042	1,057	1,277	1,332
	CO ₂	2,623	2,663	2,883	3,007
	Total	3,665	3,72	4,16	4,339

Source: Skatteverket, 2009

Biofuels from vegetable or animal oils are exempt from tax if the consumption is for space heating or as vehicle fuel (Swedish Environmental Protection Agency, 2007).

Electrical power consumption tax

The tax on consumption of electrical power was introduced in June 1951 and includes electrical power consumed in Sweden, whether it is produced domestically or imported. Since 2004 industry pays 0,5 öre/kWh but can still opt for a zero electricity tax when they are participating in the voluntary Programme for Improved Energy Efficiency (PFE) and by taking actions to reduce electricity consumption as well as electricity used in chemical, electrolytic, metallurgic and mineral processing. Electric power that is exported and consumed abroad is not taxable.

Table 7.4 Electricity tax (SEK öre/kWh)

	2006	2007	2008	2009
Electricity tax, general	26.1	26.5	27	28.2
Electricity tax, general reduced	19.4	20.1	17.8	18.6
Electricity tax, industry	0.5	0.5	0.5	0.5

Source: Skatteverket 2009a

The reduced electricity tax rate applies to users in a number of Northern municipalities. These are: Norrbotten, Västerbotten and Jämtland regions – all municipalities; Västernorrland region – Sollefteå, Ånge and Örnsköldsvik municipalities; Gävleborg region –Ljusdal municipality; Dalarna region – Malung, Mora, Orsa and Älvdalen municipalities and; Värmland region – Torsby municipality.

Thermal power output tax

Sweden also has a separate Tax on Thermal Power Output of Nuclear Power Reactors (Act 2000:466). In 2006, the tax was raised from SEK 5,514 per megawatt and month to SEK 10,200 per megawatt and month. The tax was then raised again in 2008 to 12,648 per megawatt and month (Swedish Environmental Protection Agency, 2007 & Skatteverket, 2009).

7.1.5 Tax differentiation

As has been partly explained above, energy taxes in Sweden are not levied in a uniform manner but include several instances of tax differentiation.

- Motor fuels have been environmentally classified in Sweden since the early 1980s. This classification is made on the basis of a number of parameters, such as maximum sulphur content, density etc., for the various environmental classes of petrol and diesel in the Exhaust Gas Treatment and Fuels Act, and a table showing the various tax rates in the Energy Tax Act. The higher environmental class is called MK 1 (Environmental class 1) (Skatteverket, 2009 and Swedish Environmental Protection Agency, 2007).
- The northern municipalities listed above have been charged with a reduced electricity tax scheme since 1981. In 1998, the electricity tax scheme was further refined when the tax rates were further differentiated according to high and low consumption, leaving large consumers with a higher tax rate than smaller consumers (Skatteverket, 2005a).
- In addition to the general tax exceptions applicable to industry, agriculture, forestry, and fisheries, energy-intensive industries can receive further tax reductions (24 percent of the excise duties actually paid) if the CO₂ tax burden paid by the company exceeds 0.8 percent of the value of sales. If the CO₂ tax payment exceeds 1.2 percent of the value of sales, the company receives a full refund of the share of the CO₂ tax exceeding 1.2 percent (Law (1994:1776) with 2004 revisions).
- Peat is exempted from energy and CO₂ tax even if the burning of it releases CO₂. Emissions from peat burning are included in the emission trading system.

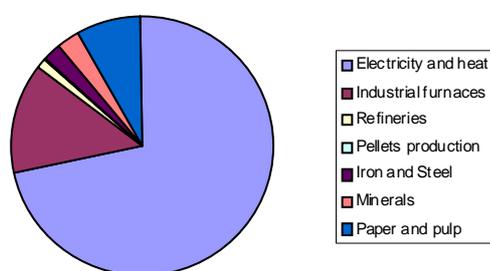
7.1.6 CO₂ emission trading system

Sweden has been included in the EU ETS since the beginning of the scheme in 2005. During the first trading phase (2005–2007) Swedish industries were allocated allowances equivalent to 22.6 million tonnes carbon dioxide per year. This amount was distributed among 719 Swedish installations, all listed in the first National Allocation Plan (NAP). The principle used to allocate the allowances within Sweden is also detailed in the NAP, whereas the overall methodology is set out in the EU Directive (2003/87/EC).

During the first trading phase most of the allowances were given to a few installations. The 40 installations with the largest number of allowances accounted for almost 80 percent of the total allocation. In addition to the allowances distributed, there was a New Entrants Reserve (NER) for new installations.

The industries faced with external competition received relatively more allowances compared with the energy producing sector. The energy producing sector has been allocated 80 percent on average, meaning that they have received allowances that cover approximately 80 percent of their expected emissions.

Share of each type of industry in ETS



Share of total allocation in Sweden

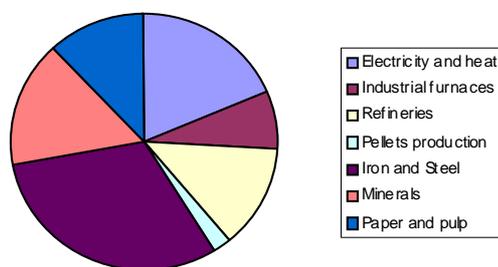


Figure 7.1 Share of each type of industry in ETS and share of total allocation in Sweden

During the second trading period 2008–2012, the EU ETS has been slightly modified. For example, more installations have been included due to a different definition of combustion installations. In Sweden this implies that

another 35 installations are included in the trading scheme during the second trading phase. In Sweden, most energy producing installations that are connected to a district heating system are included in the scheme, despite the fact that each of them is often smaller than 20 MW.

In the second trading phase, the Swedish government has decided that the energy producing sector should not receive any allowances free of charge. This implies that these installations will have to buy allowances to cover their emissions. This will in the end have effects on the power price, since most of the added cost for energy producers will be passed on to consumers.

7.1.7 Environmental subsidies, certificates and tax reliefs

A whole range of different environmental subsidies, certificates and tax reliefs related to renewable energy sources are available in Swedish energy policy.

- Green certificates in Swedish electricity production have been in use since 2003. The certificate system regulates how much renewable electricity that should be produced annually to meet set long term targets. Producers are required to hold certificates corresponding to its production and sale of electricity from renewable sources during the year. Certificates are handed out to producers based on the amount of electricity produced from renewable sources and can be re-sold (Regeringskansliet, 2006).
- Tax relief for installation of biofuels unit serving as main heating source in new houses and for installation of energy efficient windows in existing houses was applied between January 1, 2004 and December 31, 2008. The financial frame was 250 million SEK. The tax relief was 30 percent of the cost exceeding SEK 10,000, the maximum relief granted being SEK 15,000 per house.
- KLIMP (Local climate investment programmes); The idea with KLIMP (successor of the preceding Local Investment Program (LIP)) is to award grants for projects yielding the maximum possible effects to 2050 in relation to the amount of funding, in terms of lowering greenhouse gas emissions, energy transition and energy saving (Swedish Energy Agency, 2007). The Swedish Environmental and Protection Agency has during the duration of the program (2003–2008) awarded SEK 1.8 billion to 126 climate investment programmes and to 23 individual activities. The Swedish government has, however, decided not to continue the program after 2008 (Swedish Environmental Protection Agency, 2009).
- Grants for launch of energy efficient technologies. The aim is to accelerate the market launch of new and existing energy efficient technology. The maximum market launch grant is 25 percent of

certain specified costs. (Swedish Environmental Protection Agency, 2007).

- Financial support for wind power, including environmental bonus. Two specific measures for the development of Swedish wind power were adopted as part of the Energy Policy Bill (2001/02:143, bet. 2001/02:NU3, rskr. 2001/02:113). These are the market launch support for wind power and operating support for wind power, known as the “environmental bonus”(Swedish Environmental Protection Agency, 2007). The market launch support was introduced in 2003 with the budget of SEK 350 million over five years. The support was then prolonged for another five years (2008–2012) when the government accepted the wind power proposition (Prop. 2005/06:143, bet. 2005/06:NU21, rskr 2005/06:362) and was allocated another SEK 350 million (Swedish Energy Agency, 2007).
- Programme for Improved Energy Efficiency (PFE); The PFE (introduced in 2005) is directed towards manufacturing companies that are energy-intensive, use electricity in their production processes and may be presumed to be able to implement the measures required by the programme. The aim is to cost-effectively reduce greenhouse gas emissions.
- Tax relief for improved energy efficiency and conversion in public buildings. During the years 2005–2008, owners of commercial premises used primarily for public purposes have been able to apply for tax relief on investments to improve the efficiency of energy use, or to convert to biofuel, district heating or a system using a geothermal/ground/lake heat pump. Investments to improve energy efficiency or conversion qualify for 30 percent tax relief up to a maximum of SEK 10 million per building, except for investments in solar cells, which qualify for 70 percent tax relief up to SEK 5 million per building. The original budget for the scheme was SEK 2 billion, of which SEK 100 million were earmarked for solar cells. The Government has since then decided to extend the scheme and allocated another SEK 500 million per year 2007–2008 (Swedish Energy Agency, 2007).
- Conversion grants for homes and related premises. The prime aim of giving grants (from 1 January 2006) for conversion from oil for heating purposes is to reduce greenhouse gas emissions and to make energy supply more secure by reducing Swedish dependence on imported oil. The aim of supporting conversion from electric heating is to reduce electricity consumption for heating purposes and help to reduce electricity demand during peak periods. Owners of residential properties and related premises are able to receive a grant of 30 percent of the cost of materials and labour up to a maximum of SEK 30,000 per apartment for conversion from direct electric heating to systems using district heating, biofuels or a geothermal/ground/lake

heat pump. If a solar heating system is installed at the same time, the owner can receive a maximum additional grant of SEK 7,500 per apartment. The grant for conversion from oil is no longer available (since March, 2007) while the grant for conversion from electric heating is available throughout 2010 (Swedish Environmental Protection Agency, 2007).

- Solar heating and solar panel grants. Since 2000 government grants have been available for the installation of solar heating systems in houses, apartment buildings and some other premises. The main aim of these grants is to promote new technologies (Swedish Environmental Protection Agency, 2007). From January 1, 2009 the previous support is abolished and a new solar energy support program is introduced (2008:1247). The support is based on the solar systems' calculated yearly generation and amounts to SEK 2.5 /kWh (maximum SEK 7,500 /apartment and SEK 3 million/ project (Boverket, 2009).

7.2 Water pollution

7.2.1 Water effluent tax

Swedish industrial users can be charged with wastewater pollution charges calculated as a function of trade effluent loads. No charge applies for agricultural use (TemaNord, 2006).

There is also a water pollution charge introduced in 1984 related to oil spills as a part of the Measures to Combat Water Pollution from Ships Act (1980:424). The size of the water pollution charge is fixed to take account of the extent of the discharge and the gross tonnage of the vessel and is intended to be preventative rather than to compensate for oil damage or fund measures preventing damage caused by oil.

7.2.2 Water abstraction charge

Swedish municipalities levy a charge for water supply and wastewater treatment combined in the "VA-avgift". This charge is applicable to both industry and households and consists of a variable and a fixed part. Charges vary between municipalities. In 2008, annual charges for domestic water and wastewater services in different municipalities ranged from SEK 2,370 to SEK 8,031 per year for a detached house (based on, a consumption of 150m³ per year). For an apartment in a block of 15 flats (based on an average consumption of 133m³ per year) charges for water supply and wastewater services ranged from SEK 1,322 to SEK 5,917 (SWWA, 2008).

7.3 Waste

To limit the environmental effects of waste treatment and augment resource efficiency, there are a number of economic and administrative instruments. Amongst the economic instruments there are taxes and charges, but also tax reliefs and subventions.

7.3.1 Landfill tax

To minimise waste disposal sent to landfill and to promote material recycling and energy recovery, Sweden introduced a landfill tax on waste in 2000 and has thereafter introduced a ban on deposal of sorted burnable (2002) and organic waste (2005)¹⁹ (Avfall Sverige, 2009). The tax is levied on waste transported to a facility where more than 50 tonnes of waste a year is landfilled or stored for more than three years and covers conventional as well as specific industrial waste sent to landfill (Swedish Environmental Protection Agency, 2007). Since its introduction, the tax on landfill has risen 74 percent and is today set at SEK 435/tonne. The waste depot is liable for the tax.

7.3.2 Incineration tax

On July 1, 2006, Sweden introduced an incineration tax on waste. The tax is calculated based on estimates of the waste's content of fossil carbon. The tax amount has remained stable since its introduction, and is adjusted to whether and how efficiently the incineration plant produces electricity. The tax is SEK 487/tonne waste for plants without electricity production and decreases gradually with electricity production. At 15 percent, the tax is SEK 83/tonne, at 20 percent SEK 76/tonne (Swedish Waste Management, 2009). It is proposed that this tax is removed from 1. January 2009.

7.3.3 Deposit-refund schemes

Sweden has a number of deposit-refund schemes operated by trade and industry organisations:

- The system for refillable cans and PET bottles was introduced in 1994. Today, around 90 percent of the 90 million refillable bottles sold in Sweden every year are collected and refilled. The refund is SEK 0.8 (excluding VAT) per bottle (Brewers of Sweden, 2009).
- Returpack has been responsible for non-refillable aluminium cans and PET bottles since 1984. Every year, more than 600 million refundable

¹⁹ There is in Sweden no laws governing the households' responsibility to sort and handle hazardous waste but most municipalities have included this in its administrative agreements. It is the municipality that has the responsibility to collect hazardous waste.

PET-bottles are sold in Sweden. 85 percent of these bottles are recycled. The Swedish government also levies a charge of SEK 0.035 per imported 33 cl can.

Table 7.5 Deposit refunds for non-refillable cans and PET bottles (SEK per item)

Container	1984	1987	1995	2005	2006	2007	2008	2009
Aluminium cans (for recycling)	0.25	0.5		0.5	0.6	0.7	0.8	0.9
PET – small (for recycling)			1	1	1	1	1	1
PET – medium (for recycling)			2	2	2	2	2	2

Source: Returpack, 2009

7.3.4 Product taxes

Packaging charges

Sweden has had producer responsibility on packaging from 1997 and the legislation was updated in November 2006 with Regulation (2006:1273). This regulation stipulates that packages should be produced in an energy efficient way where the volume and weight is limited to a good safety and hygiene level. Producers are also responsible for arranging a system of collection and recycling connected to their operations and that waste should be handled in an environmentally friendly manner consistent with the Regulation. To finance these operation charges are imposed on certain packaging. These charges are based on the weight of the packaging.

Table 7.6 Packaging charges (SEK per kilo)

Packaging material	From July 2006	From January 2008	From January 2009
Metal (aluminium)*		0.6-1.2	0.45-0.75
Metal (steel-plate)		0.06	0.06
Metal (band and thread)			0.2
Card/Paper (liquids)		0.6	0.6
Card/Paper (other)		0.45	0.45
Card/Paper (industry)		0.02	0.02
Corrugated cardboard**		0.02-0.75	0.02-0.75
Plastic (company package)		0.45	0
Plastic (other)		200	125
Plastic (service)		180	113

* Charge varies according to sizes and includes steel thread (0.2 SEK/kilo)

** Charge varies according to product and use

Source: Repa, 2009

Batteries

Collection of batteries began in Sweden in the 1970s. A system of charges was introduced in 1990 and then updated in 1998 (1997:645). On September 26, 2008, a new battery directive was introduced in the European Union: Den (2006/66/EG). The directive should enhance and harmonise the handling of batteries in Europe. The directive is implemented in Swedish law through a new Regulation on batteries as of January 1, 2009 (2008:834). The new regulation includes all types of batteries, introduces producer responsibility and stipulates that all batteries should be recycled.

It also introduces stronger requirements for the labelling of batteries. Producers of nickel-cadmium batteries shall pay a charge of SEK 300/kilo that the producer releases to the market. The charges are collected in a battery fund that is used to cover society's costs for collecting, sorting, transporting and recycling the batteries. Financial means from the fund can be used to compensate a commune or a producer that bear any of these costs (Swedish Environmental Protection Agency, 2009).

Car tyre charge

In 1994, the Swedish tyre industry set up “Svensk Däckåtervinning AB” (SDAB) (the Swedish Tyre Recycling Organisation). The main task of SDAB was to participate in the process that led to the Directive concerning manufacturers' liability for used car tyres (1994:1236). In 2003/2004, SDAB introduced a physical collection system for the tyres and tyre charges were raised. In 2007, charges were raised again to the following rates:

Table 7.7 Charges per tyre (SEK)

Category of tyre	2003/2004	From July 2007
Category I	13	16
Category I R	8	10
Category II A	350	425
Category II B	800	1000
Category III	80	100

Source: NCM 2006 and <http://www.svdab.se/>

End-of-Life Vehicles (ELV)

In Sweden, there was a deposit-refund system for ELVs from 1975 until June 2007 where car owners were given SEK 4,000 per ELV when returning it. The system was then abandoned in accordance with the EU directive for ELVs which introduced in Swedish legislation by Regulation (2007:185). The EU Directive includes a recycling target of 85 percent from 2006 and 95 percent from 2015 (Swedish Environmental Protection Agency, 2009). Discussions of whether to re-introduce a deposit-refund system in Sweden for older cars are ongoing and have regained strength with the crisis in the Swedish car industry in early 2009 (DN, 2009).

7.3.5 Subsidies

In addition to the taxes and charges available in the Swedish system, it should also be mentioned that many waste handling stations and organic composts have been supported by the governmental support programs LIP and KLIMP (Swedish Waste Management, 2009).

7.4 Transport

7.4.1 Annual tax on vehicles

Sweden does not impose any registration taxes but levies an annual vehicle tax on cars, trucks, buses, motorcycles, tractors, motorised equipment and certain heavy-duty off-road vehicles and trailers if they are, or should be, entered in the vehicles register and have not been taken off the road (Swedish Environmental Protection Agency, 2007). The original aim of the tax was purely fiscal. It was introduced in 1922 to fund road maintenance and repairs necessary owing to damage caused by vehicles. Today the vehicle tax can be seen as a charge for the right to use public roads (Skatteverket, 2009).

Taxes on cars of model year 2006 and newer, and cars qualifying for environmental class 2005 (electric and hybrid), is determined by the car's emissions of carbon dioxide. Tax on other cars depends on the fuel they use and their weight (heavier vehicles are taxed more heavily). Tax on petrol-driven cars averages around SEK 1,500 a year (Swedish Environmental Protection Agency, 2007)²⁰.

Diesel-driven cars are taxed more heavily than petrol-driven ones, the reason being that diesel fuel is subject to lower energy tax than petrol. Vehicle tax is lower on cars in certain rural areas. The Government has decided that diesel cars with low particulate emissions should qualify for an annual vehicle tax rebate.

The vehicle tax consists of two parts:

1. A base fee of SEK 360/year
2. A CO₂ component of SEK 15/gram on vehicles emitting over 100 gram CO₂/kilometre, calculated based on normal driving conditions. For diesel cars, the sum of the base fee and the CO₂ component should be multiplied with an environmental and fuel factor of 3.3. For cars that can use alternative fuels, the component is SEK 10/gram²¹.

If the vehicle is being used for the first time during 2008 or later, the environmental and fuel factor is 3.15. A deduction on the vehicle tax is made with 384 SEK per year in sparsely populated areas.

Before 1 October 2006, Sweden had a tax exemption during the first five years on cars, light duty vehicles or busses when those fulfilled the specification for environmental class "Electricity and Hybrid". This rule has now been abolished, but those vehicles that have already been granted the exemption will keep it.

²⁰ Specific tax rates can be found at www.skatteverket.se/fordon/fordonskatt.

²¹ Alternative fuels refer to ethanol, E85, natural gas or bio gas.

7.4.2 Road Charges

Since 1 February 1998, all domestic and foreign heavy goods vehicles (HGV) above 12 tonnes driving on Swedish roads are levied with a road charge as set out under the Eurovignette Directive (99/62/EC). The road charge for Swedish-registered trucks covers the entire road network and is payable annually. The vehicle tax on these vehicles is then reduced. The road charge for foreign vehicles is payable a year at a time for using motorways and certain trunk roads ("Europe Roads") that are not motorways. Charges depend on the size and environmental classification of the HGV (Swedish Environmental Protection Agency, 2007).

Table 7.8 Road Charges in SEK 2006-2009

Number of axles	Exhaust class	Annual road charge (SEK)			
		2006	2007	2008	2009
Two or three	Euro 0	8,743	8,743	8,743	9,337
Two or three	Euro 1	7,741	7,741	7,741	8,267
Two or three	Euro 2	6,831	6,831	6,831	7,295
Four or more	Euro 0	14,117	14,117	14,117	15,076
Four or more	Euro 1	12,751	12,751	12,751	13,617
Four or more	Euro 2	11,385	11,385	11,385	12,158

Source: Skatteverket (2009) and Swedish Environmental Protection Agency (2007)

7.4.3 Congestion taxes

Stockholm has, as the first Swedish city, introduced congestion taxes intended to reduce congestion on the roads and streets in and around central Stockholm, and reduce emissions of pollutants that are harmful to health and the environment. The tax also has a fiscal purpose since most of the revenues are intended for investment in public transport (Swedish Environmental Protection Agency, 2007). Trials with the system started in August 2005 and the Government proposed that the system should be permanent in the spring of 2007 after the system was evaluated through a city referendum in 2006 (Swedish Energy Agency, 2007). Different taxes are levied on different hours of the day and are governed by law in (2004:629) and Regulation (2004:987). Newly registered environmentally friendly cars²² are no longer exempt from the tax (as from at January 1 2009) while already registered environmentally friendly cars have the exemption until August 1, 2012. Congestion tax expenses can be deducted in people's declaration for income tax payments, thus potentially reducing some of the impacts of the tax on peoples' driving behaviour.

²² Environmentally friendly cars are in this case those that have the technology for driving at least partly on electricity or gas other than liquefied petroleum gas, or those that can use a fuel combination based on alcohol.

7.4.4 *Environmental shipping lane dues and environmental landing charges*

The following dues and charges exist:

- Shipping lane charges were revised at the end of 2004 to increase the economic incentive for reducing emissions of sulphur and nitrogen oxides. Ships that only use bunker fuel having a sulphur content not exceeding 0.5 or 1.0 percent by weight qualify for discounted shipping lane dues. According to the Swedish Maritime Administration, the environmentally differentiated shipping lane dues relating to NO_x emissions from shipping have accelerated the introduction of nitrogen removal on board ship. (Swedish Environmental Protection Agency, 2007).
- Exhaust gas-related landing charges were introduced at Swedish state-owned airports in 1998. The charges scheme was modified in 2004. The charges are largely dependent on the volume of nitrogen oxides emitted by individual aircraft, although some account is also taken of hydrocarbon emissions. Charges for nitrogen oxides are based on estimates of the environmental costs the emissions cause (Swedish Environmental Protection Agency, 2007).

7.4.5 *Grants and subsidies*

The following grants and subsidies could be mentioned:

- Public transport is subsidised to make it more competitive and to achieve the aims of Swedish transport policy, including the environmental factor. Subsidies vary on an annual basis and depend on the profitability of the transport.
- Transport grants have been introduced in continuance of regional policy aims and are paid for road, rail and lake transport undertaken by companies in certain industries in the four northernmost counties in Sweden (Swedish Environmental Protection Agency, 2007).
- Grants available for biofuel stations. All larger petrol stations are since the spring of 2006 required to offer at least one renewable fuel. SEK 70 million had been granted as per December 2008 to 71 stations. Another SEK 75 million remains to be distributed during 2009/2010 (Swedish Environmental Protection Agency, 2009).

7.5 *Agriculture and natural resources*

7.5.1 *Agriculture*

- The agricultural support to Swedish farmers is extensive and has a great influence on the environmental impact of agriculture. The new

Swedish rural program ²³, 2007–2013, is financed by the EU and Swedish government. The program includes support for rural development, environmental improvements and support for improved competition strength in agriculture, gardening, ecological and cultivation. The program includes SEK 35 billion, i.e. SEK 5 billion annually (Swedish Energy Agency, 2007).

- Fertiliser tax: Sweden introduced a fertilizer tax on nitrogen (N) and phosphorous (P) and a price regulation charge in 1984. These two instruments worked in parallel until 1992 when the price regulation charge was abolished and the fertiliser tax based on the phosphorous content was replaced with a tax on cadmium. The primary aim of the tax on nitrogen in fertiliser is to reduce the environmental damage caused by the leaching of nitrogen to groundwater. The objective of the cadmium charge is to provide some incentives to use more effective abatement technology. The rates have remained stable since 1994 and are currently SEK 1.80 per kg of nitrogen (if the fertiliser contains more than 2 percent nitrogen) and SEK 30 per gram of cadmium if the cadmium content exceeds 5 gram per tonne phosphorous (Skatteverket, 2009).
- Pesticide tax: The purpose of the tax is to reduce the use of pesticides and thereby the health and environmental risks. The tax is intended to fund certain activities, such as advisory services, research and development on ways of reducing pesticide use. The rate of the tax on pesticides, which was initially introduced in 1984 (Law 1984:410), is currently SEK 30 per kg of active substance.

7.5.2 Forestry

The following grants are available within forestry: Grants for planting of energy forest on arable land (available since 1990 and lowered to SEK 5,000/ha when Sweden joined the EU); Support for growing energy crops, Grants for conservation of nature and cultural heritage and for Deciduous forestry (Swedish Environmental Protection Agency, 2009).

7.6 Outstanding propositions

The use of Economic Instruments in Swedish policy is in constant development. Some of the most pertinent proposed changes that are currently discussed are:

- Climate and Energy Policy: The Swedish Government is currently discussing a holistic climate and energy policy in two propositions. The propositions suggest a target of 40 percent reductions in

²³ Swedish translation: "Det nya svenska landsbygdsprogrammet".

emissions of greenhouse gases and a program to reach the target. They also include three action plans for a transport sector independent of fossil fuels, for the promotion of renewable energy and energy efficiency. This proposition also includes a suggestion to remove the incineration tax on waste based on a recent evaluation of the tax (<http://www.regeringen.se/sb/d/108/a/121335>).

- **Sea Protection Policy:** To protect the seas in a holistic manner, the Swedish Government has also developed the proposition “A Swedish Sea Policy”. This Proposition includes several different measures to uphold and restore the ecosystems of the seas (Prop. 2008/09:170, <http://www.regeringen.se/sb/d/108/a/122726>)

8 Summary and cross-country comparison

An overview of the use of economic instruments in the Nordic countries can be found in the table below.

Table 8.1 Overview of the use of economic instruments in the Nordic countries in 2009

	DK	FIN	IS	N	S
<i>Energy and air pollution</i>					
Excise tax on electricity consumption	X	X		X	X
Excise tax on fuel oil products etc.	X	X		X	X
Excise tax on transportation fuels	X	X	X	X	X
CO ₂ tax on fuel oil	X	X		X	X
CO ₂ tax on transportation fuels	X	X		X	X
CO ₂ emission trading energy intensive industries	X	X		X	X
SO ₂ tax	X			X	X
NO _x tax				X	X
Subsidy schemes for renewable energy, energy efficiency etc.	X	X		X	X
<i>Water pollution</i>					
Water effluent tax	X				(X)
Water supply tax	X				
<i>Waste</i>					
Tax on waste put on landfill	X	X		X	X
Tax on incinerated waste	X			X	X
Taxes, deposit-refund systems or other collection systems on beverage containers/packaging	X	X	X	X	X
Taxes on other packaging	X				X
Charges to finance collection and treatment, or deposit-refund systems for products: ELVs batteries, tyres, lubrication oil or pesticides	X	X	X	X	X
Tax on GHGs (industrial gases)	X			X	
Tax on PVC, phthalates and chlorinated solvents	X				
<i>Transport</i>					
Vehicle registration or sales tax	X	X	X	X	
Annual circulation tax	X	X	X	X	X
Environmental related or noise charges on aviation		X		X	X
Road congestion tax					X
<i>Agriculture and natural resources</i>					
Tax on extraction of raw materials	X				
Tax on pesticides				X	X
Tax on fertilizer use	X				X
Tradable fishing quotas			X		

Source: Econ Pöyry

It is not always easy to compare the countries' use of economic instruments, since there are many different designs when it comes to tax base, exemptions, rates etc. However, the following observations can be made regarding the use of economic instruments in the different countries:

- All countries except Iceland have excise taxes on electricity and fuel oil use. There are long traditions for these taxes in the countries in question.
- All countries have excise tax on transportation fuels. Also these taxes were implemented way back in time.
- All countries except Iceland also have CO₂ taxes on fuel oil and transportation fuels. These taxes were introduced in the early 1990s.
- All countries that have imposed excise and CO₂ taxes on electricity and fuel oil have exemptions and/or reduced rates for some energy intensive industries etc. to preserve their competitive position.
- All countries except Iceland have introduced CO₂ emissions trading to fulfil EU requirements. Denmark, Norway and Sweden have adjusted their CO₂ taxation schemes to avoid or reduce “double-taxation” of some emissions.
- All countries except Iceland have subsidy schemes for renewable energy, energy efficiency etc. There are various schemes in use. Sweden is the only country using a green certificate scheme to promote renewable electricity production.
- Denmark, Norway and Sweden have since the 1970s/1980s had an SO₂ tax on fossil fuels (Norway today only for fuel oils). These were among the first economic instruments introduced in environmental policy.
- NO_x taxes are imposed only in Norway and Sweden. While Sweden has had this tax for many years, Norway introduced its tax in 2007.
- Taxes on water pollution and supply is imposed only in Denmark (could eventually be used also in Sweden). However, all countries have water supply and waste water charges imposed on local level to finance water supply and treatment services.
- All countries except Iceland have waste landfill taxes, and Denmark, Norway and Sweden also have taxes on waste incineration.
- All countries have for years had some kind of taxes, deposit-refund schemes or other collection systems for refillable or recyclable beverage containers. Denmark and Sweden also have taxes on other packaging.
- All countries have introduced systems for collection and treatment of various products (batteries, ELVs, tyres etc.) when they appear as waste, mostly to fulfil EU requirements. For most of these systems producer responsibility is applied. All countries have imposed a charge on the sales of some of these products to cover the collection and treatment costs.
- Denmark and Norway has a tax on industrial GHG. Norway also has a refund system for products delivered as waste.
- Only Denmark has taxes on PVC, phthalates and chlorinated solvents.

- All countries except Sweden have vehicle registration or sales taxes on new cars. Most countries differentiate these taxes according to CO₂ emissions or fuel efficiency.
- All countries have annual circulation taxes on the ownership of cars.
- Finland and Norway has a noise charge on one airport, and Sweden has emissions-related landing charges.
- Only Sweden has a road congestion tax, which is a new, interesting policy instrument also with environmental implications.
- Only Denmark has taxes on extraction of raw materials and fertilizer use.
- Only Iceland has tradable fishing quotas.

It is hard to judge only from table 8.1 which country uses economic instruments most extensively in their environmental policy. Denmark, Norway and Sweden all have many instruments in use, with Denmark as the country with the broadest coverage.

9. How do the economic instruments work?

In this chapter we present some brief assessments of how the various economic instruments in the Nordic countries have worked, based mainly on recent evaluations or assessments we have been able to find in the respective countries (either in native language or in English). The previous report in the series (TemaNord, 2006) has evaluation of the functioning of economic instruments as a primary purpose, so our assessment here is deliberately limited in scope and focused on changes in the policy instruments since 2006. First we present some criteria for assessing environmental policy instruments.

9.1 Criteria for assessing environmental policy instruments

Environmental policy instruments include emissions taxes, tradable emissions allowances (“cap-and-trade”), subsidies for emissions reductions, performance standards, mandates for the adoption of specific existing technologies, and subsidies for research toward new, “clean” technologies. When choosing new policy instruments or assessing existing ones there are a number of criteria that are used. Below is a short overview of the most important ones, to a large extent based on Goulder and Parry (2008).

- **Cost effectiveness.** Minimizing the cost of reducing pollution by a given targeted amount requires equating marginal abatement costs across all potential options and agents for emissions reduction. In theory, these conditions are satisfied when all economic actors face a common marginal price for their contributions to emissions, achieved through an emissions tax or emissions trading (Baumol and Oates, 1971). In such circumstances, every emitter in every (emissions-producing) sector has an incentive to exploit all of its abatement opportunities until the marginal cost of reducing emissions equals the emissions price. Moreover, the cost of emissions control and the price paid for remaining emissions will be passed forward into the prices of final goods and services. Consequently, consumers will face prices reflecting the emissions associated with the production of the goods they buy or the services they use. Thus, their consumption choices will account for their contributions to emissions. Because all agents will be charged the same unit price for their direct or indirect contributions to emissions, the marginal costs of emissions reductions

of all agents will be equal. This will continuously spur emission reductions over time, often referred to as dynamic efficiency. The stronger condition of maximizing the efficiency gains from policy intervention implies a particular level for the emissions price, namely the one that equates the marginal benefits and costs of emissions reductions. In reality, environmental regulations are rarely comprehensive enough to apply a given emissions price to all economic sectors or agents.

- **Uncertainty.** Under emissions taxes, the price of emissions (the tax rate) is established at the outset. What is uncertain is the aggregate emissions quantity that will result after firms respond to the tax. In contrast, under pure emissions allowance systems, the aggregate emissions quantity is established at the outset by the number of allowances introduced into the market, while the emissions price is uncertain because it is determined by the market. Other instruments involve uncertainties about emissions prices, quantities, or both. Like an emissions tax, a tax on a good associated with emissions (for example, a gasoline tax) leaves the quantity of emissions uncertain. Direct regulatory policies leave uncertain the amount to which aggregate emissions will be reduced, although they may indicate limits on emissions at the facility or firm level. Direct regulatory policies also involve uncertainties as to the effective price of emissions; that is, the shadow price of emissions or the marginal cost of abatement implied by the regulations.
- **Administrative costs.** The costs of administering a pollution control program, particularly the costs of monitoring and enforcement, may often be important for the choice of policy instrument. In some instances, monitoring emissions is very costly or virtually infeasible. For example, it is extremely difficult, if not impossible, to keep track of “nonpoint” sources of water pollution caused by agricultural production. In circumstances where monitoring emissions is exceptionally costly, emissions pricing may lose its status as the most cost-effective option. Mandates for certain farm practices (like grassed water strips to limit chemical run-off, or lagoons and storage tanks to treat waste from large confined animal feeding operations) may be the most practical approach, as these can be monitored via satellite imagery or on-site inspections. And although an automobile’s tailpipe emissions could be taxed using information from periodic odometer readings and emissions per mile data from vehicle inspection programs, it is administratively much easier to impose emission per-mile standards on automobile manufacturers and/or tax the purchase of fuels and differentiate the vehicle purchase tax according to emissions.
- **Distributional impacts.** The distributional impacts of alternative environmental policy instruments can be considered across numerous

dimensions, such as regions, groups, or generations. Distribution of impacts from the policy instruments between owners of polluting or energy-intensive industries and other members of society (consumers, taxpayers, workers), and distribution across households of different incomes are often what that have had the greatest impact on the choice of policy instruments. Especially distribution of impacts between households and industry tends to be important, showing that command and control policy instruments like technology mandates, performance standards and permit systems with free allocation of allowances are far more common than emission taxes or fully auctioned permit systems (that follow the polluter pays principle). This is often said to be due to the considerable political influence these industries have on policy. Command and control policy instruments are also favoured because they to a lesser extent distort the companies' competitive position and avoid "leakage" (notably carbon leakage) of production to countries with weak or no policies compared to the use of economic instruments.

9.2 Key characteristics of environmental policy instruments

There are advantages and disadvantages with most environmental policy instruments. Below are some of the most important ones in connection with the most commonly used instruments.

9.2.1 Economic instruments

Emissions taxes

A tax on emissions gives emitters incentives to reduce their emissions until their marginal abatement costs equals the tax rate. An emission tax establishes a common emission price, since it imposes a single emissions price on all covered sources. Both the costs of abatement and the emissions price are reflected in higher prices of consumer products.

Tradable allowance system

Similar to a tax on emissions a system of tradable emissions allowances (or "cap-and-trade") gives emitters incentives to reduce their emissions until their marginal abatement costs equals the allowance price. This holds whether the allowances are initially distributed through an auction or by free allocation. All firms or facilities must justify their emissions by submitting allowances. An additional unit of emissions implies a cost equal to the allowance price, since it compels the agent either to purchase one extra allowance or to sell one fewer (and forgo revenue). If allowances are auctioned, both the costs of abatement and the allowance price are reflected in higher prices of consumer products as with an emissions tax. These cost are not fully reflected when allowances

are handed out for free. When the basis for free allocation is updated over time, i.e. the number of allowances received for free in the next period is dependent on the emissions in a previous period, the cost efficiency of the system is violated.

Taxes on inputs or goods associated with emissions

Another pricing instrument is a tax on an input, produced good or service associated with pollution. Taxes on gasoline, electricity or air travel are examples. These taxes may be an attractive option when it is difficult to monitor emissions directly. However, because these taxes do not focus sharply on the externality, they do not engage all of the pollution reduction channels described above, implying a loss of cost-effectiveness. For example, a tax on electricity lowers emissions by raising electricity prices, which lowers equilibrium demand and output; but it provides no incentives for clean fuel substitution in power generation or for the adoption of various “end-of-pipe” treatment. Similarly, although a gasoline tax might encourage motorists to drive hybrid or more fuel-efficient vehicles, it provides no incentives for them to drive cars that burn gasoline more cleanly, or for refiners to change the refinery mix to produce a motor fuel that generates less pollution when combusted.

Subsidies to pollution abatement

Still another potential emissions pricing instrument is a subsidy for pollution reductions, where firms are rewarded for every unit of emissions that they reduce below some baseline level. At the margin, this instrument provides the same incentives as emission taxes or cap-and-trade, since every additional unit of emissions implies a cost to the firm in forgone subsidy receipts. Thus, these subsidies can bring about the same choices for input intensities and end-of-pipe treatment as other emissions pricing policies. However, in practice such subsidies are less cost-effective than emissions taxes or tradable allowances. Since they lower firms' average costs, they provide the wrong incentives regarding the level of output, which leads to excess entry. As a result, to accomplish the same target emissions reductions as under the other two policies, regulators would need to make the marginal price of emissions (the subsidy rate) higher than under the other policies, leading to too much abatement from input substitution or end-of-pipe treatment, and too little from reduced output. This implies higher aggregate costs of achieving a given emissions target. Furthermore, funding the subsidies provides costs to the society through increasing taxes (for instance income taxes) causing distortions (for instance less labour supply) and put pressure on public budgets since the subsidies have to compete with funding for other purposes.

9.2.2 Direct regulatory instruments

Compared with emissions taxes and tradable emissions allowances, direct regulations are at a disadvantage in meeting the conditions for cost-minimization. The disadvantages reflect information problems faced by regulators as well as limitations in the ability of these instruments to optimally engage the various channels for emissions reductions.

Direct emission reduction requirements and/or technology mandates

This instrument has often been used towards industry emissions, requiring a special emission reduction, often based on technical requirements regarding the production process. The mandate may require, for example, that firms install equipment that implies a particular production method or using the best available technology (BAT). Given the heterogeneity among firms, it is extremely unlikely that a regulator would have enough information to set mandates that cause marginal costs of abatement to be equated across firms. If a single mandate is applied to all firms, cost effectiveness will be undermined to the extent that firms face different costs for meeting it (Newell and Stavins, 2003).

In addition, the technology mandate does not optimally engage all of the major pollution reduction possibilities. A technology mandate for end-of-pipe treatment generates no incentive to change the production mix towards cleaner inputs, while a mandate stipulating a particular input mix provides no incentive for end-of-pipe treatment.

Moreover, these policies do not optimally utilize the output-reduction possibilities. Although the price of the firm's output will reflect the variable costs of maintaining the new technology, it will not reflect the cost of the remaining pollution associated with each unit of output.

Technology mandates therefore do not cause firms to reduce pollution sufficiently through reductions in the scale of output. Thus, in order to achieve the overall emissions-reduction target, the regulator would have to require firms to press further on the input-substitution and end-of-pipe channels than would be necessary under emissions-pricing instruments.

Performance standards

Performance standards require that a firm's output meet certain conditions. Examples include maximum emission rates per kilowatt-hour of electricity, energy efficiency standards for buildings or household appliances, and fuel-economy requirements for new cars. Performance standards grant firms flexibility in choosing how to meet the standard. For example, car manufacturers can improve fuel-economy through their chosen combinations of reducing vehicle size, using lighter materials, changing car-body design, and advanced engine technologies. Because they offer greater flexibility, performance standards generally are more cost-effective than specific technology mandates.

As with technology mandates, performance standards fail to exploit optimally the output reduction channel. Again, firms are not charged for their remaining emissions, which implies lower output prices than under a comparable emission pricing policy, and over-reliance on reducing the emissions intensity of production either through input-substitution or post combustion (“end-of-pipe”) treatment. For example, automobile fuel economy standards do not exploit emissions reductions through incentives to reduce vehicle miles of travel (or vehicle “output”). A gasoline tax, in contrast, does provide such incentives. Moreover, cost-effectiveness generally calls for different performance requirements among firms with differing production capabilities. Regulators generally lack the information required to tailor the standards to individual firms. On the other hand, this problem could be addressed by allowing some firms to under-comply, provided that they buy credits from other firms that go beyond the standard.

Research and development (R&D) policies

Environmental improvements may require major technological breakthroughs. The emissions control policies previously discussed may be incapable of bringing about these breakthrough technologies since they provide invention incentives only indirectly – by emissions pricing or by raising the costs of conventional, “dirty” production methods through direct regulation.

The current literature does not single out any particular instrument as most effective in dealing with this problem.

No single policy instrument is superior

Several general themes emerge from the discussion, including:

- No single instrument is clearly superior along all the dimensions relevant to policy choice; even the ranking along a single dimension often depends on the circumstances involved.
- Significant trade-offs arise in the choice of instrument. In particular, assuring a reasonable degree of fairness in the distribution of impacts, or ensuring political feasibility, often will require a sacrifice of cost-effectiveness.
- It is sometimes desirable to design hybrid instruments that combine features of various instruments in their “pure” form.
- For many pollution problems, more than one market failure may be involved, which may justify (on efficiency grounds, at least) employing more than one instrument.
- Potential interactions among environmental policy instruments are a matter of concern, as are possible adverse interactions between policies simultaneously pursued by separate jurisdictions.

The last three bullet points will be discussed further in Part II of this report, focusing particularly on pros and cons of the use of instrument mixes in environmental policy in the Nordic countries.

9.3 Brief assessment of the countries' economic instruments

This section presents some recent evaluations of the use of existing economic instruments in some of the Nordic countries. Only a limited number of evaluations for Finland, Norway and Sweden have been found. It is important to note and caution that it is generally difficult to observe and evaluate the full effect of new or changed instruments until a few years have passed.

9.3.1 Finland

Government report to parliament on climate and energy

The Long-term Climate and Energy Strategy, Government Report to Parliament of 6 November 2008 (Government Report, 2008) states that investment subsidies have been effective in promoting sustainable energy use in the forest sector. However, this has not been the case in the wind power sector according to the report. Since the beginning of 2006 wind power has only received subsidies for projects with new technologies. The present structure for decisions on investment subsidies does not enable efficient decision making for large wind power projects. In order to stimulate a shift to renewable energy usage, the current support and steering systems will be intensified and structures changed.

A recent study of environmental taxes

In a Master Thesis at the Helsinki School of Economics (Helsinki School of Economics, 2008) some environmental taxes in the Finnish environmental policy are evaluated. Some important conclusions are:

- The tax refund for natural gas is on the one hand an effective instrument to encourage energy producers to use gas, but on the other hand it weakens the competitiveness of less polluting options.
- The waste tax is meant to be an incentive to reduce the amount of waste that ends up in landfills. However, the tax is not applied to private or industrial landfills. This weakens the effectiveness of the tax system as a whole. Environmental impacts of the waste tax are very difficult to evaluate. The waste tax was initially designed and implemented inadequately and the tax rate has been set far too low to have any significant impact on emissions.
- The previous minimum and maximum rates that were set to the passenger car registration tax system weakened the positive

environmental effects of the taxation. However, the new registration tax has been effectively designed and guides consumers to buy less polluting cars.

Ministry of the Environment assessment of waste tax effectiveness

The Ministry of the Environment assessed the effectiveness of the waste tax in Finland in a report published in 2005, see Ministry of the Environment (2005). The report indicates that in spite of increasing consumption, waste taxation has led to reduction of the amounts of waste ending up in public landfills. Reductions have particularly been significant for construction, commercial and industrial wastes. However, taxation has not been as effective in terms of limiting household waste. Finland's beverage packaging taxation system has effectively encouraged consumers to return used drinks packages.

9.3.2 Norway

In 2007 a public assessment group ("Særvavgiftsutvalget") evaluated among other things the environmental taxes levied by the state, see NOU (2007). Below are some of their main conclusions as well as our own assessments of the recent changes in the tax system.

The emission trading and CO₂ tax systems

When the CO₂ emissions trading system was implemented in 2005–2007 great emphasis was put on avoiding CO₂ taxation of the emissions covered by the trading system. This was followed up when implementing the current trading system from 2008, with the exception of emissions from the oil installations on the continental shelf. While the CO₂ tax for these emissions was reduced from 2008 when the trading system was implemented, there are now two economic instruments directed towards these emissions. Thus, when allowance prices are high there is a higher price on CO₂ emissions from this sector than from other emission sources. This could lead to implementation of relatively expensive abatement measures on the continental shelf, which is not cost effective.

However, this has its parallel in the taxation of CO₂ emissions from land based sources, which varies between NOK 92 and NOK 363/ton CO₂, see table 6.3. In NOU (2007) it is recommended that all emission sources not subject to emissions trading are either included in the trading system or included in the CO₂ tax system. The CO₂ tax should in principle be the same as the international CO₂ allowance price, and similar for all sources. However, in practise this may be very difficult to achieve since the allowance price in EU ETS has varied dramatically over time.

In our view the main reason for both using tax and emissions trading for emissions from the continental shelf is that the authorities do not want to reduce the tax burden on the very profitable petroleum sector, and have

therefore chosen to maintain a reduced CO₂ tax. This could have been solved by increasing other taxes, thus avoiding stimulating costly emission reductions in this particular sector.

NOx tax

This tax was imposed from 2007 on larger emission sources, but could be avoided by instead contributing to an investment fund for measures to reduce emissions. While this could be criticized for not being an economic instrument spurring cost effective emissions reductions from all sources, it could be said that a fund would have incentives to implement the cheapest abatement measures to fulfil Norway's obligations under the Gothenburg protocol. Thus, it could be seen as a pragmatic solution where the concerns for the costs and competitive position of several emission sources and a cost efficient approach towards emission reductions have both been fulfilled to some extent.

The electricity and general mineral oil taxes

As emphasized in NOU (2007) the purpose with these taxes are unclear, as they could either have a fiscal or an energy policy purpose. They can hardly be seen as environmental policy instruments, since the electricity tax is imposed on all electricity consumption regardless of environmental damages, and the mineral oil tax is not levied on fuels according to emissions.

To us it seems that the purpose is mainly fiscal. If so, all industry sectors should be exempted from the taxes, and all households should pay the same rates (NOU, 2007). If the taxes are imposed for energy policy reasons, the purpose should according to NOU (2007) be further elaborated and the taxes designed accordingly. It has been a political goal to reduce and gradually phase out the use of fuel oil, and the mineral oil tax could also be seen in the light of this, although this is not stated as a goal for the tax.

The design of the registration tax and annual excise duty

As described in chapter 6 the registration tax was redesigned from 2007, putting more emphasis on taxing high CO₂ emissions and thus favouring low emission vehicles. The Government intends to further differentiate the tax system in the years to come to spur the purchase of low emission vehicles.

This transformation of the tax system resulted in average emissions from passenger cars dropping from around 175 g/km in 2006 to 158 g/km in 2007, and this average has stayed at that level since. The new tax system also facilitates a more environmentally correct treatment of for example hybrid and electric vehicles. This is an example of an environmentally benign design of a fiscal tax, which would spur the introduction of low CO₂ emissions cars into the Norwegian car fleet. NOU (2007) recognizes this, and points out that the tax has favourable income distribution effects

through heavy taxation of luxury cars. However, it claims that since purchase of cars has rather high price and income elasticities, the distortionary impacts of this fiscal tax could be large. Therefore NOU (2007) recommends that the tax level is reduced, but that the differentiation is kept.

The registration tax change also resulted in an increase in the sales of diesel vehicles, so that the share of diesel cars of new vehicles registered is today around 73 percent (www.ofv.no). This has led to concern about increased emissions of particles, since relatively few new diesel vehicles have installed particle filters. Emissions of particles could be harmful to human health in larger concentrations which could occur in the larger cities. Partly to spur purchase of diesel vehicles with particle filter the annual excise duty has been differentiated since 2008 among cars with and without particle filter. However, this differentiation is modest and is likely to have little or no impact on consumers' choice, since the extra costs of purchasing a diesel car with particle filters amounts to several thousand NOK, while the annual tax reduction amounts to some NOK 445 in 2009. Still, the differentiation of the annual tax, which is levied for fiscal purposes, is in our view a transformation in the right direction to signalize that particle filters in diesel cars are highly desirable.

9.3.3 Sweden

This section is primarily based on the report from the Swedish Environmental Protection Agency (Naturvårdsverket), "Economic instruments in environmental policy" (Swedish Environmental Protection Agency, 2007). The report reviews existing economic instruments in the environmental field and summarises and refers to almost 200 evaluations/follow-up studies on environmental economic instruments. Particular emphasis is given to 4 environmental objectives: (1) Reduced Climate Impact, (2) A Non-Toxic Environment, (3) Sustainable Forests and (4) Zero Eutrophication. The analysis is also linked to the three action strategies: (1) More efficient energy use and transport; (2) Non-toxic and resource-efficient cyclical systems; and (3) Management of land, water and the built environment.

The evaluations analysed by the Swedish Environmental Protection Agency do not only evaluate the environmental impact of environmental policy but also distributional considerations. Traditionally, a large share of the costs of environmental policy is borne by low income groups. However, the evaluations collected by the Swedish Environmental Protection Agency point out that by raising the personal allowance in the green tax shift, Sweden has managed to neutralise some of the redistributive effects regionally and also between households. In addition, although the green tax shift has been fiscally neutral, statistical analysis shows that, on average it has had a positive effect on the disposable incomes of virtually all households (Ministry of Finance, 2003).

Reduced climate impact

The Swedish system encompasses many economic instruments aimed at reducing climate impact. Evaluations show that amongst these instruments, multi-sectoral taxes, such as the carbon dioxide tax, are the instruments with the greatest potential for influencing behaviour in the interests of sustainability. Grants and tax relief are generally believed to be less effective in the long term (Swedish Environmental Protection Agency, 2004).

It has also been concluded that the present energy tax system is a more effective means of reducing carbon dioxide emissions than the system existing in 1990. According to recent evaluations, emissions of carbon dioxide have fallen substantially compared with the reduction that would have been achieved if the 1990 energy tax regime had remained in place. Industrial emissions are, however, believed to be somewhat higher with the current reduced-rate carbon dioxide tax than they would have been under the 1990 energy tax regime (The Swedish Energy Agency, 2006). Fuel taxes have also had a positive environmental impact although the original aim of these instruments is primarily fiscal. Carbon dioxide emissions from cars are estimated to have fallen by 1.5 – 3.2 Mtonnes/year (2005) as a result of the motor fuel tax rises imposed since 1990. The fuel tax can also be considered to be relatively cost-effective as an instrument, since differentiating the tax according to environmental classes may be justified for environmental reasons. However, their cost-effectiveness is diminished by the exemptions for certain industries. Finally, the fuel tax is a dynamically efficient instrument, since it encourages technological development of more fuel-efficient products (Swedish Environmental Protection Agency, 2007).

The electricity tax can also be viewed as reaching its goal but is only cost-effective within industries and regions, not between them. This is because it cannot be regarded as cost-effective to differentiate the tax rate between northern and southern Sweden. This differentiation may instead be justified on grounds of wealth redistribution or regional policy. Another reason used to justify that the manufacturing industry pays a lower rate (SEK 0.005/kWh) than for example the service industry is that manufacturing industry faces foreign competition (Swedish Environmental Protection Agency, 2007).

A recent government report on energy efficiency assessed the effect of taxes on energy efficiency, for the period of 1990 to 2016. The overall estimation for the period shows that the energy taxes did and will contribute to a more efficient final energy usage of at least 3.4 TWh, equaling 6.7 TWh in primary usage. (SOU 2008: 25)

There have been several evaluations or assessments of support programmes, amongst them the KLIMP and LIP programmes, see Naturvårdsverket (2008) According to this study the emissions of GHG will decrease with 2.1 millions tonnes a year at a cost of approximately

100 SEK/tonne. Energy consumption is estimated to decline with 2.1 TWh per year. According to another evaluation the future energy savings will be 0.23 TWh/year up to 2016 for LIP and 0.13 TWh per year up to 2010 and 0.05 TWh/year up to 2016. (Energimyndigheten, Effektivare energianvändning 2007:21)

A Non-Toxic Environment

There are a number of economic instruments related to the Non-Toxic Environment objective. These instruments have had some proven effects; the pesticides tax has encouraged farmers to change to low-dose pesticides, charge on batteries has reduced sales of hazardous batteries and lowered cadmium emissions, the tax on cadmium in fertilisers has contributed to the present low leakage of cadmium from fertilisers to arable land and producer responsibility for car tyres has led to that virtually all tyres are recycled. However, the Swedish Environmental Protection Agency does not consider economic instruments to be the best means of combating chemical pollutants. International efforts are viewed to be of greater importance (Swedish Environmental Protection Agency, 2007).

Zero Eutrophication

There are only two economic instruments aimed at specific sectors concerned by the Zero Eutrophication environmental objective; (1) Tax on mineral fertilisers containing nitrogen and the (2) NO_x charge.

Evaluations have shown that the NO_x charge is a cost-effective component of the charges regime, and a complement to emission limits set in industrial operating permits. The charge scheme has resulted in a more rapid and cheaper emission reduction than could have been achieved by means of the more static emission conditions in operating permits. Emissions from plants subject to the NO_x charge have fallen by about 40 percent in relation to the quantity of energy generated since the charge was introduced (Swedish Environmental Protection Agency 2004).

The tax on nitrogen has had a limited effect on sales of fertiliser but has still been estimated to reduce leaching by between 1,300 and 1,800 tonnes of nitrogen per year, which may be due to changes in the use of fertilizer (Swedish Environmental Protection Agency, 2007).

More efficient use of transport

The Stockholm trial with congestion charges (from 22 August 2005 to 31 July 2006) was evaluated continuously while it was in progress and the congestion charge has now been accepted as a permanent tax²⁴. The congestion tax did according to the evaluation reduce traffic during the trial period. This in turn is believed to have reduced congestion, emissions of greenhouse gases, noise levels and concentrations of particulates and other harmful substances in the air in the city centre.

²⁴ The final comprehensive evaluations are available at [://www.stockholmsforsoket.se/](http://www.stockholmsforsoket.se/)

PART II:

Analysis of instrument mixes in Nordic environmental policy

10. Instrument mix analysis

10.1 Introduction

Overview of part II

Part I of this report provided an overview of the use of economic instruments in the Nordic countries, presented the typical properties of environmental policy instruments and made a brief assessment of how the economic instruments seem to work (Chapter 9). However, economic instruments do not function in isolation from other environmental policy instruments or from wider policies. With few exceptions, economic research has focused on the economic properties of single policy instruments or comparative properties of individual instruments (Benneer and Stavins, 2007). This part of the report expands the review and analysis in Part I to consider a broader set of environmental instruments and how they function in the Nordic countries.

The two main aims of Part II are:

- *Instrument mix overview:* Give an overview of areas of environmental policy where more than one instrument (economic or otherwise) is used to reach an environmental goal. More than one instrument is sometimes termed “instrument mix”, “double regulation”²⁵ or “multiple instruments”.
- *Assessment of how instrument mixes function:* Assess how the instrument mixes applied in a few important environmental policy areas function, as judged by different criteria.

We start in the next section by briefly reviewing what economic theory says about the use of multiple instruments. When is it efficient, when is it superfluous or even wasteful? We also discuss the complexity involved in moving from textbook principles of “first best” regulation to the real world, where common assumptions are typically violated. This is the area of second-best regulation. In section 10.3 we give an overview of types of instruments used for the main environmental policy areas in the Nordic countries. The review follows broadly the classification of policy areas used in Part I, and includes direct regulation (performance standards, technology mandates) and other instruments (e.g. voluntary agreements,

²⁵ We prefer not to use this term as it has negative connotations. As we will discuss below, there may be good reasons to use more than one instrument. We will use the two other terms interchangeably.

information disclosure). We do not go into the same level of details as in Part I, but aim to summarise the main areas where multiple types of instruments are in use. The annex provides more information in tabular form broken down for each country.

Since it is difficult to assess how multiple policy instruments work on the general level, sections 10.4 and 10.5 go more into detail for two important environmental policy areas: (1) Stationary energy production and use and climate policy and (2) Waste management policy. The two cases are based on the situations in Norway and Sweden, respectively, but similarities between countries ensure that lessons drawn are relevant across all the Nordic countries.

Supplementing the two case studies, we include a summary in section 10.6 of three other cases analysed by the OECD as part of a wider review and assessment of instrument mixes in environmental policy (OECD 2007). Finally, section 10.7 concludes and provides some recommendations regarding when it may or may not be efficient to use more than one instrument to target an environmental problem or goal.

What is instrument mix?

Economic theory generally prescribes the use of one policy instrument to achieve a specified goal or to address a given environmental problem. However, there are a number of good arguments for using a mix of instruments to address a specific environmental problem (OECD, 2007). Many environmental problems are of a “multi-aspect” nature; in addition to the total amounts of releases of a certain pollutant, it can for example also matter where and when emissions take place, how a polluting product is applied and so on. Also, certain instruments can mutually reinforce each other, as when a labelling scheme stimulates the responsiveness of agents to an environmental tax, while the existence of the tax help draw attention to the labelling scheme (OECD, 2007).

Often a mix of instruments is required to address non-environmental weaknesses in markets where the environmental policy instruments operate, such as lack of information, ill-defined property rights, market power etc (OECD, 2007). Sometimes such mixes can also limit compliance cost uncertainty, enhance enforcement possibilities and reduce administrative costs. But when applying several policy instruments in a mix, there is a danger that one instrument will unnecessarily hamper the flexibility to find low-cost solutions to a problem that another instrument could have offered if it had been used on its own. In other cases, some of the instruments in a mix are simply redundant, contributing only to increase administrative costs.

The next sections will discuss both the situation where multiple environmental policy instruments are considered in isolation to address an environmental problem and the more general situation where it may also

be important to bring in additional (non-environmental) instruments into the mix to address other failures in the wider economy of importance to how the policy mix works.

10.2 Theory and practice in the use of instrument mixes

Chapter 9 discussed some well-known properties of main types of environmental policy instruments. As pointed out by Goulder and Parry (2008), no single instrument is clearly superior along all the dimensions relevant to practical policy choice. That is one reason why many countries use multiple instruments in environmental policy.

But as we shall see, even if in reality there may be good reasons to employ more than one instrument to regulate an environmental problem, the actual choice of instrument mix in the Nordic countries may in many cases seem ad hoc and unrelated to economic efficiency or cost effectiveness²⁶. Typically, the evolution of environmental policy is shaped more by the political economy in the countries, that is, the policy-addition process driven by the multiplicity of national institutions (Helm, 2005). Multiple instruments may also reflect the politicians' tendency to try to "fix everything" – both price and quantity – even when policy may be better served by fixing one and letting the markets determine the other (Hepburn, 2006).

The aim of this section is to clarify what economic theory says about the use of multiple instruments to address an environmental problem and when it can be justified on economic grounds. Under which circumstances may the use of one or more instruments to reach one target increase environmental effectiveness²⁷, cost effectiveness or economic efficiency? What is the optimal mix between economic instruments and other environmental policy instruments? When may additional non-environmental policy instruments be desirable to increase the efficiency of the environmental policy mix? As mentioned in the introduction to Part II this is a relatively new and evolving area of research. More common are the analyses of single instruments or comparisons of single instruments. Our modest aim is therefore to provide the analytical framework or backdrop to thinking about instrument mixes in the case study examples to follow. We primarily focus on efficiency and cost effectiveness concerns, but also bring in other dimensions of relevance to policy choice (e.g. distributional equity).

²⁶ The efficiency criterion assesses an instrument's (or instrument mix's) ability to attain a level of pollution control that maximises net benefits. The cost effectiveness criterion assesses the ability to reach a given level of pollution reduction at the lowest cost.

²⁷ By "environmental effectiveness" is often meant the certainty by which a policy instrument will achieve the target.

Environmental policy in an ideal world

A classic result from economics is that it is optimal to use one instrument per target or objective (Tinbergen, 1952). In textbook environmental economics this means that each negative environmental effect (or externality) can be corrected by levying a tax on the source of the problem (e.g. the amount of pollution). The tax²⁸ should be set so that what it costs to reduce the emission level by the last unit equals the reduced environmental damage. This is where net benefits are maximised, sometimes called a Pareto optimal situation²⁹. This level can also be achieved if emission permits are issued to polluters, who are then allowed to trade them. Marginal abatement costs are then equalised across pollution sources and equal to either the tax or the permit price, respectively. This approach uses the prices as information carriers of the social costs of production and consumption in markets. The rationale for government intervention is that economic agents causing the externalities have no reason to adjust their pollution levels when the use of the environment as a sink is free to them. The sink is a public good, which, as pointed out by Paul Samuelson, typically is underprovided since nobody can be excluded from its use and users are therefore prone to free ride³⁰.

If there are multiple externalities, multiple taxes (or tradable permit schemes) can be implemented to deal with each environmental problem. If there are positive externalities, these can in an analogous way be stimulated by using subsidies. This textbook “first best” solution to “internalising externalities” rests on a number of assumptions. These include full information about the abatement costs, that the marginal environmental damage curve is known and that there are competitive markets (i.e. no firms have market power). Further, considering the wider economy within which environmental regulation works, first-best assumes that the effects of the taxes/subsidies are small across the rest of the economy and that there are no other constraints or pre-existing distortions in the economy which reduce the effects of environmental policy instruments.

If any of these assumptions are violated there may be differences between the efficiency of economic instruments (e.g. taxes and tradable permits), and there may be reasons for combining instruments. The textbook more generally prescribes that if there is more than one market failure (i.e. other than the environmental problem), each failure should be addressed by using one instrument.

²⁸ Sometimes called a Pigovian tax.

²⁹ A situation where no one can be made better off in welfare (utility) terms without making someone else worse off.

³⁰ If the markets could have dealt optimally with environmental externalities through Coasian bargaining between those who suffer from pollution with the polluters, government intervention would not be necessary. But as is well-known, there are many reasons why the Coase Theorem does not hold in practice for most environmental problems, a critical one being the high transaction costs typically involved.

Where theory meets reality: second-best regulation

As is well-known by environmental regulators and environmental economists alike, the textbook assumptions do not carry over to the real world. However, that is not to say that economic instruments have little to offer. It rather means that such instruments may be more efficient if combined as hybrids (e.g. taxes and tradable quotas), or in certain situations with direct regulation instruments or other instruments in the tool box (e.g. information disclosure and labelling schemes). In that way the favourable properties of each instrument, as described in chapter 9, can be harnessed to the best effect.

The justification for using multiple instruments can be explained referring to theory. First, when analysing single instruments, e.g. pollution taxes, it is typically assumed that the intervention does not influence the rest of the economy (i.e. taxes and environmental changes are relatively small) and that other markets are efficient in allocating resources (there are no market failures). This is called a partial equilibrium analysis. It may sometimes be a good approximation to reality, but in the majority of cases these two assumptions do not hold. The correct way is then to analyse environmental policy instruments in a so-called general equilibrium framework where direct and indirect effects across the whole economy are considered. Hence, in this more realistic world, “first-best” environmental regulation as discussed above is not possible. This is where theory of second-best regulation comes in.

The second-best problem is, according to BenNer and Stavins (hereafter “B&S”) (2007: p116), generally defined in the following way: “If a constraint exists within the general equilibrium system that prevents attainment of one Pareto optimal condition, then attainment of other Pareto optimal conditions is no longer necessarily desirable, i.e., welfare improving”. This result builds on work by Lipsey and Lancaster (1956). This means that a Pigovian tax to correct an externality to reach a Pareto optimal situation for a specific environmental problem may not increase overall welfare if there are other market failures/constraints in other areas of the economy. The relevant constraints may be of many types including classic market failures or political/policy failures.

If these “other constraints” are market failures, the welfare of fixing the market failure caused by the environmental externality may change in three ways: (1) Increase the welfare loss of the other market failures (they are “jointly reinforcing” in the terminology of B&S); (2) Decrease the welfare loss of the other market failures (or “jointly ameliorating”); or (3) Have a neutral effect, that is, be unaffected by and not affecting other market failures.

An example may make this clearer. It is well-known that the need to raise taxes by governments creates distortions in for example labour and capital markets. Workers work less than optimal since there is a wedge between what they get paid and what employers would be willing to pay

for labour. This creates a welfare loss. Without considering these wider effects of for example pollution taxes and (freely allocated) tradable permits, these two instruments have similar properties in terms of efficiency and cost-effectiveness. When considering the general equilibrium effects, the two instruments may have quite different effects in overall welfare terms. One reason is that the revenue collected through pollution taxes can be used to reduce other distortionary taxes (“revenue recycling”). But doing that also creates a so-called tax interaction effect where the tax increases cost of labour and capital (which can be seen as an implicit tax on these input factors). This increases the welfare loss of tax distortions in these markets. The tax interaction effect may offset some (or even all or more) of the revenue recycling effect (see e.g. Parry et al, 1999). If the recycling effect is bigger, it is sometimes called a “double dividend” of environmental taxation.

Hence, when considering wider effects of environmental regulation, the analysis of overall welfare effects and costs becomes complex. It may be optimal to use an environmental instrument in combination with a non-environmental instrument (in the example above, a tax reduction policy)³¹ rather than the environmental instrument independently. But, as discussed subsequently, in the presence of other market failures and constraints, it may also be better to combine two environmental instruments, such as tradable permits and taxes instead of using one of them independently (with or without a corresponding tax reduction policy)³². In the consideration and use of multiple instruments indirect costs of other constraints can be reduced and potential benefits enhanced.

The distortionary effects of taxes is an area of second-best regulation which has been much studied in the literature and which requires advanced general equilibrium models to capture effects throughout the whole economy. But there are many other and less researched examples where one constraint or violation of the assumptions under first-best regulation implies that a combination of instruments can do better than any of the types of instruments on their own. Below we go through a few important environmental policy situations where the theory of second-best have important implications for the choice of using more than one environmental policy instrument, i.e. an instrument mix.

³¹ Which by our definition of is not an environmental instrument mix in the narrow sense (just one environmental instrument).

³² This consideration of course also depends on whether and how many of the environmental permits are allocated for free vs. Auctioned (in which case they would also generate revenue).

*Situations of instrument mix regulation*³³

If there are several market failures, what are the effects of their interaction? To what degree does an instrument designed to address one market failure need to be coordinated or changed in light of other market failures?

There are many combinations of market failures that may justify also using an instrument mix rather than a single environmental policy instrument. We summarise a few below, with particular relevance for pollution problems (rather than natural resource management problems).³⁴ To make the analysis manageable, some important pairs of market failures for environmental policy are considered rather than several such failures at once.

Multiple externalities

Environmental externalities may interact with other types of externalities in ways that are jointly ameliorating or jointly reinforcing, in the same way as discussed above. A common example is the interaction between positive externalities (so-called “spillovers”) from technological innovation and negative externalities from pollution. Policies that target only one of these externalities may have indirect effects on the other. The interaction of the negative pollution and positive technology externality argues for policy coordination. For example, policies to reduce pollution should be designed in such a way as to promote, rather than hinder technological change (Jaffe et al., 2003). Taxes and emissions trading increase the cost of pollution and create incentives to increased diffusion of existing abatement technologies and may increase incentives for investment and innovation. In contrast, technology-based standards inhibit innovation and diffusion of new technologies, as firms are forced to use prescribed technologies and have no incentives to develop new ones.

However, the price signal from an environmental tax may not be enough to give polluters incentives to develop and adopt abatement technologies, if there are market failures in the research and development (R&D) market³⁵. One important failure stems from the inability of inventors to fully capture the returns from the knowledge they create. This will mean that less R&D is carried out than what is optimal. For example, other firms may be able to copy a new technology. This market failure is an argument for combining the tax with direct support to environmental R&D (or strengthened patent rules) to correct for the positive externality. There are also arguments that the diffusion of technologies also are sub-

³³ This section draws particularly from B&S (2007) and to a lesser extent from Goulder and Parry (2008) and Hepburn (2006).

³⁴ As pointed out by B&S (2007) any type of constraints hindering a first-best solution (e.g. political or policy constraints), other than market failures, may have the same implication for use of instrument mixes as we discuss for the examples of market failures.

³⁵ This failure works in addition to other common failures not discussed specifically here, e.g. as noted by Stavins (2001: page 42) that “many firms are simply not well equipped internally to make the decisions necessary to fully utilize these [market-based] instruments”.

ject to market failures. Specifically, early adopters of a new technology could achieve lower production costs for the new technology over time through learning by doing. This would award external benefits to later adopters of the technology and might justify some short-term assistance for adopting the new technology (Goulder and Parry, 2008). There may also be other reasons why technology is not developed and adopted in an efficient way, justifying several instruments in combination with a price signal set by the environmental policy. Evidence suggests that environmental policy alone does not create sufficient incentives to overcome completely the technological market failures (Jaffe et al., 2005). A recent study by Greaker and Pade (2008) finds that CO₂ taxes under certain conditions of market failures in the R&D market should be set higher today to stimulate technological change.

Unobservable behaviour and externalities

A very common feature of environmental problems is the difficulty of regulators to observe, measure and monitor behaviour that causes the environmental externality. One example is illegal disposal of waste, which may be difficult to punish since such behaviour is hard to detect. For emissions from mobile sources, the problem is that emissions are costly to measure (e.g. installing monitoring equipment on a country's fleet of cars). So, in these cases instruments that combine a tax and a subsidy can be designed to work in the same way as pollution tax on the unobservable and unmeasurable activity (B&S 2007, Fullerton and Wolverton, 2000). Deposit-refund systems in waste management are examples of this principle.

As pointed out by B&S (2007: page 120) “the optimal use of multiple instruments when undesirable behaviour is unobservable is not restricted to two instruments nor to combinations of taxes and subsidies. In some cases, combinations of taxes on various inputs and outputs may be more efficient than a single tax. For example, mobile source emissions cannot be effectively taxed, due to the cost of measuring these emissions. Traditional approaches to mobile source regulation have focused on fuel efficiency restrictions and input taxes on gasoline. Given heterogeneity in preferences and driving styles, a combination of taxes on gasoline, engine size, and age of car can better approximate the tax on emissions than the use of any of these taxes in isolation”.

Hence the same conclusion emerges as above, that if there are several externalities or violations of standard assumptions (e.g. that emissions cannot be measured), a policy mix may be justified and more efficient than individual instruments levied on proxies of the source of the environmental externality. Environmental economists have studied such instrument combinations particularly in waste management (deposit-refund systems). However, other areas are less well studied.

Imperfect information and externalities

Many environmental problems are characterized by imperfect information, for example related to the effects of consuming certain products. If people care about environmental problems, but have little information about them, they will not be able to adjust their behaviour. In this case, there are two market failures. The first failure is the external effects of production and/or consumption of certain goods. The second market failure is the limited information (or education of people supposed to digest such information) that hinders people in making informed choices where the external effects are part of the basis for decision-making. This was also found in Braathen (2007) and OECD (2007). These two market failures are jointly ameliorating in the language of B&S (2007).

Typical examples are labelling schemes for energy efficient appliances, which helps facilitate better decision-making among consumers (e.g. how long it will take to save on electricity bills the increased costs of new, energy efficient fridge). This is an environmental information instrument. According to B&S (2007: 121) “A mix of instruments, in particular some form of standards (which could be in the form of tradable permits or a tax) plus information disclosure requirements, can yield a more efficient solution in the presence of these potentially jointly ameliorating market failures. In practice this coupling of instruments is frequently observed, but current practice appears to be to use one instrument to address one failure and another instrument to address the other failure without consideration of their potential interaction”.

Hence, there may be good reasons to combine environmental information and/or education instruments with market-based price signals more explicitly in the mix – to achieve more out of the mix than the sum of the effects of its individual parts, to paraphrase a well-known expression.

Uncertainty

There are also several situations where there is an exogenous constraint that cannot be overcome (e.g. a market failure, political constraint or policy failure), so that the environmental policy will have to find a second-best solution using combinations of instruments under this constraint.

An important area of discussion here is if regulators are uncertain about pollution abatement costs and cannot change their policy frequently and observe responses by firms to seek to establish the cost level (i.e. a political constraint). In comparing a choice between two instruments, a price and quantity instrument, the optimal policy to choose ex ante is the instrument that is expected to exhibit the smaller degree of efficiency (deadweight) loss ex post (Weitzman, 1974). The well-known trade-off between a price and a quantity instrument here depends on the slopes of the marginal abatement cost and marginal damage cost curves.

However, as pointed out by B&S (2007), under a range of realistic conditions the most efficient policy ex ante is a combination of a tax (and pos-

sibly a subsidy) and quantity restrictions – a so-called hybrid instrument. The logic is that taxes and (tradable) permits (can be used to protect against the failings of the other. In the words of B&S (2007: 122): “Permits can protect society from extremely high levels of pollution, whereas taxes can provide incentives to clean up more than required by permits if costs are low. This suggests a three-part policy mechanism: a fixed quantity of tradable emission (abatement) permits; a subsidy (per unit of emissions) paid by the government to any firm whose permit holdings exceed its emissions; and a tax (per unit of emissions) paid by firms if their emissions exceed their permit holdings (Robert and Spence, 1976)”.

So, under this system, emissions are limited in the most cost effective way through the tradable permit allocation. If abatement costs turn out to be lower than expected, an extra incentive for more abatement is given by the subsidy. If abatement costs instead turn out to be greater than expected, a “safety valve” from the overall cap on emissions is provided by the tax that can be paid instead of abatement for emission levels exceeding the cap. (B&S, 2007)

Despite the efficient property of this “safety valve system”, no such hybrid instrument has been applied to date. But as we shall see, some countries combine quantitative restrictions with taxes, but not primarily with efficiency in mind.

Other constraints and market failure combinations

Above we have discussed some of the most important situations where the use of an instrument mix to address an environmental problem may be justified on economic grounds. These situations have both included “pure” environmental policy mixes and mixes that have included instruments that are not primarily environmental (e.g. tax reduction policies). There are also other cases where second-best instrument mixes may be called for. Two cases include the situation where the polluting firm is a monopoly, and the situation where there are imperfect property rights interacting with externalities (like for example in fisheries regulation).

Two final examples we will briefly mention here go beyond the more traditional considerations of economic efficiency and cost effectiveness. First, the choice of policy instruments can be limited by what B&S (2007) call the political participation constraint. In some cases the first-best policy may not be possible feasible because the policy’s costs or benefits may be distributed in such a way that main stakeholders are unwilling to provide required political support. There may also be entrenched political or ideological views connected with certain types of environmental instruments which may them harder politically to accept (regardless of costs and benefits to different stakeholders).

Instrument mixes may work better under such *political constraints* than individual (unpopular) instruments. One example is hybrid systems, tradable permits with a safety valve, which have been shown to have

welfare properties equal to or better than a pure tax systems while at the same keeping some of the politically desirable characteristics of a pure permit system (Pizer, 2002). It is easier to accept a tradable permit system for polluting industries than a tax – and the “political costs” are therefore much lower. When one of the issues of stakeholder concern is distributional equity, it may be a second-best optimum to use a combination of instruments to better achieve both cost effectiveness and stakeholder concerns (as there typically is a trade-off between the two).

A final external constraint that may influence instrument choice is the *administrative costs* or capacity of implementing the policy. A common example of this comes from policies to regulate non-uniformly mixed pollution, that is, where the environmental damage depends on where pollution occurs. Taxes and tradable permit systems achieve cost-effective abatement when pollutants are uniformly mixed, an important argument in favour of such instruments. The standard example is emissions of greenhouse gases. With non-uniformly mixed pollutants things usually become more complex. In theory, an “ambient tradable permit” system which takes account of the spatial distribution of pollution sources will be cost-effective under such circumstances (Montgomery, 1972). However, the implementation of such a system is very demanding and costly, though the design is relatively simple. An alternative in such situations is the use of a second-best instrument mix. B&S (2007: 125) recommends that: “A market-based instrument – such as tradable emission permits or an emission tax (in the interest of cost effectiveness) – can be combined with localized ambient standards to prevent concentrations from exceeding accepted levels in particular localities (so-called “hot spots”)”.

In practice, we know that in terms of these two final constraints, administrative costs are less important than overcoming the political constraint in the environmental policy mixes we observe in Nordic countries today.

Final thoughts – bridge to the case studies

From the discussion above it is clear that under a fairly broad set of realistic circumstances the use of instrument mixes can be justified on economic grounds – pure environmental instrument mixes and in combination with other types of instruments. This justification comes from the recognition that environmental policy is usually developed and executed in second-best settings. That said, however, it is also important in practice to consider that instrument mixes may often be applied in ways that make them less efficient still than single instruments in second-best settings where a well-designed policy mix would have been better. In other words, that theory and practice say that instrument mixes may be optimal in many situations, should not be taken as a justification of existing, inefficient instrument mixes. As argued by OECD (2007) and others, to go further in the choice of policy instruments, environmental policy prob-

lems must be analysed in detail case by case. That is what we intend to do in the remainder of Part II.

In sections 10.4–10.6 we investigate more in detail the use of instrument mixes for five environmental policy areas. There we demonstrate that some of the instrument mixes achieve efficiency gains along the lines we have discussed above, while other instrument mixes combine instruments in ways that cannot have been guided by economic efficiency considerations. We also find many examples where the discussion of choosing the correct instrument is pointless when the target itself is ill-advised. Before these case studies, we briefly review the use of multiple instruments in the Nordic countries.

10.3 Overview of instrument mixes

In the Annex to Part II we present a tabular overview of the main types of environmental policy instruments in the various areas for each Nordic country. There are many similarities between the countries when it comes to the use of policy instruments directed towards all environmental problems and sectors. Below we present a short summary overview of the policy instruments used, based on the more detailed Annex.

We have divided the policy instruments into the following three main categories:

10.3.1 Economic instruments:

- Taxes and charges
- Tradable permits (mainly EU ETS)
- Other (deposit-refund systems, certain types of subsidies for clean energy etc., but not support/funding for research on renewables etc)
- Direct regulation (“Command-and-Control”):
- *Technology mandates*: a specific requirement regarding the production process (for example to install particular equipment, abatement technology etc)
- *Performance standards*: requirement that a firm’s output meet certain criteria (e.g. max emission rates per kWh of electricity, energy efficiency standards for buildings or household appliances, fuel economy requirements for new cars etc). This category also includes (non-tradable) emission permits/allowance given to specific large emission sources (e.g. a large factory).

10.3.2 Other policy instruments:

- *Information disclosure*: Includes labelling (e.g. certification of “green products” etc), public disclosure (e.g. rating of firms by the

government, information campaigns to save on electricity etc) and certification schemes (“Svanemerket” etc)

- *Agreements*: Negotiated agreements or similar between industry sectors (typically) and the government to voluntarily reduce pollution to some agreed levels.
- *Other*: This is for instrument types that do not fit in the other categories like bans on certain substances, other types of regulations.

The sectors are arranged according to the types of environmental problems/sectors under the main categories we have used for Part I of the report, with the exception that we have merged transport with energy and air pollution.

There are often several instruments in use for each environmental problem, reflecting both that different policy instruments are used for various emission sources (sectors) and that several instruments are directed towards the same environmental problem in one source/sector. However, the overview is quite rough, and there may be some overlap.

Below is a brief summary focussing on the similarities between the policy instrument use in the countries.

10.3.4 Energy and air pollution:

- *Electricity use*: All countries except Iceland have taxes on electricity use. Most countries also have subsidies for various energy efficiency measures and technical standards for insulation etc. in houses, some performance standards for products, information (labels etc.) about electricity use in apparel and other equipment. Some countries also have agreements between large industrial energy consumers and the authorities on energy efficiency.
- *Electricity production*: Regulations for new production capacity are applied in all countries. Fossil fuelled power plants need emission permits, and would be a part of EU ETS for CO₂. Renewable production capacity also needs permission to build. Almost all countries have support schemes to promote renewal electricity production (wind, waves, bio etc.). Information activities connected to these activities are common.
- *Fuel oil use*: There are taxes on fuel oil use in most countries and subsidies for energy efficiency measures and fuel switch, some energy standards, information about subsidies and how to switch to renewable energy etc. Many of the same policy instruments as used for promoting efficient electricity use are also applied for fuel oil use (see above).
- *Transportation fuels*: All countries have taxes on fuel use, most countries also have various subsidies for alternative fuels. Information about specific fuel use for new cars is applied in all countries

according to EU rules. Sales taxes differentiated according to fuel use are applied in most countries.

- *GHG emissions from households:* Most countries have CO₂ taxes on household fuel oil use, subsidies etc. on reducing fuel oil use (see above) and information activities.
- *GHG emissions from industry:* Most countries have taxes on fuel oil use for some industries, EU ETS is applied for other industries. Support schemes for measures to reduce use of fossil fuels exist in most countries.
- *GHG emissions from transportation:* Taxes on fuel and information about CO₂ emissions from new cars are the most common measures (see also under transportation fuels above).
- *SO₂:* Tax on sulphur content in fuel oil is applied in most countries, limits for sulphur content in fuel oil is also existent in some, while individual emission limits and/or general emission standards exist for some industries.
- *NO_x:* Performance standards for vehicles and some industries are most common. Norway and Sweden also have taxes on some sources.
- *Toxic substances to air/water:* Technology requirements for industries and products are most common, also individual emission limits and/or general emission standards for some industries as well as ban on use of some substances. Information activities about damages from use of products containing toxic substances are widely used. Some countries also use taxes towards some substances.

10.3.5 Water pollution

- *Industry:* Individual emission limits and/or general emission standards for the polluting industries is used in all countries.
- *Agriculture:* Subsidies to avoid release to water, some technology mandates and information about behaviour to avoid release to water are most widely used.

10.3.6 Waste

- *Landfills:* Most countries have tax on waste put on landfills, technical requirements to avoid release to water and air (methane) and ban on landfilling certain waste categories exist in all countries.
- *Incineration:* Tax on waste delivered for incineration is common, as are emission standards.
- *Households:* Municipal charge on waste delivery, deposit refund systems, information about recycling etc, requirements for waste sorting exist in all countries

- *Industry*: Tax (charge) on waste delivery, deposit-refund systems, information about recycling etc., requirements for waste sorting, performance standards for handling of own waste are widely used.

10.3.7 Natural resources:

- *Forestry*: Performance standards and laws for forestry management
- *Fisheries*: Quota (non tradable) regulations on catchment according to the resource situation is used.
- *Nature conservation*: Funding for conservation of land (e.g. compensation payments to forest owners), conservation of land (natural parks, protected areas etc) are the most common instruments.

The overview show that broad mixes of policy instruments are used towards energy production, energy use (including electricity and fuel oil) and GHG emissions, toxic substances and waste handling. To some extent a mix of instruments are also used in the transportation sector. Further information is given in the Annex.

In our case studies in the next two sub chapters we have chosen to look further into stationary energy production and use, including climate change policy as one case, and waste treatment as another case. Both these areas are characterised by the use of combinations of several instruments.

10.4 Case study 1: Stationary energy production and use, and climate change policy

In this case study we aim to analyse the various policy instruments used towards stationary energy production and use and to curb greenhouse gas (GHG) emissions in the Nordic countries. Many of the same instruments are used in all countries. The analysis focuses on Norway since a discussion on these issues has been going on for some time. However, the lessons drawn from this case naturally extends to the other Nordic countries.

The study is limited to stationary energy use, since this area has a wide mix of policy instruments in use. We also include electricity production, since the policy instruments used towards production and use to some extent are connected. Energy use in transportation also is subject to several economic instruments, but these are not overlapping in the same sense as for stationary energy use.

10.4.1 Several layers of policy instruments

Most energy production and use bring about negative externalities. These can include emissions of GHG from burning of fossil fuels, emissions of

sulphur and particulate matter (using fossil and bio fuels), aesthetics and noise (wind power), destructions of nature (hydro power sites) and radiation (nuclear power). Producers and consumers do not normally consider such costs. Therefore, correcting these negative externalities is important, and could be done by the use of several policy instruments.

There are many policy instruments used towards stationary energy production/use and GHG emissions, and the economic instruments used are listed and described in the country chapters. Below is a brief overview of the various instruments used.

Electricity production and use

In Norway and most of the other Nordic countries new power plants need permission for emissions to air (and water), and for GHG they will be subject to the EU emissions trading system EU ETS. Interventions in nature and other negative impacts from new hydro power plants, wind-mill parks, biogas and biomass productions, district heating etc. are also directly regulated through various requirements at the approval stage of the project. Furthermore, there is a wide array of grant schemes for renewable electricity production like wind, (small) hydro and other renewable power sources. Most of the grants are directed towards investments in production capacities in these new technologies, but in some countries there are also grants directed towards technology development. In Sweden a Green certificate system to promote renewable electricity production is in place, and Norway is presently investigating the possibilities to join this system, replacing current public subsidy schemes for these technologies.

There is an electricity tax on most users with different rates for households and industry. Households face the highest rates, while most industries pay the EU minimum rate. Some energy intensive industries are exempted from the tax according to EU rules. Other selected industries can join a voluntary scheme where they are granted the lower tax rate if they introduce certain energy saving measures. The households in Northern Norway (Finnmark and Northern Troms) are exempted from the tax. Similar schemes are in place in some other Nordic countries.

Subsidies for installation of various energy efficiency measures in households and industry exist. These are either aimed at reducing electricity consumption (grants for investment in heating pumps, switching to waterborne solutions based on renewable sources or district heating), but also to switch to renewable heating sources like pellets heating. Various information campaigns inform about alternative measures that households can implement to reduce energy consumption.

Similar grants exist for industry companies and public buildings etc. that implement measures to reduce energy consumption or switch to renewable energy sources. Grants are also given to investments in new and innovative energy solutions in industry processes, conversions from elec-

tricity heating to water borne heating systems based on renewables and so on. Some grants are also directed towards measures in some industries. A wide variety of information activities on energy efficiency and substitution are also directed towards industry.

Mineral oil use

Both households and most industries are subject to a general tax on mineral oil (fuel oil) use. A few industries have a reduced tax rate. In addition, many of the grant schemes and information activities mentioned under electricity use above also apply for fuel oil use. But since some 75 percent of the energy used for space and water heating purposes in Norwegian households is electricity, the activities mostly benefits electricity use even if they are directed towards energy use in general. Oil products only counts for 6.5 percent of household energy use according to Statistics Norway, but the share in industry is somewhat higher.

GHG emissions

CO₂ taxes are imposed on fuel oil use for both households and industry. Some industries have a reduced tax rate, including CO₂ emissions from the continental shelf. CO₂ tax on natural gas use is also proposed. The tax rates per carbon content in the fuels vary between fuels. The CO₂ emissions trading system covers most of the emissions from industries not covered by the CO₂ tax, with the exception of emissions from petroleum activities which are both taxed and included in the trading system. For some of the GHG emissions that are not subject to either tax or emissions trading, voluntary commitments from industry to reduce emissions have been used.

SO₂ emissions

SO₂ emissions are also considered here since they are highly related to fuel oil use. Sulphur in mineral oil is taxed, and the sulphur content in the various oil products is also regulated. SO₂ emissions from industry processes are regulated by technical and/or emission standards. Previously an agreement between industry and authorities on tax cuts in return for emissions reductions was in effect. However, these policies have little importance today since sulphur content in oil products and SO₂ emissions have been substantially reduced.

But also many goals

There are several official goals related to GHG emissions reductions and energy use that the various instruments should contribute to fulfil. EU policies and goals in the energy and climate policy are important for the formation of national goals. The new EU 20–20–20 targets by 2020, i.e. 20 percent GHG emission reductions, 20 percent renewable energy share and 20 percent increase in energy efficiency will be important for the

future implementation of policy instruments. The new EU directive on renewable energy (RES-Directive) gives each member country (and Norway and Iceland if this becomes part of the EEA agreement) targets for the share of renewable energy in their domestic energy supply.

Furthermore, all countries impose several taxes and charges for fiscal reasons. In Norway there are also goals related to economic development in rural areas and some industries that are important in these areas that are addressed through the various policy measures described above, mainly through the exemptions in the electricity tax. Also, some distribution goals connected to poorer households could eventually be added to these goals.

Environmental policy goals

Norway, like the other Nordic countries, is through the Kyoto Protocol committed to limit GHG emissions during the 2008–2012 period. Furthermore, Norway has committed itself to reduce emissions further by 2020 and become carbon neutral within 2030 as part of an ambitious, global agreement where other industrialized countries also commit themselves to substantial commitments. The other Nordic countries have similar goals.

There are also goals connected to emissions of SO₂, NO_x, PM etc. to fulfil the national goals in the Gothenburg protocol that all Nordic countries are committed to.

Energy policy goals

According to St. prp. 1 (2008–2009) Olje- og energidepartementet (the budget proposal from the Ministry of Petroleum and Energy for 2009) some of the key goals for the energy policy are:

- Ensure an efficient, secure and competitive power supply and well-functioning markets for efficient and environmental friendly energy solutions
- Ensure necessary flexibility in the energy system to cover changes in the hydro power production
- Promote more efficient energy use
- Increase the use of other energy sources than electricity, fuel oil and natural gas for heating
- Increased production from renewable energy sources (for quantification of contribution from new renewables: see section 6.1.8)
- Introduce and develop new technologies and solutions in the energy market
- Increase knowledge about options to use efficient and environmental friendly energy solutions
- Contribute to the overall national goals for GHG emission reductions
- Contribute to environmental friendly use of natural gas in Norway

In addition there are several different sub-goals connected to R&D, water resource management etc.

Is there a hierarchy of goals?

The goals for emission reductions and environmental improvements could perhaps be considered as “primary” goals, i.e. goals directly related to welfare improvements for society. The goals related to efficient energy production and use could also be put in the same category.

It could be that some of the other goals for production of renewable energy, and in particular the quantified goals for the production from the various renewable sources, are not “primary” goals even if they are clearly stated political goals. It is for instance hard to see why the society should have a specific goal for the production of wind power, since there are no positive externalities connected to this or other similar technologies (Bruvoll and Dalen, 2008). If the wind technology is profitable, the power market itself will ensure that it is built if the expected future power price is large enough to cover the costs, given that there are profit maximising actors and competition in the power market. If this and other technologies are to be supported by grants and other schemes, there must be some indirect effects or other value of this power that the market does not take into consideration when deciding which alternative technologies to pursue. GHG emissions could be one such externality, but as long as GHG emissions from power production are covered by EU ETS promoting renewable power production will not lead to any net GHG emission reductions (see discussion below). Some other could be local pollution and damage to nature from for instance new hydro or natural gas fired power plants. The latter is taken care of through the process of granting concessions for new hydro power projects and natural gas power plants. Also, wind power and other renewable sources have negative externalities that must (and are) taken into account, and it is not obvious that these in general are less than for instance the externalities connected to hydro power. It is also hard to see that there are issues related to diversification and security of power supply, flexibility etc. that implies public support for these technologies.

R&D support could be important to develop new production technologies for power production. But most of these technologies are mature, and the subsidies are mostly not for primary introduction but to fulfil goals to ensure a considerable amount of electricity production from these technologies.

We are then left with the potentially saved GHG emissions as the main reason for promoting renewable energy production. If the alternative is another renewable source like hydro, there will be no GHG emission reductions in Norway. New renewable capacity could lead to reduced power imports and thus emission reductions in other countries if

the power supplied is based on fossil fuels. But these emissions are the responsibility of the exporting countries.

The goals for more efficient energy use could have somewhat different impacts than the goals for renewable electricity production. There are several low or no cost actions that could be taken both in industry and households to use energy more efficiently, and thus reduce overall energy consumption without reducing industry production or household services or comfort. Such actions could be cheaper for the society than for instance investments in new power production capacity. Thus, energy efficiency measures could be a win-win situation for all actors.

The impacts on GHG emissions of a goal for more efficient electricity use would be very much similar to the goal for renewable electricity production. But abatement costs could be reduced, since several of these actions could imply lower costs per reduced CO₂ equivalent than alternative actions.

Promotion of renewable power will not lead to any net GHG emission reductions

The problem to be solved should be addressed as close to the source as possible. Therefore, each country is responsible for the GHG emissions within their territories, and most countries curb their emissions at source when this is possible. In the Nordic countries taxes and emissions trading are the main policy instruments to reduce GHG emissions. For the sources not covered by these instruments other instruments like direct regulations or voluntary agreements could be an alternative.

Emissions from power production in the Nordic countries and other countries that are part of the EU ETS are covered by this emissions trading system. Thus, there is a cap on overall emissions within the trading system, and the permit trading and corresponding permit prices ensure that emissions are reduced in a cost effective way to fulfil the overall cap. Within this framework, special actions to reduce emissions for instance through promoting renewable power production will not lead to any net emission reduction. Such an emission reduction will lead to excess number of permits that will be sold and utilised to increase emissions from other sources within the trading system. This implies that emission reductions from other sources within the system could be smaller than would otherwise be the case. The total emissions from sources in the system will not be affected, since they are given by the overall emission cap. The actions would lead to increased compliance costs since renewable power would displace other, cheaper abatement options within the trading system.

Could there be some positive long term impacts on GHG emissions?

It has been argued that promoting renewable energy sources and similar actions could make it easier to gain acceptance for larger emission cuts beyond 2012 when the Kyoto Protocol expires. While this could be the

case, it is hard to see that this could have any large impact on future goals. EU and some other countries have already declared their goals for 2020 and 2030, and how far they are willing to reduce emissions further if other countries also take on emission goals. Furthermore, EU has declared that the emissions trading system will be in use also after 2012.

However, it could be that countries outside the EU would be more willing to limit their emissions if renewable power and other energy production are developed. Then these options need to be cheaper than alternative abatement options. If these alternative sources are developed to become highly competitive with fossil fuel sources because of the government support, then perhaps also EU and other countries could be willing to take on stronger commitments. It could also be that it will be easier to tighten the overall emission cap for the emissions trading system if cheap renewable power production capacity is developed or heavily supported.

Another argument used for promoting renewable power is that we will need emissions fee power in the long run to reduce emissions considerably, since other sources within the emissions trading system (industry, aviation etc.) cannot reduce their emissions enough. But this is exactly what the emissions trading system will solve by itself. By tighten the overall emissions cap over time emissions will be reduced where it is easiest and cheapest, eventually in the power sector if this sector offers the cheapest solutions. Instead of trying to pick long time technology winners in the power sector by promoting renewable technologies, one should instead tighten the overall emissions cap. If tightening the cap is not a viable option, support to renewable power offers a poor case as a second best solution, since it will not contribute to lower overall emissions as long as the excess allowances can be used by others within the trading system.

This discussion shows that there are arguments for support to R&D on renewable energy technologies, and not for the large scale introduction of these technologies as long as emissions from the power sector are covered by an emissions trading system. Such support could for instance yield spillover to several non-Annex I countries, and contribute to long term emission reductions.

Should reconsider the policy instrument mix in light of the emissions trading system

The discussion above shows that promoting renewable power production in the Nordic countries to reduce GHG emissions is hard to justify unless renewable power supply is a goal in itself and not primarily related to GHG emissions. It has been a separate goal for years in most Nordic countries, and in recent years also backed by EU directives. Therefore, actions to fulfil these goals have been necessary.

As argued above such actions will result in increased GHG abatement costs and no net GHG emission reduction when an emission trading sys-

tem is in operation. It should, however, be noted that this has only been the case since the emissions trading system was implemented in 2005. Previously there was no cap on overall emissions, and then increased renewable power production could lead to net GHG emission reductions. Thus, the renewable power production goals and related policy instruments should be considered in the light of the policy instrument change in the GHG policy, to see if they still are justified.

Promoting renewable energy and energy efficiency to reduce fossil fuel consumption could reduce emissions

The situation is different when it comes to GHG emissions subject to a tax or other instruments, and not a permit trading system with an overall emission cap. Since there is no overall cap on the taxed emissions, the subsidies of renewable energy to substitute use of fossil fuels or to use the fuel more efficient could lead to emission reductions beyond what would otherwise be the case. Whether this would be a cost efficient emission reduction depends on the abatement costs of alternative abatement actions. The subsidy rate per unit GHG emission reduction compared to the CO₂ tax rate could indicate the cost efficiency of this action.

More efficient electricity use could reduce GHG abatement and electricity supply costs

Industries and households will for many reasons not invest in energy efficiency measures even if the savings far outweigh the costs (i.e. the costs are “negative”). Regarding buildings, machines, household equipment etc. the specific energy use is more or less embedded in the equipment when it is produced/bought. A part of this is the so-called landlord-tenant challenge, where the landlord has few or no incentives to invest in measures to reduce energy consumption in buildings since the tenants will carry the energy costs through the building’s lifetime. But even when the owner and user is the same person (as is to a large extent the case in Norway where most households own their homes) investments in profitable energy saving measures are not made. This is often explained by lack of funding (people and companies may face capital constraints) and that people often have a high discount rate for such investments (they would rather use the money today than have some savings over some future years). Also, lack of information about potential actions, their costs and effects could be important hindrances.

For existing buildings and equipment there is often a wide variety of low or no cost actions to take to reduce energy consumption. But for the same reasons as mentioned above, households and industries tend to invest less in such actions than optimal.

When buying new household appliances and other equipment consumers and industries should be aware of the energy consumption of the various alternatives, to be able to take this into account in their purchase

decisions. Also during daily use industry and households should have incentives to reduce energy consumption through energy prices.

Therefore, promoting energy efficiency investments and –behaviour should be addressed at various levels through different policy instruments. Technical and performance standards affect the design and construction of new buildings and some equipment, and contribute to reduced energy use. Subsidies for various energy saving measures (including fuel switch) addresses existing buildings and machinery, and promotes energy saving in the existing stock of houses and equipment. The various taxes (including emission permit costs) on electricity and fuel oil give users regularly signals through energy prices of the real costs of energy use, and affect the amount of fuel used.

Information activities could impact all these various decisions, in particular information about various energy saving investments in existing buildings and machinery, and how to save energy through daily use. Thus, information activities could contribute to strengthen the impacts of the taxes and subsidies. Several investigations show that information activities in combination with taxes increase the impacts (elasticity) of the taxes, among other cases in the energy efficiency policy, see OECD (2007) and Braathen (2007).

Thus, the combination of policy instruments towards energy efficiency in households and industry used in Norway does not seem to act against each other or weaken the overall impact. The instruments used seem necessary to promote energy efficiency at various levels, and the information activities tend to strengthen the impacts of the other policy instruments. To the extent that the instruments spur low cost actions that would otherwise not be implemented, it could be said that they contribute to increased cost effectiveness in GHG emissions reductions and energy supply.

But subsidies could also do some harm

As we have seen in this report the Nordic countries make widespread use of support schemes to promote renewable energy sources and energy efficiency, including green certificates, investment and production subsidies, tax exemptions, reductions and refunds. Subsidies and similar support should be used to correct for positive externalities like learning in the development phase for new technologies (Greaker and Rosendahl, 2007). In this phase subsidies should be granted as a support for research and development. But when the technology is developed its implementation and diffusion may be best left to the market.

Subsidies to emissions-free energy sources would like taxes on polluting technologies increase the use of emissions free technologies, and reduce the use of polluting technology. But an important difference is that subsidies will increase total energy consumption, while all taxes tend to reduce energy consumption (Bye and Bruvoll, 2008). The market prices on energy would be reduced, and the lower prices will reduce the profit-

ability of developing new technologies. Thus, subsidies of emissions free technologies could yield double negative impacts in relation to environmental friendly goals (Bruvoll and Dalen, 2008). Therefore, subsidies tend to increase abatement costs, and they are only optimal if the use and development of the subsidized technologies have positive side-effects themselves, i.e. in terms of learning by doing (Bye and Bruvoll, 2008).

Green certificates have an advantage over simple lump sum subsidies since the certificate market will realize a cost effective investment for capacity expansion under a green production share constraint, and could be comparable to an auction based subsidy system (Bye and Bruvoll, 2008). The producers of green energy harvest a certificate price in the certificate market in addition to the energy price in the energy market, which increase the profitability of producing energy from green technologies.

The instrument mix used towards GHG emissions could be more cost effective

The policy instruments used directly towards GHG emissions sources in Norway are a combination of emissions trading, CO₂ taxes and voluntary agreements. From 2008 more than 70 percent of total GHG emissions are covered by tax or emissions trading. The authorities have been very careful to avoid overlapping use of these instruments, and have removed taxes for emission sources that have been included in the trading system. The only exception is emissions from the petroleum activities on the continental shelf, where the previous CO₂ tax rates were reduced when the sector was included in the trading system from 2008. Thus, there are two policy instruments directed towards the emissions from these sources. The tax does not serve as a “safety valve” on allowance prices, i.e. payable only when the allowance price reaches some threshold value. Use of two instruments contributes to higher abatement in this sector compared to other sectors that only are subject to tax or emissions trading, and leads to an increase in the overall abatement costs.

Also, there are currently no links between the tax rates and the allowance price in the emission trading system. The tax rates for all sources could have been set to mirror the allowance price, at least on an annual basis, to contribute to cost effectiveness. Alternatively, one could expand the trading system to sectors that are currently covered by the CO₂ tax. There might be fiscal reasons why this is not done, but such changes are something that should be considered.

The various fuels are not taxed consistently according to carbon content, and some few industries have reduced rates. The tax rates for land based sources vary between NOK 92 and NOK 363/ton CO₂ (see table 6.3). The reason for this seems to be political goals to reduce industry's costs, since fuels mostly used by industry have the lowest rates, and to shelter some industries that are important in rural areas. Reduced tax rates

are probably one of the few ways to subsidize these industries without violating EEA and WTO rules. However, increased GHG compliance costs are an indirect impact from this policy.

Some GHG emissions from production of aluminium, ferroalloys and various chemical products etc. are not subject to any policy instruments. Previously some of these emissions have been subject to voluntary agreements on emission reductions between industry and the authorities. The reason why these emission sources have not been faced with taxes or emission trading seems mainly to be a political goal of maintaining these industries' competitive position and keep them in Norway. Their main competitors are located in the non-Annex I countries, i.e. in the countries that have not taken on any emission goals under the Kyoto protocol. It could be argued that putting too high burdens through taxation or emissions trading would force these companies to close down their activities in Norway, to be replaced with production capacity in countries with no GHG commitment. To avoid such carbon leakages some special treatment of these emission sources could be justified. However, these emission sources should have some incentives to reduce emissions on the margin, for instance through being a part of the emissions trading system where most of their allowances could be given them for free.

Conclusion: the instrument mix used should be re-considered in light of the introduction of emissions trading

There have and still are several policy instruments in use to promote renewable electricity production and more efficient use of electricity to reduce GHG emissions from electricity production. Emissions from power production are since 2005 covered by the EU ETS, implying that total emissions from the system have a cap. Thus, promoting renewable electricity production or efficient use of electricity will not lead to net emission reductions as long as emissions from power production is covered by emissions trading. Therefore, the goals and policy instruments used should be reconsidered to see if they are still needed or could be redesigned. Also, changes in the use of policy instruments like taxes and emission permit trading directly towards the various GHG emission sources should be considered to ensure more cost effective emission reductions.

10.5 Case study 2: Waste management policy in Sweden

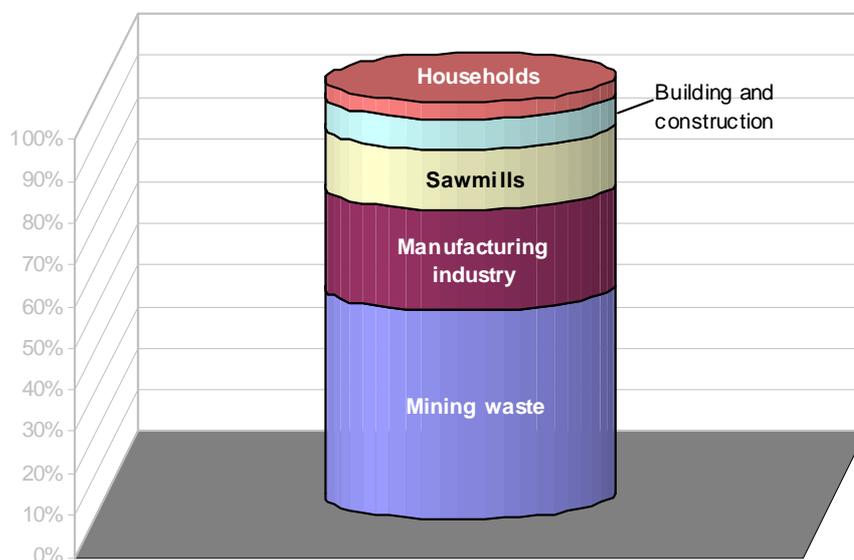
Swedish waste policy has developed continuously during the past decades with the aim to reduce the total amount of waste generated and to improve waste management. Waste has gone from simply being “handled” to becoming an important resource for recycled material and for energy generation.

Waste management in Sweden follows clear policy goals and is guided by both direct regulations and economic instruments, to a large extent based on EU regulations. Most other Nordic countries have similar goals and policy mixes.

10.5.1 Swedish waste

Around half of the generated waste in Sweden in 2006 consisted of mining waste, followed by waste from the manufacturing industry. Households produced approximately 4 percent of all waste generated.

Figure 10.1 Waste generation per source in percent (2006)



Source: Avfall Sverige (2009)

The total amount of waste generated is increasing. From 1998 to 2007 the quantity of household waste increased by around 24 percent, corresponding to around 1 million tonnes. However, parallel to this increase, the amount of recycled material has also increased.

Biological treatment occurs through digestion or composting. Digestion produces biogas, which may be used for vehicle fuel, and bio-fertiliser, which is an excellent nutrient. Composting provides a long-acting fertiliser, which is used for soil improvement in gardens, parks and freehold land. Waste incineration is a way to extract energy from waste. Every year, it provides enough heat to meet the needs of 810,000 average sized houses and electricity for more than 250,000. Energy recovery from waste incineration increased by approximately 47 percent from 2003 to 2007 (Avfall Sverige, 2008).

10.5.2 Swedish Waste Management Policy

The Swedish waste management policy is part of the sixteen national environmental objectives that have been adopted by the Swedish Riksdag (Swedish Environmental Objectives Council, 2008). Waste management falls under the environmental objectives; “A Good Built Environment”, “Reduced Climate Impact” and “A Non-Toxic Environment”. The objective of “A Good Built Environment” has several waste related interim targets including:

- “The total quantity of waste should not increase, and the maximum possible use should be made of the resource that waste represents, while at the same time minimising the impact on, and risk to, health and environment.
- By 2010 at least 50 per cent of household waste is to be recycled by recovery of materials, including biological treatment.
- By 2010 at least 35 per cent of food waste from households, restaurants, institutional catering and shops is to be recycled by biological treatment.
- By 2010 food and similar waste from food manufacturing facilities etc are to be recycled by biological treatment.
- By 2015 at least 60 per cent of phosphorus compounds in sewage are to be recycled for use on productive land, of which at least half should be used on arable land” (The Environmental Objectives Secretariat, 2009).

In addition, one of the interim targets for the objective “Reduced Climate Impact” calls for Swedish emissions of greenhouse gases to decrease to at least 4 percent below 1990 levels³⁶. The environmental objective “A Non-Toxic Environment” includes six interim targets relating to knowledge, information, the phasing out of hazardous substances, reduction of health and environmental risks, guideline values, and the remediation of contaminated sites.

There are, however, no established national objectives for the actual performance of the waste management infrastructure, including collection systems and treatment capacity.

10.5.3 The EPA Waste Plan

The Swedish Environmental Protection Agency (EPA) has produced a national waste management plan based on the environmental quality objectives. This plan explains the significance of the objectives and it clarifies the connection between objective and the national measures con-

³⁶ Measured as an average over the period 2008–2012.

ducted. It also analyses the effects of various policy instruments and measures.

10.5.4 EU Objectives

Sweden and the other Nordic countries are guided by the principles and decisions of EU waste management. EU decisions set the framework for the national waste management. The EU approach to waste management is based on three principles that are sometimes also referred to as the “EU waste hierarchy” (EU Directive 2006/12/EC):

1. Prevention or reduction of waste production and its harmfulness: To reduce the amount of waste generated and reduce its hazardousness by reducing the presence of dangerous substances in products, through:
 - i. development of clean technologies more sparing in their use of natural resources;
 - ii. the technical development and marketing of products designed so as to make no contribution or to make the smallest possible contribution, by the nature of their manufacture, use or disposal, to increasing the amount or harmfulness of waste and pollution hazards;
 - iii. development of appropriate techniques for the final disposal of dangerous substances contained in waste destined for recovery
2. Recycling and reuse: If waste generation cannot be prevented, as many of the materials as possible should be recovered by means of recycling, reuse or reclamation or any other process with a view to extracting secondary raw materials, or use the waste as a source of energy. The European Commission has defined several specific 'waste streams' for priority attention, the aim being to reduce their overall environmental impact (including packaging waste, end-of-life vehicles, batteries, electrical and electronic waste). EU directives now require Member States to introduce legislation on waste collection, reuse, recycling and disposal of these waste streams.
3. Improving final disposal and monitoring: When waste cannot be recycled or reused, it should be safely incinerated, with landfill only used as a last resort. The EU has recently approved a directive setting strict guidelines for landfill management. It bans certain types of waste (such as used tyres) on landfills, and sets targets for reducing quantities of biodegradable waste. Another recent directive lays down limits on emission levels from incinerators (European Commission, 2009).

10.5.5 Swedish waste treatment

Responsibilities

In Sweden, the responsibility for the waste management is divided between:

- Local authorities (municipalities): responsible for household waste
- Producers: responsible for their respective product groups
- Other waste holders and producers (essentially industry and business): where the responsibility does not rest with the other two categories

Waste Management Practices

In Sweden all waste is treated according to its characteristics and depending on local and geographical circumstances it is recycled and reused to the greatest extent possible. Guided by national targets and EU directives, Swedish municipalities decide themselves how they wish to organise their waste management.

10.5.6 Policy instruments for sustainable waste management

A number of policy instruments aim to make Swedish waste management more ecologically sustainable. Their primary aim has been to increase recycling and reduce the amount of waste going to landfill. Further objectives are to reduce the volume of waste and the hazards it poses. The main policy instruments used in Sweden are:

- *Producer responsibility.* Producers are within selected fields required to collect and recycle their products when they are discarded as waste. The objective is to reduce the volume of waste, increase recycling, and encourage environmentally sustainable product development. Swedish law lays down producer responsibility obligations in five areas:
 1. Packaging
 2. Tyres
 3. Newsprint
 4. Vehicles
 5. Electrical and electronic productsA voluntary producer responsibility agreement has also been negotiated for office paper. Other producer responsibilities are imposed by EU regulations, such as prohibitions on the use of hazardous substances in products.
- *Municipal waste planning.* Since 1991, each municipality must have a waste plan, which should cover all types of waste found in the municipal area and identify the actions necessary for their appropriate environmental management and their management as resources.

- *Prohibitions and emission restrictions on the landfilling of burnable and organic wastes.* The landfilling of burnable wastes has been prohibited since 2002, and in 2005 the ban was extended to organic wastes. The intention of the law is to encourage conservation of resources and reduce environmental impacts. New EU regulations have also been introduced to reduce environmental impacts on land, water and air. Existing landfill facilities must comply from 2005 and incineration plants from 2008.

Sweden has had strong demands on emissions from waste incineration from the early 1980s. Since 2005, Sweden applies the restrictions and demands on emissions from incineration placed by EU Directive 2000/76/EC. Emission permits list the categories and quantities of hazardous and non-hazardous waste which may be treated, the plant's incineration or co-incineration capacity and the sampling and measurement procedures which are to be used. There are also imposed technical requirements for landfills to avoid leakages to soil and water and to prevent release of methane.

10.5.7 Economic instruments for sustainable waste management

There are a number of economic instruments used to stimulate waste treatment. These are used and levied primarily by the municipalities and producers that handle household waste.

- *Waste collection fees.* Municipal costs for waste handling are charged through a waste collection fee. The local government determines the municipal waste collection fee and it hence varies throughout the country. The waste collection fee must cover the municipality's entire costs for waste management. In order to transfer more waste to recycling, some municipalities have introduced a weight-based fee where, in addition to the basic fee, one pays for each additional kilo of waste collected. 26 municipalities had introduced the weight-based charge in 2007. The collection vehicle is then equipped with a weighing system and equipment for identifying each individual container (Avfall Sverige, 2009).
- *The landfill tax.* Under the Landfill Tax Act, in force since January 2000, all material entering landfill facilities is taxed, while material removed from the facility qualifies for a deduction.
- *Waste incineration tax.* On 1 July 2006 a tax was imposed on the fossil component of waste disposed of by incineration. The aim of the tax is to encourage recycling, to reduce carbon dioxide emissions, and to encourage cogeneration (combined heat and power generation). The tax is levied on domestic waste only. The amount of tax charged is based on an assumed fossil content of the waste stream. Waste

incineration facilities with only heat generation pay SEK 444 per tonne of waste, while facilities that generate power as well pay a lower rate. However, this tax is about to be removed.

- *Taxes on packaging*, deposit-refund systems etc. To reduce waste generation there are several product taxes and deposit-refund systems, see chapter 7.
- *Government investment grants*. During 1998 and 2001, the Local Investment Programmes (LIPs) were a form of government assistance aimed at encouraging sustainable investments. The programmes covered on average 30 percent of project investment costs. Grants have also been directed towards climate investment programmes (KLIMP), starting in 2003, but is now removed. The programmes are aimed at encouraging local climate mitigation work and thereby assisting in the achievement of Sweden's objective of reducing climate impacts. A quarter of the grants have been used to increase the production and utilisation of biogas from waste.

10.5.8 A hierarchy of goals

As in the case study for stationary energy production and use it seems to be a hierarchy of goals in the waste management policy also. It can be seen from the goals for the Swedish waste management policy described above that they are almost entirely related to environmental issues, like: "A Good Built Environment", "Reduced Climate Impact" and "A Non-Toxic Environment". Thus, most goals about how waste should be treated could be seen as sub-goals for these environmental goals.

However, there also seems to be a goal to promote more efficient (sustainable) resource use through recycling or energy recovery of various waste fractions to save the use of natural resources like timber, metals and oil. This is seen by some as more efficient use of resources than sending the waste to landfills and incineration plants. Most of these goals in Sweden have been met or almost met. Furthermore, no new goals for material recovery are in the pipeline (http://www.boverket.se/Global/Webbokhandel/Dokument/2008/God_bebyggd_miljo_fordjudpad_2007.pdf)

Both landfilling, incineration, material and energy recovery of waste causes emissions and environmental problems (Bruvoll and Bye, 2002). Emissions to air from waste treatment consists of GHG, SO₂, NO_x, VOC and several toxic substances like lead, cadmium, mercury, PAH and dioxins. Discharges to water comprise heavy metals, nitrogen and phosphorous, as well as some organic compounds. In addition to these problems, land use for landfills is seen as a challenge that can cause conflicts with alternative use and surrounding areas.

A general rule is to address the challenges as close to the source as possible. The same environmental challenges as in waste treatment are in most other sectors curbed through taxes on emissions or products causing

emissions, direct regulations, emissions trading and so on (Bruvoll and Bye, 2002). These environmental challenges should to the extent possible be treated equally across sectors, to ensure cost effective results from the interventions. Thus, the use of policy instruments that contribute to cost effectiveness should be used. Local problems like land use conflicts should be settled locally according to local conditions.

10.5.9 The taxes on waste landfilling and incineration should be directed towards emissions

Emissions from landfills and incineration plants are regulated through technical standards and/or performance standards. In some countries a combination of emissions standards and technical requirements are used. This could take into account conditions in the local recipient, for instance when it comes to emissions to air causing local problems and releases to water of various substances. However, some of these substances also cause regional problems and have national goals, and the policy should take this into account.

In addition, taxes on waste delivered for landfills and on incineration or on emissions from incineration are directed towards the same environmental problems. These taxes are designed somewhat differently among the countries. In Denmark the tax is put on waste delivered for landfilling and incineration, Finland only taxes waste put on landfills, Norway taxes waste put on landfill, the fossil carbon content of waste delivered for incineration and emissions from incineration, while Sweden taxes waste put on landfills and the fossil carbon content of waste delivered for incineration. This shows that most countries impose “proxy” taxes on emissions; instead of taxing emissions directly they are for administrative and/or technical reasons levied on the amount of waste delivered. For CO₂ emissions this is the usual way of taxing, since there is a clear relationship between the carbon content of the product/waste and the emissions when the product/waste is burned. Norway is the only country taxing emission (other than CO₂) from incineration directly and having a differentiated landfill tax based on the technical standard of the landfills. The purposes of the taxes are several; reduce emissions through reducing the amount of waste delivered for final treatment, spur sort out of especially harmful waste fractions, promote material and energy recovery as well as minimization of waste generation.

Is it necessary to regulate emissions from landfills and incineration through both direct regulation and taxation? Based on pure economic textbook considerations the first best choice would be to impose taxes directly on the emissions. Then waste treatment plant owners would have the incentives to reduce emissions the way they find most cost effective. This could either be through end-of-pipe cleaning, sorting out some waste

fractions that cause the emissions or reducing the amount of waste treated at the plant. Combinations of actions could also be possible.

However, emissions are costly and sometimes also difficult to monitor. For instance, leakages of methane to air and various substances to soil and water from landfills are impossible (or prohibitively expensive) to monitor accurately. Therefore, the best way to curb these emissions is through imposing technical standards on how to capture these emissions. Also for emissions from incineration plants technical standards for instance on what cleaning devices to use could be an alternative to costly and complicated monitoring, but generally taxation of emissions are easier for these sources than for landfills. The taxation of actual emissions from incineration in Norway based on monitoring shows that this is possible.

A combination of direct regulations and taxes on emissions could lead to better dynamic efficiency through giving emission sources incentives to reduce emissions beyond technical regulations. However, most of the present taxes in the Nordic countries are levied on the amount of waste that is delivered to the landfills and/or incineration. Thus, this only gives incentives to reduce the amount of waste delivered, and does not for instance spur emission reductions through end-of-pipe actions or similar. These taxes could be interpreted as a scarcity price for space and costs related to the waste treatment as such, implying that the purpose is not to reduce emissions. It could perhaps give municipalities incentives to start sorting out and collecting some waste fractions. But since municipalities are not profit maximizing units and in effect have monopoly on household waste collection and handling, it could be easier for them to pass on the tax to consumers. Furthermore, since the households often pay a flat rate for the waste they deliver they have no incentives to reduce waste generation. It is therefore hard to see that the taxes put on waste delivered for final treatment have substantial impacts on emissions.

The Norwegian waste tax system comes close to an optimal tax system, and gives incineration plant owners incentives to reduce emissions and landfill owners to reduce release to soil and water. However, this system also faces the same challenges from potential lack of incentives for emission reductions for plant owners and the problem of taxing methane and releases to water. Instead, a tax based on technical conditions on landfills has been chosen as a proxy.

In addition to technical regulations a tax system like the Norwegian could give landfills and incineration plant owners' incentives to reduce emissions over time. The Nordic countries which have not designed their taxes that way should consider this.

10.5.10 Actions to phase out landfilling of biodegradable waste could be cost effective

EU regulations require ban on landfilling of biodegradable waste due to the high methane emissions, and the Nordic countries are following up on this. Given that waste put on landfill will generate emissions of GHG and leach harmful substances to soil and water for many years, there could be arguments for limiting the landfilling of waste that generates these emissions. Especially the long term generation and emissions of methane, which is a very powerful GHG, could be substantially reduced through such actions. Since the releases to air and water will go on for many years, also long after the landfill has closed down, it could be cost effective to phase out landfilling. It would gradually reduce the need to follow up landfills with controls and eventually implementation of new technical measures to avoid releases. Furthermore, emissions of methane are often hard to capture effectively, thus reducing the generation of methane through reducing the amount of waste landfilled could be the most effective alternative. However, this should be justified through a cost benefit analysis.

10.5.11 The goals for material and energy recovery are not necessary for environmental reasons....

Regulating the environmental problems at the source as they are today with technical and/or performance standards, and/or with taxes imposed on emissions would ensure an efficient and cost effective waste treatment. Requirements for waste sorting into various fractions for material recovery and reuse or energy recovery would then yield few if any additional benefits. Of course, sorting out hazardous waste that could cause emissions of various kinds of toxic substances could be beneficial, since these emissions could be hard and/or costly to capture through various cleaning devices.

Also when the environmental impacts from reduced use of natural resources and other energy sources are considered it is hard to see that the requirements for waste sorting and reuse are justified. The environmental problems related to natural resources extraction, oil production and use etc. should be dealt with at source. If this is dealt with cost effectively, actions to reduce the extraction and use of these resources could contribute to increased compliance costs. It is also highly uncertain if such policies contribute to overall emissions reductions of for instance GHG, since the recovery activities also cause emissions.

10.5.12and they are not necessary for optimal natural resource use either

In the public debate there seems to be a perception that sorting out waste fractions like paper, glass, metals, plastic etc. for material recovery con-

tributes to more efficient resource use, since it reduces the use of new materials (saves trees for instance). One might even get the impression that recycling and reuse is a high level goal in itself, and should be promoted regardless of cost. The fact that energy recovery has been considered inferior to material recovery in the so-called “waste hierarchy” indicates this.

From a resource perspective there seems to be no reasons why the authorities should promote material recovery and energy recovery of waste. If there are competitive markets for various goods (including waste fractions) and prices include environmental costs of the various handling alternatives, the market participants will themselves find the most profitable ways and amounts of material and energy recovery to the benefit of the whole society. Which waste fractions to recover, what kind of recovery and the amount of waste to recover should be decided based on cost benefit considerations. History has shown that markets themselves have initiated collection and recovery of waste fractions like metals and paper when this is profitable. What are needed are clear price signals to market participants of true environmental costs and scarcity value of resources which can be achieved through competitive markets for the waste products and taxes on the emissions from the various sources in the waste handling system.

Also, there is currently no general shortage of natural resources in the world or locally that should warrant such actions from the authorities. Bruvoll and Bye (2002) show that for most of these resources the amounts of recovered material is insignificant compared to the use and stocks of the natural resources in question. For the resource with the highest recovery, namely paper, one saves the use of a renewable natural resource (trees) where the stocks are growing in the Nordic area, and it is not certain that reducing tree cutting in this area is beneficial from an overall policy point of view. But if tree saving is wanted, one could likely promote this through other and more efficient measures. Bruvoll and Bye (2002) also shows that international markets effectively reflects shortages of resources (for example some precious metals).

Thus, it is hard to see that policy goals and actions to promote material and energy recovery could be justified from a natural resource shortage perspective.

10.5.13 Recycling could be costly

Recycling efforts and policies tend to focus entirely on the positive environmental impacts of recycling, while neglecting other important costs to society. From an economic point of view there is nothing inherently benign about recycling. Recycling policies ought, just as any other policies, to pass standard cost-benefit and economic efficiency tests (Berglund, 2003).

Berglund (2003) presents three studies on the efficiency of recycling behaviour and waste management policies in Sweden. The first is an econometric analysis of the most important determinants of inter-country differences in waste paper recovery and utilization rates. This paper concludes that relative waste paper recovery and use depend largely on long-standing economic factors such as population intensity, income and competitiveness on world markets. As recovery and utilization rates are determined by economic and demographic characteristics the degree of policy flexibility in affecting these rates may be limited. In particular, an ambitious utilization rate target may be very costly to enforce as it can conflict with existing trade patterns of paper and board products as well as with other environmental goals.

In his second study of the spatial cost efficiency of the Swedish legislation on waste disposal handling, Berglund focuses on corrugated board and recognize that the different counties in Sweden possess different economic prerequisites in terms of waste paper recovery and utilization potential. The conclusion is that, from an efficiency point of view, the recovery efforts should be concentrated to the highly populated and urbanized counties, and not be uniformly divided throughout the country.

Finally, Berglund has also analysed households' perceptions of recycling activities in the municipality of Piteå. The purpose of the analysis was to both analyse if moral motives matter for the assessment of households' waste sorting costs and for the efficiency of introducing economic incentives for stimulating households' recycling efforts. The empirical results support the notion that moral motives significantly lower the costs associated with household recycling efforts.

These results are similar to what Bruvoll (1998) finds when she examines waste disposal options in Norway. She finds that the social costs of recycling are higher than the social costs from both landfill and incineration for several waste fractions and that the largest cost component for recycling was found to be the households' time for sorting the waste. Her study hence does not support the ranking of "reduce" as the superior alternative in the waste hierarchy. However, there are several studies showing that recycling and sorting activities increase the utility of participants in the recycling programs (Berglund, 2003).

10.5.14 Special treatment of hazardous waste seems necessary

As previously mentioned a ban on delivering hazardous waste, i.e. products that contain toxic substances that could be released to air and water, for landfill or incineration seems necessary in addition to the other policy instruments used towards landfills and incineration. There are policy goals to completely phase out the release of these substances. Furthermore, they could be hard to capture from landfills and incineration with-

out costly and complex cleaning devices. This justifies the special treatment of this kind of waste.

By giving the producers and importers the responsibility for handling this waste as most Nordic countries have done, one has also given them incentives to treat the waste in a cost efficient way and in the longer run to develop products with less harmful substances. The various producer schemes for batteries, cars and car tyres, electric and electronic products etc. have been important in this respect.

10.5.15 The deposit refund systems for bottles and cans avoid littering

For many years the Nordic countries have had deposit refund systems for beverage bottles and cans and some other similar products. These containers are not considered as hazardous waste, and they could therefore be treated together with ordinary household waste (but some of this is hard to incinerate properly). There have been several analyses trying to assess whether recycling or reuse of these containers is environmentally beneficial when looking through the whole product and recycle chain, and the results vary somewhat.

One aspect with this policy that is often forgotten is that it prevents littering from empty bottles and cans in public areas. Broken glass bottles could cause damages for humans and animals and ignite forest fires, and all this kind of littering causes negative visual impacts for most people. Besides, it requires measures to collect such waste from streets and places. Deposit refund systems for these containers could therefore both reduce some problems in the waste handling process and reduce littering.

Packaging taxes are probably not necessary from an environmental point of view

Weight- and volume-based taxes on packaging like cardboard, paper, metals, plastic etc. are imposed in Denmark and Sweden. The main goal for these taxes seems to be to reduce the amount of packaging and through this reduce the amount of waste generated, and perhaps also to limit the resources used for production of the package and the environmental problems related with this.

Packaging is often seen as “unnecessary” use of resources, which should be limited to fulfil good safety and hygiene levels. However, producers should be able to decide the necessary level of packaging themselves both from a safety, hygiene and marketing level. If the environmental problems related to production and waste handling is dealt with at the source of the problem, as is done in Sweden and most Nordic countries, there should be no additional environmental reasons for taxes on packaging. This requires that packaging producers have paid for any carbon content of fossil-fuel inputs into the packaging upfront and that the disposal of packaging does not cause significant externalities apart from any carbon release from fossil fuel inputs. The first requirement may not

always be fulfilled, but the latter must be considered to be a minor problem. For some few products consumed outdoor littering could be a problem, and the tax could eventually reduce the amount of this somewhat by minimizing packaging.

There could be arguments for using packaging taxes for fiscal reasons. To assess the effectiveness of this, one should among other issues analyse the price elasticities of the various products subject to the packaging tax, to see if the demand for these product responds relatively little to price changes compared to other potential products for fiscal taxes.

10.5.16 Information activities could increase the impacts of other instruments

There have been various information campaigns and other information activities carried out to inform people about how to treat various types of waste, where to deliver it and how to reduce the amount of waste generated. As in most other sectors such activities are often necessary to ensure that people have the right information to make their own choices. Thus, information activities most likely have increased the effects of the other policy instruments such as the various recycling activities.

10.5.17 Conclusion: the various policy instruments used should be reconsidered to avoid overlap

As we have shown in this case study there are several policy instruments directed towards the waste treatment sector to reduce the environmental impacts from waste handling, in particular the reduction of GHG emissions. Both taxes on waste delivered for final treatment and on emissions, as well as regulations to reduce emissions from incineration and landfills are used. In addition, several measures are taken to reduce the generation of waste and to sort out various waste fractions for recycling or energy recovery.

The EU ban on putting biodegradable waste on landfills implies that several of the current policy measures directed towards landfills will be unnecessary. Technical requirements for existing landfills will still be necessary to avoid future leakages to air and water, since releases from landfills are difficult to monitor and tax. Emissions from incineration plants should be taxed directly in combination with a tax on the fossil carbon content on the waste as in Norway, and waste containing hazardous substances should still be sorted out and treated separately to avoid releases of these substances to air. Deposit refund systems for bottles and cans could be kept to avoid littering. Information activities to support these activities should be kept.

The various goals and measures for material and energy recovery should be carefully considered, since they do not seem necessary for nei-

ther environmental nor optimal natural resource use reasons. Furthermore, packaging taxes are not necessary either from an environmental point of view.

These conclusions reflect the view in Kinnaman (2006), Dijkgraf and Gradus (2009) and Fullerton & Wu (1998).

10.6 Findings from recent OECD instrument mix review

OECD (2007) presents some cases from member countries where several mixes of instruments in the environmental policy have been used. The following cases from the Nordic countries are presented:

- Non-point sources of water pollution in Denmark
 - NO_x and SO₂ emissions in Sweden
 - Mercury emissions in Norway and Sweden
- These cases are briefly presented and summarised below.

10.6.1 Non-point sources of water pollution in Denmark

The policy instruments used

The policies have targeted nutrients (i.e. nitrogen and phosphorous) run-off from agriculture and similar activities, and the use of pesticides. The background for this is major eutrophication problems in Danish lakes and coastal waters; significant public focus on possible dangers to health and environment associated with pesticide usage, and the need to comply with various EU Directives etc. It is estimated that about one-third of the nitrogen added to the soil leaches out from the root zone, and is thus no longer available for plants. Part of the nitrogen that leaches denitrifies into the air, while other parts could end up in rivers, lakes, coastal areas or in the groundwater causing excessive growth of algae etc reducing oxygen levels in water bodies.

The cornerstone of the Danish policies addressing nutrients run-off is an obligatory, detailed accounting system for the use of nitrogen in inorganic and organic fertilisers and the use of catch crops (i.e. crops that fix nitrogen from the air) at the farm level, which sets limits on the plant-available nitrogen to be applied to different crops. Under this system, a preliminary, yearly nitrogen quota is calculated for each farm, depending on the size of the arable land, the crops planted, the soil category, etc. The quotas are based on norms for nitrogen application that are set 10% below the estimated economic optimum for the different crops, thus causing crop production per area unit to be lower than what it otherwise could have been. The preliminary quotas for each year are modified, depending on weather conditions that have prevailed in that year in different parts of the country.

Linked to the nitrogen quota system has been a continued increase in the assumption used in the quota calculations concerning how much of the nitrogen in manure is available for uptake by the plants. These assumptions affect how much manure farmers may dispose of on their fields. The accounting system also includes a possibility for farmers to have their nitrogen quotas increased somewhat if they can document that their yields per area unit are consistently higher than the assumptions used in the calculation of the national norms. These claims have to be verified by certified experts.

There are substantial fines for exceeding the quotas – DKK 20 per kg N in significant cases. This is e.g. 4– 5 times higher than the price paid per kg N in artificial fertilisers.

To fulfil the EU Nitrates Directive the Danish authorities have set maximum limits on the livestock density on farms. These maximum limits have been decreased over the years, and are now 1.7 animal units per ha for cattle and 1.4 animal units for other animal categories. Danish farmers that have more animals than allowed by the land they use may enter into agreements with other farmers, so that the surplus manure can be spread out on their fields.

In 2002, farmers were given the option to sell part of their nitrogen quota for a 5– year period – through an auctioning system. The idea was that by only accepting the cheapest bids from the farmers, one would obtain environmental improvements at the lowest possible cost to society as a whole. To be eligible to participate in the bidding, farmers had to have utilised more than 50 percent of their quotas previously, and they had to offer at least a 10 percent reduction in their respective quotas. It was, however, not a requirement that the farm be situated in an environmentally sensitive area. This instrument was discontinued as from 2004 – in part due to the high budgetary costs per unit reduction in nitrogen leachate obtained.

The policy to curb nitrogen release also comprises the following instruments:

- Research to promote better utilisation of animal food
- Subsidies for permanent wetlands creation
- Subsidies for forest creation
- Subsidies for environmentally sensitive areas
- Subsidies for organic farming
- Tax on fertilisers

Many of the instruments addressing nitrogen run-off obviously also impact on phosphorous application and leaching. In order to help reaching a target of a 25 percent reduction in the phosphorous surplus by 2009, a tax on phosphorus was introduced from 1 April 2005. As the loss of phosphorus is determined by the stock of minerals in the soil built up over a

long time period, the aim of a tax would be a reduction of the accumulation of phosphorus in the soil – not an “immediate” reduction of phosphorus leaching.

It was recognised that a tax on phosphorus in commercial fertiliser would be comparatively simple to administer. Such a tax would provide an incentive to limit application of phosphorus from commercial fertilisers, for example, by paying more attention to the amount of phosphorus already available in the soil and by cultivating crops that require less use of phosphorus. These effects were, however, estimated to be of limited importance. A tax on phosphorus in commercial fertiliser could, on the other hand, be seen to be “unfair”, since farms without access to livestock manure would pay a disproportionate amount of the tax. The environmental effect of such a tax would chiefly derive from the fact that livestock manure would be transported further away and spread on larger acreages than at present.

At present, mineral phosphorus is added to animal feed that is lacking in available phosphorus. A second option considered was to introduce a tax directed at these phosphorous amounts. The environmental effect of such a tax would stem from a reduction in the amount of mineral phosphorus added to the feed, as a result of the increased use of phytase instead. The addition of phytase to the feed increases the proportion of phosphorus in the feed that animals can digest. A tax on all phosphorus in feed would also provide an incentive to replace feed phosphate with phytase, but it would in addition reduce the use of feed with a high content of non-utilisable phosphorus. Such a tax could have been levied on the total content of phosphorus in feed mixtures for livestock – but it would not cover feed that is never traded (i.e. feed grown on the farmers own fields).

Another option would have been to introduce a tax on phosphorus in feed, combined with a basic deduction corresponding to the natural phosphorus content of corn. This would mean that the natural phosphorus content in animal feed would be more or less exempt from tax. However, such a tax would still involve discrimination between domestic feeds and imported feeds with high phosphorus content. Still another possibility would have been to tax both phosphorus in feed and phosphorus in commercial fertiliser. However, this might result in some feed being taxed more than once – first through a tax on the phosphorus in commercial fertiliser, next through a tax on the phosphorus content of the feed produced with taxed commercial fertiliser.

In the end, it was chosen to levy a tax only on mineral phosphorus added to animal feed. The tax rate was set to DKK 4 per kg phosphorous. It is too early to say whether the tax has had any significant environmental impacts. In the tax proposal, it was estimated that the tax would engender a reduction in the use of mineral phosphorous feed additives from 9 000 tonnes to around 4 000 tonnes in 2010. It was at the same

time assumed that the use of such additives anyway (in the absence of a tax) would decline; from 13 500 tonnes in 2004 to 9 000 tonnes in 2010.

The reduction in the use of additives that is assumed to take place regardless of the introduction of the new tax is – of course – partly driven by the use of other policy instruments that impact on the total number of animals, like the tightening of the regulation of livestock density, conversion of agricultural land into wetlands, changes in the EU Common Agricultural Policy, etc.

In addition to the tax on mineral phosphorous, subsidies to create crop-free buffer zones along rivers and lakes.

To regulate the pesticides use the rules regarding the approval of pesticides were tightened. The toxicological impacts of each of the products used were to be considered. Large farms were required to keep a spraying log, farmers were obliged to have a spraying certificate, and the use of pesticides in environmentally sensitive areas was banned. In addition, a tax of 3 percent of the wholesale value of pesticides was introduced – which according to OECD (2007) hardly could be expected to have a major impact on farmers' behaviour. However, the tax is 35 percent of sales price pesticides and 25 percent for other plant protecting substances. The 3 percent tax is on protecting substances that re not plant protecting substances.

Furthermore, a tax on pesticides has been in use. Several different tax models were considered when an increase in the pesticides tax was prepared in the mid-1990s. Ideally, the tax-base should be related as closely as possible to the environmental damage done by the different pesticide products. However, an exact match is impossible to achieve in practice. One option that was considered was to let the tax vary with the amount of active ingredients in the pesticides. Such a tax base would be easy to administer – but the link with the environmental effects would be rather weak. This is in part because a number of low-dose products have come on the market over recent decades, with potentially larger negative environmental impacts per kg or litre than older, high-dose, products.

Another option would be to levy the tax according to the standard dose for each pesticide. A later expert group concluded that it could be possible to define unambiguously the standard dose for each product, but the group also meant that the environmental impacts of using such a tax-base would only be marginally better than if the tax was based on the value of each product. Eventually, it was decided to relate the tax to the price of each product – which is obviously relatively remote from the harm they cause to the environment and/or human health. The tax rates differ between different main categories of pesticides.

Evaluation of instrument use

The nutrient quota sales system is according to OECD (2007) an example of a policy mix that hampers the environmental effectiveness and the

economic efficiency of both individual instruments and the overall instrument mix. They emphasise that what the farmers offered to sell was a reduction in their nitrogen quotas – not necessarily a reduction in their actual nitrogen use. If a farmer did not use a considerable share of his legal quota at the outset, he could sell (some of) the unused part, without any impact either on the actual nitrogen application or on his yields.

For a farmer that (without any restrictions) applies nitrogen in an optimal manner, the “shadow value” per kg nitrogen should equal the price of N in fertiliser. An evaluation indicates that this price is around EUR 0.5–0.7 per kg, and estimates that the shadow value of a kg N actually applied is about EUR 0.8–1.0. This contrasts with an average price of the accepted bids in 2002 of about EUR 3.8 per kg nitrogen quota reduction – making the instrument very lucrative for farmers that participated, and very costly for society as a whole.

The instrument also included forestry farms, many of which are not required to produce nitrogen accounts. Hence, there is considerable uncertainty about how large a reduction in actual nitrogen losses the instrument induced. Estimates vary between 4 and 67 tonnes. With annual costs related to the scheme of some EUR 1.5 million, this leads to a cost of between EUR 23 and EUR 380 per kg of actual reduction in nitrogen leaching!

There were three problems with this instrument. First, the fact that it focussed on reductions in the quotas rather than on actual nitrogen use opened up opportunities for widespread free-riding, inviting offers from farmers who (for some reason or another) would not have used their full quota anyhow. Second, it did not focus on areas where reductions in nitrogen application would provide the most important environmental benefits. Third, and most importantly, far too costly bids were accepted. There ought to have been a ceiling for accepting bids that reasonably well reflected the economic value of the environmental damage being caused by an additional kg of nitrogen loss.

The possibilities for, and impacts of, replacing some of the existing regulations on nitrogen use in the agriculture sector e.g. with a tax on the nitrogen surplus (calculated for the sector as a whole) have been considered. Inputs of nitrogen to the sector (feedstuff, fertilisers, etc.) would have been taxed at the wholesale level, while refunds would be given to those who took nitrogen out of the sector (slaughterhouses, mills, etc.). The taxes and refunds would be passed on backwards and forwards in the supply chain, leaving a tax on the nitrogen surplus as the net result. Several studies have found that such a change in approach could lead to increased economic efficiency, while preserving the environmental integrity of the instrument mix.

Such a tax on the nitrogen surplus of the sector could also have allowed a similar tax on the phosphorous surplus of the sector to be implemented instead of the rather narrow tax-base that was in fact imple-

mented. A key link between the two tax-base choices is that the administrative costs related to the necessary reporting and enforcement mechanisms would have been spread over two rather similar taxes.

In spite of the economic efficiency arguments in favour of letting a tax on the nitrogen surplus of the sector replace current regulations, such a change in policy approach has not been made. Part of the reason is that the current regulatory system has provided significant environmental improvements – although probably at a higher economic cost than necessary. There seems according to OECD (2007) to be a certain “status quo bias” among policy-makers who hesitate making changes to a “team” that looks as if it is “winning”.

10.6.2 NO_x and SO₂ emissions in Sweden

Air quality has improved in Sweden over the past 15 years, with concentrations for the major pollutants having dropped between 1986 and 2002 by 85 percent for SO₂, and by about 40 percent each for nitrogen oxides (NO_x) and particulates. But soil acidification is still a major issue, and only a minor part of the sulphur and nitrogen deposition occurring in Sweden stems from sources within the country.

The policy instruments used towards NO_x emissions

Sweden has over the years struggled to reduce NO_x emissions, and failed to achieve the target of 30 percent reductions between 1980 and 1995. Half of the emissions derive from transportation. Originally the policy was only relying on a command and control approach. In order to achieve a more rapid emissions reduction and to provide an incentive for cost effective emission reductions a refunded charge on NO_x emissions from energy generation at combustion plants was introduced in 1992.

The charge is levied at a rate of SEK 40 per kg of emitted NO_x. The abatement cost was found to range between SEK 3 and SEK 84 per kg reduced NO_x. A charge of SEK 40 per kg was therefore considered reasonable. The charge has remained constant in nominal terms since introduction. The charge is based on actual measured NO_x emissions of NO_x, and is imposed irrespective of the fuel used. Since there is no direct link between the fuel used and emissions direct emission measurement is thus likely to lead to a much more precisely focussed incentive than a charge based on fuel characteristics or other emissions proxies.

The refunding of revenues raised by the charge is linked to the high monitoring costs of NO_x emissions. The charge is applied to measured emissions, or to presumptive emissions levels of 250 mg NO_x per MJ for boilers and 600 mg NO_x per MJ for gas turbines. Plant operators may choose to pay the charge on the basis of presumptive emissions levels instead of installing measuring equipment, although in most cases the

presumptive emissions levels are substantially higher than actual emissions, so measurement is generally preferred.

Initially, the charge was confined to about 124 combustion plants (182 boilers) producing at least 50 GWh of useful energy per boiler. As monitoring costs went down, the charge was extended to include all boilers producing at least 40 GWh, and in 1997 the limit was lowered to 25 GWh of useful energy per year. Another motivation to lower the threshold was to avoid that some energy producers supply just under the limit to avoid the charge. At present about 260 plants (460 boilers) are subject to the charge, emitting about 15 000 tonnes of NO_x a year. Most of the liable plants are found in energy production (e.g. heating and power plants).

To avoid distorting the pattern of competition between the plants which are subject to the NO_x charge and those that are not, the system is designed so that all revenue (except the cost of administration) is returned to the participating plants, in proportion to their production of useful energy. This also avoids the incentives to replace existing equipment with inefficient, smaller, boilers that are not subject to the charge.

Boilers with high emissions relative to their energy output are net payers to the system, and sources with low emissions relative to energy output are net recipients. This feature of the system encourages the targeted plants to reduce their NO_x emissions per unit of energy to the lowest possible level. In 2004, the refund was SEK 8.94 per MWh useful energy according to OECD (2007).

The total charge amount is returned to the participating plants (with the exception of only 0.7 percent, which is kept for administration costs). The refund to each plant is proportional to their production of useful energy. This encourages the targeted plants to reduce their emissions of nitrogen oxides per unit of energy to the lowest possible level.

The policy instruments used towards SO₂ emissions

Sweden long used a command and control approach to regulate sulphur emissions. The Environmental Protection Act (1969) set up guidelines to allocate individual permits to major stationary sources. For installations that entail a major environmental impact, the proponent must apply for a permit. Limits for the sulphur content of various fuels have also been set up.

In 1991 a sulphur tax was introduced as an additional measure, to comply with the national targets set up in a faster and more cost-effective way. When the tax was introduced, the maximum sulphur content of coal and fuel oils was already low by European standards. The sulphur tax was designed to achieve further reductions from these already low levels. The tax is applied on the sulphur content of heavy fuel oils, coal and peat. The tax rate corresponds to SEK 30 per kilogram of sulphur content. The rate of the tax is relatively high compared to taxes levied on SO₂ in other OECD Countries. The corresponding rate in Norway is about NOK 17/kg.

The sulphur tax can be refunded if sulphur is removed from the exhaust gases and if emissions of SO₂ have been reduced through the use of desulphurisation techniques or other techniques (Norway has a similar system). The refund is SEK 30 per kg of sulphur in proportion to the reductions achieved. Tax reimbursements are mostly based on continuous monitoring systems. In addition to applying a mix of direct regulation and economic instruments to reduce SO₂ emissions, the Swedish government also use financial support programmes to stimulate innovation.

Evaluation of instrument use

The NO_x charge and SO₂ tax are applied as complements to direct regulation. Maintaining the NO_x and SO₂ emissions standards is meant to ensure a minimum environmental quality level. In addition, EU Directives make explicit reference to limit values for local air quality. Geographically differentiated taxes rates could have been introduced to address the spatial component. Geographically differentiated standards – like the Norwegian geographically differentiated regulation on the sulphur content of fuel oil – could have served a similar purpose. Designing instruments to address local problems can be complex, and it may be that the associated economics costs are larger than the environmental benefits obtained. In addition, as total depositions in Sweden are larger than total emissions, attaining a reduced level of deposition at the local level also strongly rests on international co-operation to tackle acidification.

However, studies show that the environmental benefits of the Swedish NO_x charge could justify a major part of the tax (Huhtala and Samakovlis, 2007). We are not familiar with any studies assessing whether the tax rate corresponds to the marginal damage costs. A study for Norway (ECON, 2003) shows that marginal damages from NO_x emissions in urban areas in Norway amounts to about NOK 36/kg and NOK 15 kr/kg in rural areas. The NO_x tax rate in Sweden is SEK 40/kg (or NOK 33/kg with current exchange rates). If the damage costs in Sweden are the same as in Norway, the current Swedish NO_x tax rate seems to be a little above the average damage cost estimate (NOK 25/kg). In Norway the tax rate is NOK 15/kg based on abatement costs to fulfil the Gothenburg protocol.

The total NO_x emissions fell from 306 000 tonnes in 1990 to 197 000 tonnes in 2004. By far, most of the emission reductions between 1990 and 2004 took place in the transport sector. Although it affects only 8 percent of total Swedish NO_x emissions, the charge has been quite effective in reducing emissions from the plants that it covers – in part, because the rate is quite high. Total emissions from the plants covered by the charge have been relatively stable (because of the increasing number of plants covered they haven't gone down), but emissions per MWh energy produced have been reduced, and are less than a half of what they were in 1990.

The motivation for including a refund mechanism in the NO_x charge was indeed to address competitiveness concerns – both internationally

and vis-à-vis other (smaller) domestic plants that (due to the high costs of the equipment needed to measure the emissions) do not have to pay this charge. The refund mechanism also made it possible to set rather high rates in the charge.

Total SO₂ emissions in Sweden have decreased from almost 120 000 tonnes in 1990 to 47 000 tonnes in 2004. The 2010 target – which in 2005 was revised downwards by the Swedish Parliament, from 60 000 to 50 000 tonnes – have thus already been met. By far the largest emission reductions have taken place in the category “other combustion”. This is probably related to the Swedish sulphur tax, which has led to a fall in the sulphur content of oil-based fuels of more than 50 percent beyond the legal standards. The sulphur content of light oils has now fallen below 0.076 percent (i.e. less than half the legal limit of 0.2 percent). The tax is estimated to have reduced emissions of sulphur dioxide by 80 percent compared to 1980 level.

It could in our view be questioned whether the use of several policy instruments have been necessary towards SO₂ emissions, and if not a tax would have been sufficient. However, a tax alone would perhaps give refineries and coal importers limited incentives to reduce the sulphur content of the products, since the tax could be passed on to consumers. Therefore, the double regulations may have been justified. But a tax could have replaced the individual permits to major stationary sources.

10.6.3 Mercury emissions in Norway and Sweden

Norway

Emission limits in discharge permits issued pursuant to Norway’s Pollution Control Act are the most important tool for reducing mercury releases from the manufacturing sector. This legislation prescribes maximum allowable releases of mercury (and other pollutants) from industrial facilities to the environment (air, water and soil/groundwater). The releases from such point sources are regulated individually on a basis of national standards or guidelines. In addition, several industrial plants are covered by BAT requirements of the EU IPPC directive. Strict emission limits have been set for several industries emitting mercury.

Legislation to prevent certain products containing mercury from being marketed nationally or to limit emissions cover thermometers, electrical and electronic products, batteries, antifouling preparations and wood preservatives, pesticides, dental amalgam (to be collected from dental clinics), new crematoria, packaging materials etc. (OECD, 2007). In December 2007 the Ministry of Environment imposed a general ban on the use of products containing mercury in Norway, including dental amalgam.

There are also special regulations for management of waste containing mercury. Products like batteries, electric and electronic articles, fluorescent light tubes, dental amalgam filter residue and end-of-life vehicles

have either producer take-back requirements where producers are required to take back the product when it ends up as waste and treat it properly, or there are special collection and treatment facilities established by the authorities. There is also legislation prescribing maximum allowable concentrations of mercury in wastewater sludge used as fertilizer on agricultural land. Also, there is legislation banning incineration of waste containing more than 0.25 percent mercury and maximum limits to the release of mercury from waste incineration, and a tax on mercury emissions among other hazards from these facilities (see case study II above).

Sweden

Sweden has since early 1990s had the ultimate aim of their policy to totally phase-out the use of mercury, mainly by regulatory means supported by voluntary measures. Between 1992 and 2003 approximately 95 percent of the sold amounts of mercury in products were phased out.

Point sources are regulated by the Swedish Environmental Code. Specific point sources are regulated individually on the basis of national and European Union standards/guidelines. Discharge of pollutants from point sources to air, water and soil may in general not be undertaken without prior permission from a competent authority. In the permission procedure, firms are generally required to use “Best Available Techniques” (BAT).

A combination of agreements, bans on use, producer take-back responsibility (see above) and restrictions on use have been used to reduce the use of mercury. Municipalities have the responsibility to set up collection schemes and ensure special treatment for hazardous household waste, including mercury-containing waste. There are limits for mercury emissions to air and release into wastewater, as well as specification for the depositing of solid incineration residues. The government has given financial support for collection schemes etc. for mercury, including awareness-raising activities. A general ban on the marketing, use exports and imports of mercury and mercury-containing products have been proposed.

The Swedish position is that mercury is a substance that remains a threat to human health and the environment in perpetuity, and for this reason it should not be recycled. Instead, mercury-containing waste should be dealt with in a permanently safe and environmentally acceptable way. Therefore, the Swedish Government has decided that waste containing more than 0.1 percent mercury shall be finally stored in a deep bedrock repository, at the latest by 2015.

Evaluation of instrument use

Emissions in both Norway and Sweden have decreased substantially since 1990. Emissions to air of mercury stem from a number of different point sources, dominated by a few large emitters, and large number of products and diffuse sources which have more complex release- and exposure patterns, with waste incineration being a major component

(OECD, 2007). In addition, mercury can evaporate from deposited mercury-containing waste and from land where such waste was previously deposited. Further, while some of the mercury emitted to air will mix in the atmosphere and contribute to a global problem, some of the mercury compounds will deposit closer to the pollution source, thus representing a local and/or a regional environmental problem. Hence, the complexity of the mercury problem calls for instruments to address emissions from point sources, instruments to help isolate mercury in the waste streams, and instruments to address the temporary or permanent storage of mercury-containing wastes, etc. Norway and Sweden both have instruments in place that seek to address all – or most – of these different aspects of the problem.

For example, Sweden has a broad spectrum of emission standards for point-sources of mercury emissions. It also seeks to prevent mercury from coming into the economy, by strictly regulating the sale of mercury-containing products, by not reimbursing medical expenses if dental amalgam is used, etc. Further, significant subsidies have been applied to promote the collection of mercury from a broad range of historical sources. In addition, all the mercury that has been collected is to be stored in special facilities deep underground, in order to prevent future evaporation.

It would not be possible to address all the relevant aspects of the mercury problem properly (only) with a single instrument, like for example a single tax or trading system. Some of the sources would be impossible to tax, and therefore have to be regulated through technical requirements and other instruments. Also, since mercury do not disappear and could be released again after storage, strict requirement about waste handling need to be enforced.

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PART I:

General

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Sammendrag

Resymé

Denne rapporten består av to deler. Del I presenterer en oversikt over bruken av økonomiske virkemidler i miljøpolitikken i de nordiske landene med hovedfokus på endringer i perioden 2006-2009. Del II gir en kort oversikt over de ulike virkemidlene (også andre enn de økonomiske) brukt i landene mot ulike miljøproblemer, og presenterer to case-studier som vurderer områder hvor en miks av virkemidler benyttes mot et miljøproblem. Det er generelt få endringer i bruken av økonomiske virkemidler siden 2006. Innføringen av EUs kvotehandelssystem ETS og endringer i de fleste landenes registreringsavgifter (engangsavgift) til i større grad å baseres på spesifikt drivstoff-forbruk eller CO₂-utslipp er de viktigste endringene. Generelt kan avgiftssystemene gjøres mer effektive ved å behandle ulike sektorer og brensler mer likt. Ettersom CO₂-utslippene fra kraftproduksjon nå er omfattet av kvotehandel, bør målene og virkemiddelbruken som benyttes til å fremme fornybar elproduksjon revurderes for å se om de fremdeles trengs eller bør reformuleres. De ulike virkemidlene som benyttes overfor avfallsbehandling bør også revurderes for å unngå unødvendig overlapping. De ulike virkemidlene som benyttes for å fremme energieffektivisering ser ut til å supplere hverandre.

Bakgrunn

Miljø- og energigruppen under Nordisk Ministerråd publiserer hvert annet eller tredje år en rapport om bruken av økonomiske virkemidler i miljøpolitikken i de nordiske landene. Denne rapporten er en del av denne serien. Første del av rapporten presenterer en oversikt over bruken av økonomiske virkemidler med hovedfokus på endringer i perioden 2006-2009. Den andre delen av rapporten gir en kort oversikt over de forskjellige virkemidlene (d.v.s. også andre enn de økonomiske) som benyttes i landene mot de ulike miljøproblemene, og presenterer to case-studier på områder hvor en miks (d.v.s. mer enn ett) av virkemidler benyttes mot et miljøproblem. Case-studiene er stasjonær energiproduksjon og –bruk, inkludert klimapolitikk i Norge, og avfallspolitikken i Sverige. Siden det er mange likheter i virkemiddelbruken mellom de nordiske landene er case-studiene utformet slik at de er relevante for de fleste av landene.

Økonomiske virkemidler kalles ofte incentiv-baserte virkemidler og omfatter følgende:

- Utslippsavgifter, d.v.s. avgifter ilagt enten direkte på utslippene eller på en innsatsvare, produkt eller tjeneste assosiert med forurensning (for eksempel avgift på karboninnholdet i drivstoff)
- Avgifter på produkter ut fra andre hensyn enn miljøbeskyttelse, men som også kan ha positiv miljøeffekt (for eksempel kjøpsavgift på biler, elavgift)
- Pante-returordninger hvor kjøperne betaler en avgift ved kjøp av et produkt for å få refundert hele eller deler av denne når produktet leveres inn til behandling når det ender opp som avfall.
- Subsidier til utslippsreduksjoner
- Subsidier for produksjon av fornybar energi, energieffektiviseringstiltak (enøk) etc. som indirekte kan gi miljøfordeler (inkludert såkalte grønne sertifikater for fornybar elproduksjon)
- Handel med utslippstillatelser, hvor et tak settes på de samlede utslippene og utslippstillatelser fordeles gratis eller auksjoneres blant utslippskildene
- Gebyrer ilagt salg av produkter for å dekke kostnadene ved innsamling og behandling av produktene for å sikre høy innsamlingsgrad og forsvarlig behandling når de ender som avfall.

Konklusjoner og anbefalinger

Få endringer siden 2006

Generelt er det få endringer i avgiftssystemene og -satsene siden 2006. De fleste avgiftssatsene er justert i henhold til prisstigningen. De viktigste endringene som berører alle de nordiske landene er innføringen av EUs kvotehandelssystem (EU ETS), som ble innført på forsøksbasis fra 2005, men som er gjort permanent fra 2008. De fleste kvotene deles ut gratis til bedriftene som systemet omfatter. For å redusere omfanget av ”dobbel beskatning” har Danmark, Norge og Sverige justert sine CO₂-avgiftssystemer.

Danmark, Finland og Norge har endret sine registreringsavgifter ved kjøp av nye biler slik at de i større grad baseres på spesifikt drivstoffforbruk eller CO₂-utslipp. Det norske systemet er endret mest i denne retningen. Videre er det gjennomført noen endringer i årsavgiftene for eie av kjøretøy i retning av å miljødifferensiere avgiftene. Alle de nordiske landene vil ha miljødifferensierte årsavgifter fra 2010.

Videre er det innført en del systemer for produsentansvar, hovedsakelig for å oppfylle EU-krav. Dette dreier seg om bl.a. innsamling og behandling av bilvrak og elektrisk og elektronisk avfall.

Tabell 1 gir en oversikt over bruken av økonomiske virkemidler i de nordiske landene. Det er vanskelig å vurdere bare ut fra tabellen hvilke av

landene som benytter økonomiske virkemidler mest intensivt i miljøpolitikken. Danmark, Norge og Sverige har alle mange slike virkemidler i bruk, hvorav Danmark ser ut til å ha den mest omfattende bruken. Det er ikke alltid lett å sammenlikne landenes bruk av økonomiske virkemidler, ettersom det er mange ulike utforminger av avgiftsgrunnlaget, unntak, satser etc.

Tabell A Oversikt over bruk av økonomiske virkemidler i de nordiske landene i 2009.

	DK	FIN	IS	N	S
<i>Energibruk og luftforurensning</i>					
Elektrisitetsavgift	X	X		X	X
Avgift på fyringsolje etc.	X	X		X	X
Avgift på transportdrivstoff	X	X	X	X	X
CO ₂ -avgift på fyringsolje	X	X		X	X
CO ₂ -avgift på drivstoff	X	X		X	X
Handel med CO ₂ -utslippkvoter for energi-intensive bedrifter	X	X		X	X
SO ₂ -avgift	X			X	X
NOx-avgift				X	X
Subsidieordninger for fornybar energi, energieffektiviserings-tiltak etc.	X	X		X	X
<i>Vannforurensning</i>					
Avgift på spillvann	X				(X)
Avgift på bruk av vann	X				
<i>Avfall</i>					
Deponiavgift	X	X		X	X
Forbrenningsavgift	X			X	X
Avgifter, pante-returordninger eller andre returordninger for drikkevarer-emballasje	X	X	X	X	X
Avgifter på annen emballasje	X				X
Gebyrer for å finansiere innsamling og behandling eller pante-returordninger for produkter: bilvrak, batterier, dekk, smøreolje, plantevernmidler	X	X	X	X	X
Avgift på drivhusgasser (industrigasser)	X			X	
Avgift på PVC, phthalates og klorbaserte løsemidler	X				
<i>Transport</i>					
Registeringsavgift (engangsavgift)	X	X	X	X	
Årsavgift	X	X	X	X	X
Miljø/støyrelaterte gebyrer i luftfart		X		X	X
Rushtidsavgift i byer					X
<i>Landbruk og naturressurser</i>					
Avgift på uttak av naturressurser	X				
Avgift på plantevernmidler				X	X
Avgift på bruk av kunstgjødsel	X				X
Omsettelige fiskekvoter			X		

Kilde: Econ Pöyry

Danmark har hatt en avgiftsfrys

Danmark innførte en frys i sine avgifter fra 2001/2002, noe som har gjort at de fleste avgiftssatser har vært uendret siden. Subsidier for vindkraftproduksjon og annen fornybar kraftproduksjon er økt for perioden 2008-2011. Danmark er fremdeles det eneste landet med avgift på vannforurensning og avgift på PVC, phthalater, klorbaserte løsemidler og på uttak av naturressurser. Fra april 2007 ble det gjennomført noen viktige endringer i systemet for registreringsavgiften som favoriserer små, driv-

stoff-effektive biler på bekostning av de med høyt drivstoff-forbruk. El- og hydrogendrevne biler har fullt fritak fra avgiften. Fra 2010 vil det bli innført en NO_x-avgift og en rekke andre avgifter.

Endringer i bilavgiftene i Finland

Det finske systemet med avgifter på energi- og utslipp til luft har vært mer eller mindre uendret siden 1997, bare avgiftssatsene er noe justert. Registreringsavgiftene for kjøretøy ble endret i 2008, og differensiert i henhold til spesifikt drivstoff-forbruk. Avgiftssatsene ble generelt kuttet med 1/6. Årsavgiften for kjøretøy vill sannsynligvis bli endret fra 2010 og bli basert på CO₂-utslippene fra kjøretøyet.

Island har ingen avgifter på stasjonært energiforbruk eller luft-forurensning

I Island stammer det aller meste av el- og varmeproduksjonen fra vannkraft eller jordvarme. Den lokale luftkvaliteten er god, og det har derfor ikke vært noen grunn til å avgiftsbelegge stasjonært energiforbruk fra et miljøsynspunkt. Det er imidlertid fiskale avgifter på transport-drivstoff, og systemet har i hovedsak vært uforandret i mange år. Landet har også en avgift på registrering ved kjøp av nye privatbiler, som er differensiert etter motoreffekt, og en vektavgift på alle kjøretøy. Kjøretøy større enn 10 tonn betaler en spesiell vekt-distanseavgift. Island har ingen avgifter på avfallsbehandling, men noen gebyrer og panteordninger for drikkevareemballasje, bilvrak etc. Systemet med omsetning av individuelle fiskekvoter for fiskere er relativt unikt, og ser ut til å ha fungert bra.

Flest endringer i avgiftssystemene i Norge

Avgiftssatsen for grunnavgiften for bruk av mineralolje ble økt i 2008 for å komme på linje med den generelle elavgiften for å unngå substitusjon fra elektrisitet til fyringsolje. Men industrien betaler en svært lav, EU-minimum elavgift, noe som betyr at den relative elprisen har blitt enda lavere enn tidligere for disse brukerne. CO₂-avgiftssatsene er hovedsaklig justert i henhold til prisnivået, men nesten halvert for offshore-installasjonene fra 2008 for å redusere omfanget av ”dobbel avgiftsbelegging” på grunn av innlemmingen av EU ETS for denne sektoren.

En NO_x-avgift på utslipp fra store kilder ble innført i 2007 for å bidra til å nå det nasjonale målet for disse utslippene. Det ble inngått en avtale mellom myndighetene og industrien om at bedrifter som betaler inn til et fond for å finansiere utslippsreducerende tiltak kan få fritak for avgiften. Videre ble det avsatt et mindre beløp på statsbudsjettet for å gi kompensasjon for de virksomhetene som vil bli mest berørt av avgiften.

I 2007 ble også engangsavgiften ved registrering av nye biler betydelig endret. En CO₂-komponent ble innført til erstatning for slagvolum-komponenten. Avgiften er nå basert på vekt, motoreffekt og CO₂-utslipp. Avgiftssatsene er blitt ytterligere endret siden 2007, og systemet favoriserer i dag sterkt kjøp av lavutslippskjøretøy og straffer kjøp av biler med

høye utslipp. El- og hydrogendrevne biler har fullt fritak for avgiften. Årsavgiften for kjøretøy er fra 2008 differensiert ut fra om dieselskjøretøy har partikkelfilter eller ikke.

Sverige er et eneste nordiske landet med grønne sertifikater

I Sverige har det meste av systemet for avgiftslegging av energibruk og utslipp til luft vært mer eller mindre uendret siden 2006, bare avgiftssatsene er justert. På grunn av innenlandsk bilproduksjon er Sverige det eneste nordiske landet uten registreringsavgift. Men man har en årsavgift differensiert etter miljøkriterier. Sverige er også det eneste nordiske landet med et system for handel med grønne sertifikater for fornybar elproduksjon. Videre er Stockholms rushtidsavgift, som ble gjort permanent fra 2007, et interessant eksempel på en ny miljøavgift som kan være et eksempel for andre byer.

Avgiftssystemene kan gjøres mer effektive

Det er ingen tvil om at CO₂- og forbruksavgiftene på ulike energivarer i betydelig grad har bidratt til utslippsreduksjoner. Men avgiftssystemene kunne bli mer kostnadseffektive hvis avgiftssatsene varierte mindre mellom sektorene. Videre bidrar reduserte rater for naturgass i noen land til å svekke konkurranseposisjonen til utslippsfrie alternativer.

Også CO₂/drivstoff-differensieringen av engangsavgiftene på kjøp av kjøretøy har hatt effekt gjennom en reduksjon av de spesifikke utslippene fra nye biler. Men effektene avhenger i stor grad av størrelsen på differensieringen, og jo flere land som differensierer sine avgiftssystemer, jo sterkere signaler sendes til bilprodusentene om å utvikle biler med lave utslipp.

Ulike subsidiesystemer for fornybare energikilder blir evaluert i mange land, og det stilles spørsmålsteget ved effektiviteten av tilskudd og avgiftslettelser for disse kildene. I Norge vurderes det å innføre et system med grønne sertifikater for fornybar el koblet til det svenske systemet.

Virkemiddelmiksen for å fremme fornybar elproduksjon bør vurderes på nytt i lys av innføringen av kvotehandel for CO₂

Det er mange mål i den norske miljø- og energipolitikken, men de viktigste målene ser ut til å være å redusere utslippene av drivhusgasser og bedre energieffektiviteten. En rekke virkemidler som subsidier, informasjon for å fremme fornybar el og mer effektiv bruk av el for å redusere utslippene av drivhusgasser fra elproduksjon har blitt benyttet i de fleste nordiske land. Det er også avgifter på CO₂-utslipp, elforbruk og bruk av fyringsolje i tillegg til kvotehandel for CO₂-utslipp. Utslippene fra kraftproduksjon er siden 2005 omfattet av EU ETS, noe betyr at de totale utslippene fra kvotehandelssystemet har et tak. Dette betyr at å fremme produksjonen av fornybar el eller effektiv bruk av el ikke lenger gir noen netto utslippsreduksjoner. Derfor bør målene og virkemidlene som benyttes gås gjennom på nytt for å se om de fremdeles trengs eller bør endres.

Endringer i bruken av virkemidler som avgifter og kvotehandel direkte rettet inn mot ulike kilder for utslipp av drivhusgasser bør vurderes for å bidra til mer kostnadseffektive utslippsreduksjoner. CO₂-avgiftene bør utformes mer likt på tvers av kilder, og avgiftssatsene kan settes slik at de gjenspeile kvoteprisene i kvotehandelssystemet, eller kvotehandelssystemet kan ekspanderes for å inkludere noen sektorer som i dag dekkes av CO₂-avgift.

Virkemidlene som benyttes for å fremme energieffektivisering supplerer hverandre

Mer effektiv el- (og energi)bruk vil redusere det totale energiforbruket. Siden det er en rekke tiltak med lave eller ingen kostnader som kan gjennomføres både i industrien og husholdningene for å bruke energi mer effektivt og som kan være billigere for samfunnet enn for eksempel investeringer i ny produksjonskapasitet for el, er det fornuftig å fremme enøk-tiltak. Det er en rekke årsaker til at husholdninger og bedrifter ikke vil investere tilstrekkelig i slike tiltak.

Å fremme enøk-investeringer og mer enøk-vennlig atferd må adresseres på mange plan gjennom ulike virkemidler. Tekniske standarder og standarder knyttet til forbruk eller utslipp påvirker design og konstruksjon av nye bygg og en rekke typer utstyr, og bidrar til redusert energiforbruk. Subsidier for ulike energisparetiltak (inkludert substitusjon mellom energibærere) retter seg inn mot eksisterende bygg og utstyr, og fremmer redusert energibruk i eksisterende bygnings- og kapitalmasse. De ulike avgiftene (inkludert kostnader til utslippskvoter) på el og fyringsolje gir brukerne signaler gjennom energiprisene om de reelle kostnadene ved energibruken, og påvirker omfanget av energibruken. Informasjonsaktiviteter kan påvirke alle disse ulike beslutningene, og bidra til å styrke virkningene av avgifter, utslippshandel og subsidier.

Derfor ser det ikke ut til at kombinasjonene av virkemidler rettet mot energieffektivisering i husholdninger og industri som benyttes i Norge og de fleste nordiske landene motvirker hverandre eller svekker de totale effektene. I den grad virkemidlene fremmer billige tiltak som ellers ikke ville blitt gjennomført kan det sies at de bidrar til økt kostnadseffektivitet i utslippsreduksjonene av drivhusgasser og i energiforsyningen.

De ulike virkemidlene i avfallspolitikken bør revurderes for å unngå overlapping

Selv om vårt case-studie viser at et er mange mål i Sverige og de fleste andre nordiske landene for hvordan avfall bør sorteres og behandles for å kunne material- eller energigjenvinnes i henhold til det såkalte "avfallshierarkiet", er det primære målet knyttet til å redusere miljølempene knyttet til avfallsbehandling, spesielt å redusere utslippene av klimagasser. Noen mål ser også ut til å være relatert til å fremme mer effektiv (bærekraftig) ressursutnyttelse for å spare uttak av naturressurser som tømmer, metaller og olje. Avgifter på avfall levert til forbenning og deponering er innført i de fleste nordiske landene. I Norge er utslippene fra

avfallsforbrenning avgiftsbelagt direkte og avgiften på deponering er differensiert ut fra miljøstandarder på deponiet. I tillegg er det i alle landene en rekke reguleringer for å redusere utslippene fra forbrenning og deponier. Dessuten er det innført en rekke virkemidler for å redusere mengden avfall som genereres og for å sortere ut ulike avfallsfraksjoner for material- eller energigjenvinning.

Mange av disse virkemidlene er overlappende og flere av dem synes unødvendige. EUs forbud mot deponering av biologisk avfall, som følges opp av alle nordiske land, innebærer at en rekke av de eksisterende virkemidlene som rettes inn mot deponier vil bli unødvendige. Men tekniske krav til eksisterende deponier vil fremdeles være nødvendige for å unngå fremtidige utlekkinger til vann og luft, ettersom lekkasjene er svært vanskelige å måle og avgiftsbelegge. Utslipp fra forbrenningsanlegg kan skattlegges direkte i kombinasjon med en avgift på det fossile karboninnholdet i avfallet slik som det gjøres i Norge, for å gi langsiktige incentiver for å redusere utslippene. I tillegg kan en vurdere å regulere utslippene av noen stoffer som eventuelt ikke avgiftsbelegges, mens andre reguleringer eller tekniske krav til utslippene fra avfallsforbrenning synes unødvendige. Avfall som inneholder helse- og miljøskadelige stoffer bør fortsatt sorteres ut og behandles separat for å unngå utslipp av disse til luft. Pante- og returordninger for flasker og bokser kan beholdes for å unngå forsøpling. Informasjonstiltak for å støtte de ulike virkemidlene bør beholdes.

De ulike målene og tiltakene for material- og energigjenvinning bør vurderes nøye, ettersom de ikke ser ut til å være nødvendige verken fra et miljøsynspunkt eller ut fra hensyn til optimal utnyttelse av naturressurser. Gitt riktige prissignaler, inkludert miljøkostnader, vil markedene selv finne de samfunnsøkonomisk mest lønnsomme måtene og mengdene for material- og energigjenvinning.

Annex: Review of instrument mixes

For each country we present a short overview of the use of policy instruments used in the various areas in the Nordic countries³⁷. In the tables for each country it is indicated by an “X” in the cells where an instrument is used, and no “X” if it is not in use.

The instruments in the table are divided into three main categories (see the columns of the table below):

Economic instruments:

- Taxes and charges
- Tradable permits (mainly EU ETS)
- Other (deposit-refund systems, certain types of subsidies, but not support/funding for research on renewables etc)

Direct regulation (“Command-and-Control”):

- *Technology mandates*: a specific requirement regarding the production process (for example to install particular equipment, abatement technology etc)
- *Performance standards*: requirement that a firm’s output meet certain criteria (e.g. max emission rates per kWh of electricity, energy efficiency standards for buildings or household appliances, fuel economy requirements for new cars etc). This category also includes (non-tradable) emission permits/allowance given to specific large emission sources (e.g. a large factory).

Other policy instruments:

- *Information disclosure*: Includes labelling (e.g. certification of “green products” etc), public disclosure (e.g. rating of firms by the government, information campaigns to save on electricity etc) and certification schemes (“Svanemerket” etc)
- *Agreements*: Negotiated agreements or similar between industry sectors (typically) and the government to voluntarily reduce pollution to some agreed levels.

³⁷ We were unable to assemble this information for Iceland.

- *Other*: This is for instrument types that don't fit in the other categories like bans on certain substances, other types or regulations.

The rows in the table are arranged according to the types of environmental problems/sectors under the main categories we have for Part I of the report (except we have merged transport with energy and air pollution).

There are often several instruments in use for each environmental problem, reflecting that different policy instruments are used for various emission sources (sectors) and that several instruments are used towards the same environmental problem towards one source/sector. The division is quite rough, so there may be some overlap between each line. There are explanations for each table.

Explanations to the table lines:

Energy an air pollution:

- *Electricity use*: Instruments that aim to reduce the use of electricity
- *Electricity production*: Instruments directed towards existing producers and production based on new, renewable sources.
- *Fuel oil use*: Instruments to reduce the use of fuel oil, typically for heating. These are fuels not used for transport (next category). For example tax on the part of the fuel oil which is not specifically targeted for SO₂ or CO₂ (covered by next categories)
- *Transportation fuels*: Diesel and petrol. Taxes, subsidies for alternative fuels, information about fuel use for new cars.
- *GHG emissions*: We have divided this into different sectors, as different sectors may be treated quite differently. There is some potential overlap here for “transport” with transport fuels above.
- *SO₂, NO_x*: Tax, standards and other regulations
- *Toxics substances to air/water*: These substances are typically regulated using standards because small amounts are very toxic and damaging. This would be substances like mercury and products containing it.

Water pollution:

- *Industry*: In most cases, large point sources (e.g. large factories) have effluent permits (i.e. max discharge to a river per time unit or something). Indicate broad types of instruments.
- *Agriculture*: Water pollution from agriculture is related to many, smaller sources. Technical standards and subsidies are used.

Waste:

- *Landfill:* Various taxes and standards, information etc.
- *Incineration:* Same as above
- *Households:* Specific instruments influencing household waste generation and recycling etc
- *Industry:* Specific instruments influencing industry waste generation and recycling etc

Natural resources:

- *Forestry:* Types of instruments influencing environmental impacts of forestry
- *Fisheries:* Not gone into this very much

Nature conservation: This is the category which covers creation of protected areas, natural parks, subsidies for conservation of cultural landscapes, biodiversity

Table A1 Overview of instrument use in Denmark

	Economic instruments			Direct regulation	Other policy instruments			
	Taxes, charges	Permit trading	Other	Technology mandates	Performance standards	Information disclosure	Agreements	Other
<i>Energy and air pollution:</i>								
Electricity use	X		X	X	X	X		X
Electricity production		X	X	X				
Fuel oil use	X		X		X	X		
Transportation fuels	X					X		
GHG emissions:	X					X		
- Household	X			X	X	X		
- Industry	X	X				X		X
- Transport	X		X					
SO ₂	X			X	X			
NO _x	(X)			X	X			
Toxic substances to air/water				X	X			
<i>Water pollution:</i>								
Industry	X						X	
Agriculture	X		X	X	X	X		
<i>Waste:</i>								
Landfill	X			X				X
Incineration	X			X	X			X
Households	X		X			X		X
Industry	X		X			X	X	X
<i>Natural resources:</i>								
Forestry	X				X			X
Fisheries								
Nature conservation			X					X

Energy and air pollution

- Electricity use: Subject to taxes both in households and industry, subsidies for various energy efficiency measures, technical standards for insulation etc. in houses, performance standards, information (labels etc.) about electricity use in apparel and other equipment, agreements between large energy industrial energy consumers and the public.
- Electricity production: EU ETS, subsidies for renewable electricity production, technology mandates for power producers
- Fuel oil use: Tax, subsidies for phasing out fuel oil heaters and demand of replacing old fuel oil heaters either with newer more efficient heaters or by switching to more energy efficient solutions.
- Transportation fuels: Fuel taxes, information on fuel use
- GHG emissions from households: Taxes on fuel oil use, on reducing fuel oil use, standards on fuel use in new houses etc., information about energy efficient solutions when building new houses and refurbishment.
- GHG emissions industry: Taxes on some fuel oil use for some industries, emissions trading, agreements for some large industrial energy consumers.
- SO₂: tax on fossil fuels, standards on sulphur content in fuels, regulation of emissions from industry sources
- NO_x: A tax on NO_x is expected to be introduced 1. January 2010. Large CHP plants have emissions limits for NO_x

Water pollution

- Industry: Tax on wastewater, large industrial energy consumers and polluters are required to publicly disclose their environmental stands
- Agriculture: Tax on pesticide use, subsidies to avoid release to water, some technology mandates. Information about behaviour to avoid release to water.

Waste

- Landfills: Tax on waste, technical requirements to avoid release to water and air (methane), ban on landfilling certain waste categories.
- Incineration: Tax on waste delivered for incineration, emission standards for incinerators, legislation towards combustion of waste and deploying new technology
- Households: Tax (charge) on waste delivery, deposit refund systems, information about recycling etc, requirements for waste sorting
- Industry: Tax (charge) on waste disposal and the use of specific materials like PVC, deposit-refund systems, information about recycling etc., requirements for waste sorting, rules for how to dispose

or recycle hazardous waste, different agreements and subsidies towards the industry regarding recycling of packaging materials and used building materials.

Natural resources

- Forestry: Program to increase the amount of forest in Denmark, thereby also improving the water environment
- Fisheries: NA
- Nature conservation: Funding for conservation of land, conservation of land (natural parks, protected areas etc).

Table A2 Overview of instrument use in Finland

	Economic instruments			Direct regulation	Other policy instruments			
	Taxes, charges	Permit trading	Other	Technology mandates	Performance standards	Information disclosure	Agreements	Other
<i>Energy and air pollution:</i>								
Electricity use	X		X		X	X	X	
Electricity production		X	X	X				
Fuel oil use	X		X		X	X		
Transportation fuels	X		X			X		
<i>GHG emissions:</i>								
- Household	X		X			X		
- Industry	X	X	X					
- Transport	X					X		
SO ₂			X	X	X			
NOx				X	X			
Toxic substances to air/water				X	X	X		X
<i>Water pollution:</i>								
Industry				X	X			
Agriculture			X	X	X	X	X	
<i>Waste:</i>								
Landfill	X			X	X	X		X
Incineration				X	X			X
Households	X		X			X		X
Industry	X		X	X	X	X		X
<i>Natural resources:</i>								
Forestry			X		X	X	X	
Fisheries					X	X		X
Nature conservation			X		X	X	X	X

Energy and air pollution

- Electricity use: taxes, subsidies for energy efficiency measures, standards for some energy use, information about energy efficiency measures, agreement with industry on energy efficiency improvements,

- Electricity production: EU ETS, subsidies for renewable electricity production, technology mandates for existing producer (nuclear m.m.)
- Fuel oil use: Tax on fuel oil, bio fuel oil used in working machines (diesel) or in heating is tax-exempted. Information about investment funds for using alternative fuels etc. Investment subsidies for biofuels used in large properties.
- Transportation fuels: Taxes on fuel use, information about the fuel use and emissions of the new cars. Investment subsidies for biofuel production.
- GHG emissions households: CO₂ fuel taxes, car sales tax, natural gas has been granted a 50 percent discount on the CO₂ tax. Information about CO₂ emissions from new cars.
- GHG emissions industry: Taxes, EU ETS, subsidies
- SO₂: reduced tax rates (subsidies) on desulphurised fuels, standards for industry
- NO_x: standards for industry and vehicles
- Toxics substances to air and water: technical and performance standards for industry, products etc. Bans on use of some substances

Water pollution

- Industry: technical and performance standards
- Agriculture: support schemes, technical and performance standards, information activities and agreement with authorities.

Waste

- Landfill: The waste tax, standards and information activities, ban on landfilling some fractions
- Incineration: Standards.
- Households: Municipal waste charges, deposit refund systems, information activities, requirements for waste sorting etc.
- Industry: waste charges, deposit refund systems, standards for handling of own waste, producer responsibility, bans on some waste handling

Natural resources

- Forestry: Direct aid or loans to finance measures intended to protect the sustainability of wood production, maintain the biological diversity of the forests, and carry out projects for managing the forest nature and other supportive measures. Protecting areas, standards for forestry management. Information activities, agreement with authorities on forest management.
- Fisheries: Licensing for fisheries according to fish population

- Nature conservation: compensations to landowners for protecting areas, performance standards for protected areas.

Table A3 Overview of instrument use in Norway

	Economic instruments			Direct regulation	Other policy instruments			
	Taxes, charges	Permit trading	Other	Technology mandates	Performance standards	Information disclosure	Agreements	Other
<i>Energy and air pollution:</i>								
Electricity use	X		X	X	X	X		
Electricity production		X	X	X		X		
Fuel oil use	X		X	X		X		
Transportation fuels	X		X			X		
GHG emissions:								
- Household	X		X			X		
- Industry	X	X	X				X	
- Transport	X		X			X		
SO ₂	X			X	X		X	
NOx	X		X		X		X	
Toxic substances to air/water	X			X	X	X		X
<i>Water pollution:</i>								
Industry					X			
Agriculture	X		X	X		X		
<i>Waste:</i>								
Landfills	X			X				X
Incineration	X				X			
Households	X		X			X		X
Industry	X		X		X	X		X
<i>Natural resources:</i>								
Forestry					X			
Fisheries								X
Nature conservation			X					X

Explanation of the various instruments used:

Energy and air pollution

- Electricity use: Subject to taxes both in households and industry, subsidies for various energy efficiency measures, technical standards for insulation etc. in houses, performance standards for gas fired plants, information (labels m.m.) about electricity use in apparel and other equipment.
- Electricity production: Regulations when new hydro and wind installations are built (technical mandates). Gas fuelled power plants need emission permits for CO₂ and other substances, and would be a part of EU ETS. Support schemes to promote renewal electricity production (wind, waves, tidal power etc.). Grants to investments in windmill production capacity etc. Information activities for this.

- Fuel oil use: Tax on fuel oil, subsidies for energy efficiency measures and fuel switch, some energy standards, information about subsidies and how to switch to renewable energy etc.
- Transportation fuels: Taxes on fuel use, various (indirect) subsidies for alternative fuels, information about specific fuel use for new cars.
- GHG emissions from households: Taxes on fuel oil use, subsidies etc. on reducing fuel oil use, information about this
- GHG emissions industry: Taxes on fuel oil use for some industries, permit trading for others, agreements for some industries. Support for measures to reduce use of fossil fuels
- GHG emissions for transportation: Taxes on fuel, information about CO₂ emissions from new cars.
- SO₂: Tax on sulphur content in fuel oil (refunded when emissions are cleaned), limits for sulphur content in fuel oil, individual emission limits and/or general emission standards for some industries, agreement on emission reductions from industry.
- NO_x: tax on some emission sources, economic compensation for those most affected by the tax, performance standards for vehicles and some industries, agreement on emissions reductions in return for NO_x tax reduction
- Toxic substances to air/water: Taxes on use of some substances (TRI and PER) , technology requirements for some industries and products, individual emission limits and/or general emission standards for some industries, information about damages from use of products containing toxic substances, ban on use of some substances.

Water pollution

- Industry: Individual emission limits and/or general emission standards for some industries
- Agriculture: Tax on pesticide use, subsidies to avoid release to water, some technology mandates. Information about behaviour to avoid release to water

Waste

- Landfills: Tax on waste put on landfills, technical requirements to avoid release to water and air (methane), ban on landfilling certain waste categories
- Incineration: Tax on waste delivered for incineration, emission standards for incinerators
- Households: Municipal charge on waste delivery, deposit refund systems, information about recycling etc, requirements for waste sorting

- Industry: Tax (charge) on waste delivery, deposit-refund systems, information about recycling etc., requirements for waste sorting, performance standards for handling of own waste

Natural resources

- Forestry: performance standards for forestry management
- Fisheries: Quota (non tradable) regulations on catchment
- Nature conservation: Funding for conservation of land, conservation of land (natural parks, protected areas etc). agreements on conservation, information activities on conservation.

Table A4 Overview of instrument use in Sweden

	Economic instruments			Direct regulation	Other policy instruments			
	Taxes, charges	Permit trading	Other	Technology mandates	Performance standards	Information disclosure	Agreements	Other
<i>Energy and air pollution:</i>								
Electricity use	X		X	X	X	X		
Electricity production	X		X	X			X	
Fuel oil use	X		X	X		X		
Transportation fuels	X		X			X		
GHG emissions:								
- Household	X		X			X		
- Industry	X	X					X	
- Transport	X				X	X		
SO ₂	X							X
NO _x	X							
Toxic substances to air/water	X				X	X		X
<i>Water pollution:</i>								
Industry	X				X			X
Agriculture	X					X		
<i>Waste:</i>								
Landfills	X			X				X
Incineration	X				X			
Households	X		X			X		X
Industry	X		X		X	X	X	X
<i>Natural resources:</i>								
Forestry	X		X					
Fisheries								
Nature conservation			X					X

Explanation of the various instruments used:

Energy and air pollution

- Electricity use: Subject to taxes both in households and industry. Reduced tax for industry and for certain Northern municipalities. Also tax reliefs for biofuels installed in new houses and subsidies for

conversion to sustainable energy sources. Standards and information activities on electricity efficiency.

- Electricity production: Tax on thermal power output of nuclear power reactors. Also Green certificates for production and available grants for launch of new technologies such as wind power, property tax on wind and hydro power, Programme for Improved Energy Efficiency (PFE), information disclosure.
- Fuel oil use: Sales tax on mineral oil levied according to volume. LPG, coal-based fuels and petroleum coke taxed by weight, information disclosure. Support for efficiency measures.
- Transportation fuels: Taxes on fuel use, exemptions for various purposes, biofuels from vegetable or animal oil is exempt from the tax. grants available for biofuel stations. Information on new car fuel use.
- GHG emissions from households: Taxes on fuel oil use, subsidies etc. on reducing fuel oil use, information disclosure.
- GHG emissions industry: Taxes on fuel oil use for some industries, EU ETS. Agreements with some industries.
- GHG emissions for transportation: Taxes on fuel, subsidies etc. for alternative fuels, environmental performance ranking for cars, information disclosure.
- SO₂: Tax on sulphur content in fuel oil. Oil ranked in environmental classes after sulphur content. Exceptions for certain manufacturing industries apply.
- NO_x: Tax on combustion plants generating more than 25 GWh/year.
- Toxic substances: taxes on the use of some substances, performance standards for some industries, ban on use of some substances, norms for the quality of air and information disclosure.

Water pollution

- Industry: Wastewater pollution charges for industrial users and for oil spills, norms for the quality of water.
- Agriculture: Fertilizer tax, pesticide tax, information activities

Waste

- Landfills: Tax on waste put on landfills, technical requirements to avoid release to water and air, ban on landfilling certain waste categories based on EU regulation.
- Incineration: Tax on waste delivered for incineration, emission standards for incinerators through EU regulation.
- Households: Municipal charge on waste delivery, deposit refund systems, information about recycling etc, requirements for waste sorting, product taxes.

- Industry: Municipal charge on waste delivery, tax on GHGs (industrial gases), deposit-refund systems, producer responsibility (also voluntary), information about recycling etc., requirements for waste sorting

Natural resources

- Forestry: Tax incentives for the forest sector, grants for planting forest etc.
- Fisheries:

Nature conservation: Grants for conservation of land.