

The financial crisis and fiscal consolidation in green budgets





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*Annegrete Bruvoll, Friðrik Már Baldursson, Silja Kralik
and Haakon Vennemo*

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Nordic Council of Ministers

Ved Stranden 18

DK-1061 Copenhagen K

Phone (+45) 3396 0200

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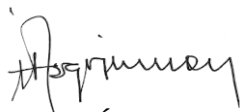
Preface

The financial crisis has developed into a debt and budget crisis, particularly acute in several European countries. From the environmental side it has long been emphasized that while policy in the first phase required and led to stimulation measures, fiscal consolidation efforts in this phase should focus on increased tax revenue through new and increased environmental taxes and charges, and on expenditure cuts achieved by reducing environmentally harmful subsidies. There is considerable international attention to the potential and the need for reducing environmentally harmful subsidies, particularly related to consumption and production of fossil fuels.

This project adds insight into the potential contribution to fiscal consolidation from environmental tax and subsidy reforms, i.e. strengthening public budgets while at the same time improving economic efficiency and the environment.

The potential in getting the prices right is particularly high for greenhouse gas emissions. The report concludes that, within reasonable prices, the revenue potentials in green fiscal consolidation are substantial in a system with taxes and/or auctioned emission permits covering all greenhouse gases. Despite these potentials, there are no clear signs that the financial crisis has led to general increases in environmental taxes, fees or tradable quota prices so far. Still, the single country studies reveal implementation of new revenue generating environmental instruments after 2007, such as carbon taxes and increased pollution charges.

Given the multiple benefits of environmental efficiency and fiscal improvements, the authors recommend the use of environmental taxation and removal of environmentally harmful subsidies as part of the solution to the financial crisis.



Halldór Ásgrímsson
Secretary General
Nordic Council of Ministers

Summary and policy recommendations

An important manifestation of the economic downturn of the last few years is that countries have huge public sector deficits and excessive amounts of public debt. This has led countries to look for additional sources of revenue as well as cutting expenditure.

Environmental taxes, fees and income from tradable quotas are potential sources of revenue. While most taxes are detrimental to economic efficiency, environmental taxes, fees and tradable quotas will often increase economic efficiency and economic welfare. We have a win-win situation: Revenue is raised to reduce deficits, and efficiency is increased, at the same time.

By general consensus environmental taxes and quotas are too low in almost all countries and have too many exemptions compared to the optimal situation. In some countries environmental taxes are negative, that is, environmentally harmful goods and activities are subsidized. Fossil fuel is the prominent example. In joint work the IEA, OPEC, OECD and World Bank have recently argued that under current trends fossil fuel subsidies could reach USD 660 billion by the end of this decade. In the countries that carry this furthest, fossil fuel subsidies amount to 20–30% of GDP.

Given the twin challenges of increasing environmental taxes and consolidating public budgets we ask

- What are the revenue potentials of increasing environmental taxes and from reducing direct budgetary subsidies in relation to public sector deficits?
- To what extent have countries used the occasion of the economic downturn to reform environmental policy?

The revenue potential in Europe lies mainly with carbon pricing

We find that most of the potential of environmental pricing for reducing public sector deficits in Europe lies with carbon pricing.

To argue this case we examine the optimal emission taxes on the air pollutants SO₂, NO_x, PM_{2.5}, NH₃ and VOC. We make use of analyses carried out at IIASA that estimate target emission levels across Europe in 2020 and the associated marginal cost of reaching the targets in each EU member country. The estimated marginal environmental costs equal optimal environmental taxes. We find that revenue from the optimal

taxes, imposed on the optimal quantities, amount to EUR 7 billion in 2020 across Europe.

EUR 7 billion is a significant amount, but compared to the GDPs and even budget deficits of European countries it is a small figure. We have not examined the potential revenue impact of discharges to water, but the results found for pollutants to air give an indication.

The potential for revenue from carbon pricing is much higher, but the actual potential does of course depend on the price and whether or not potential quota revenue is handed over to businesses in the form of non-auctioned quotas. In order to illustrate the potential of carbon pricing for public revenue we hypothetically impose a price of EUR 50 /ton CO₂ on European Union carbon emission levels of 2009, that is, one year into the economic downturn. In the long run emissions are planned to go down, especially when associated with high emission prices. To the extent they go down our illustration overestimates revenue.

Given our assumptions the potential revenue associated with a EUR 50 per ton price on CO₂ amounts to EUR 240 billion. This amount of course dwarfs the EUR 7 billion revenue potential from air pollutants. In some of the countries hit by the economic downturn the revenue from a EUR 50 per ton price on CO₂ would be a quite helpful contribution to lowering budget deficits. It would for instance cover almost half the deficit of Iceland and Portugal, more than half the then deficit of Iceland and one fourth of the 2011 budget deficit of Greece. (The deficit of Iceland is currently lower than in 2011). By comparison the potential revenue from a carbon price of EUR 8 per ton CO₂, similar to the current EU ETS level, is fairly modest. In all countries considered it would matter less than one percentage point for budgetary deficits.

In order for carbon pricing to contribute this much it would be essential that all quotas were auctioned with the proceeds going to the state. Emissions not covered by EU ETS would have to be covered by an environmental tax of EUR 50 per ton. Any suggestion to this effect may conceivably run into political opposition, as businesses would worry about the consequences of an additional expense in times of economic difficulty. The counter-argument to this opposition is of course that deficits must be reduced in one way or another. By relying on an economic instrument that improves economic efficiency European governments will in fact burden businesses and societies less instead of more.

We conclude that the revenue potentials are substantial in a system with carbon taxes and/or auctioned emission permits covering all greenhouse gases within reasonable prices, considering what prices are necessary to meet the GHG challenge.

Most countries have not increased environmental taxes or reduced direct subsidies substantially during the economic downturn

Despite the potential found in particularly carbon taxation, we do not find clear signs of *general* increases in environmental taxes, fees or tradable quota prices during the economic downturn so far. Still, when going into details in our case studies (Iceland, Ireland and Estonia), we do find that new revenue generating environmental instruments have been implemented after 2007, such as carbon taxes and increased pollution charges. In Iceland a carbon tax on fossil fuel has been introduced and the taxation of vehicles has been changed so as to reflect carbon emissions. Iceland seems to turn to taxation of natural resources and tourism, in addition to harmonizing their climate policy with other European countries. Still, despite its concurrence in time, it is not clear whether the policy changes are influenced by the financial crisis.

In Estonia the overall picture is that there have been no major changes in the environmental policy objectives in response to the crisis. The increase of environmental taxation and finding ways for cutting environmentally related subsidies was already agreed before the financial crisis, in 2005. However, the necessity to balance the budgets had direct effect on the timing of introducing the new tax rates. Further, during 2010 and 2011 the state sold the greenhouse gas emission allowances, and abolishing environmentally harmful subsidies has also been part of a wider tax reform programme. This has helped slightly to balance the government budget and reduce costly tax exemptions.

Particularly Ireland seems to discuss the potential of using pollution taxes for fiscal consolidation. It seems clear that the financial crisis has been important for the introduction of a carbon tax in addition to other environmental charges, and de facto contributed to reform implicit subsidies. The carbon tax started out at a relatively low level in order to give time for adjustments, and has later increased beyond the market price in the EU ETS. Still, the contribution from environmental taxes compared to the budget deficit is relatively low, at present tax rates.

Despite some signs of increasing environmental pricing, it is difficult to identify to what extent policy changes result from the crisis, or would be planned in any case. Many of the policy changes may also be planned before the crisis. Neither did we find signs of reducing on-budget environmentally harmful subsidies in our case studies. Such subsidies are most extensively used in developing countries, and the potentials in European countries may be more limited.

The revenues from pricing GHG emissions, tradable carbon quotas and/or carbon taxes, dominate the potential environmental revenues. At present the revenues from the European Emission Trading System are limited due to free allocation. In principle giving away tradable quotas is equivalent to auctioning the quotas and then handing over the revenue to the exact same buyers of quotas. In other words, handing over tradable quotas is a way of spending revenue.

The EU will start auctioning a greater share of quotas from 2013, but the majority of quotas will continue to be handed out for free. We find few or no signs that the economic downturn has led anybody to call for more auctioning. On the contrary the EU has decided that states may compensate major power consumers for the price of carbon when purchasing electricity. When it comes to other environmental stressors the EU generally makes use of a command-and-control policy that generates little revenue. Well-known examples of command and control are the IPPC directive, LCP directive, and BAT directive. The EU also allows policies financed outside public budgets, such as green certificates and feed-in tariffs financed by an addition to the general tariff.

In USA, where the public finance situation also is grave there have been few if any recent suggestions to raise taxes or fees on environmental bads.

Some countries are lowering environmental subsidies, but public sector deficits may not be the primary reason

Several countries in the world subsidize consumption of environmental bads, in particular consumption of fossil fuels. In some countries fossil fuels subsidies amount to huge shares of GDP. In Uzbekistan subsidies on fossil fuel were 30% of GDP in 2011. In Iran the share was 23% and in Turkmenistan 19% of GDP. Most of the major subsidizing countries (but not Uzbekistan) are petroleum exporters.

Some of the subsidizing countries including Iran are taking steps to bring down the subsidies. But in relation to our research question it should be added that the public finance situation of these countries is in general much better than in Europe/USA. Iran, for instance, had an 8% public sector surplus in 2011. Moreover the countries that subsidize fossil fuels have in general been hit less by the economic downturn than Europe and the USA. It seems from the analyses of the IEA and other organizations as well as our own investigation that countries are bringing down subsidies in order to reduce economic waste in the economy, not because the economic downturn forces them to. Most of these countries respond to a pull-effect rather than a push-effect.

A range of sources for reducing environmentally harmful subsidies have been identified in Ireland. These form potential sources for fiscal consolidation in addition to increasing environmental taxes. However, these reforms appear to have only limited budgetary potentials, to the extent that estimates of revenue foregone exist.

Policy recommendations

Given the multiple benefits of environmental efficiency and fiscal improvements, we recommend a broader use of environmental taxation as part of the solution to the financial crisis. We conclude that the revenue potentials are substantial particularly for greenhouse gas emissions. This requires a system with carbon taxes and/or auctioned emission permits covering all greenhouse gases. Along with pricing externalities,

we also strongly recommend the phase out of environmentally harmful subsidies. Both strategies contribute to budget balances, and to get the prices right and hence improve environmental and economic efficiency.

The energy intensive industries are the main sectors benefiting from environmental tax exemptions in present policy regimes, and will be the main losers in a system with environmental tax increases. If compensation is given, this will reduce the net revenue potential to the public. To avoid new, inefficient subsidies and tax expenditures, is important to identify what interests lose, and whether compensation is needed according to political preferences.

Compensation, which is principally new subsidies, should be levied as close to the prioritized groups as possible. Earlier experiences show that reforms should be carried out along with high quality, reliable information about the benefits and costs, in order to communicate the net benefits to the society. There is also a range of efficient instruments and examples of compensation packages used to alleviate the impacts of removing subsidies to low income groups.

PART I: Background and theory

1. The challenge

The financial crisis asks for new solutions to resolve budget deficits and to stimulate the economies towards more sustainable production structures. Environmentally harmful subsidies pose heavy burdens on public budgets around the world. The value of fossil fuel subsidies is roughly estimated to almost 1% of world GDP (IEA et al. 2010), in some countries as much as up to 30% of GDP. These subsidies add to environmental costs and increase global warming. In addition to direct subsidies, lacks of and exemptions from environmental taxes represent other forms of subsidies. Reforms of environmentally harmful subsidies can potentially mitigate the financial crisis. Setting the prices right by lowering direct subsidies and increasing revenues from environmental taxes can contribute to balance the public budgets. Moreover, this helps the economies to achieve climate policy goals in a cost-effective manner. A core problem is that subsidies will benefit significant groups, hence reforms prove to raise significant opposition. It is thus important to reveal what groups benefit from the subsidies, and whether compensation is needed.

This project adds insight into the potential contribution to fiscal consolidation from environmental tax and subsidy reforms, i.e. strengthening public budgets while at the same time improving economic efficiency and the environment. We further discuss whether this potential has been utilized so far. The financial crisis hit harder outside the Nordic countries, Iceland excepted. We discuss the financial crisis, the environmental tax policy responses in Iceland, Estonia and Ireland as case studies.

2. The financial crisis

The start of the global financial and economic crisis is sometimes dated to August 9, 2007, when the French bank BNP Paribas suspended the calculation of the value of three hedge funds. The bursting of the U.S. housing bubble caused the values of securities tied to real estate pricing to plummet, and spread out to financial institutions globally. This first stage of the crisis was at heart a private debt crisis: Excessive private debts were revealed along with a lack of oversight over debt. Once the crisis emerged banks and other financing institutions lost confidence in private sector bonds (papers that finance private sector debt) and financing institutions lost confidence in each other. The private debt crisis initiated failures of businesses, declines in consumer wealth, and a downturn in economic activity that led to the global recession from 2008.

Governments responded to the recession of 2008 with expansionary fiscal and monetary policy. In 2011 the US, Japan, Greece, Spain, United Kingdom and New Zealand (in descending order) all had budget deficits of 8% of GDP or more. The expansionary policies of 2008 and 2009 mark the second stage of the overall financial and economic crisis. Berghäll and Perrels (2011) discuss environmental implications of the expansionary fiscal policies, in particular the implications of the “green stimulus” components.

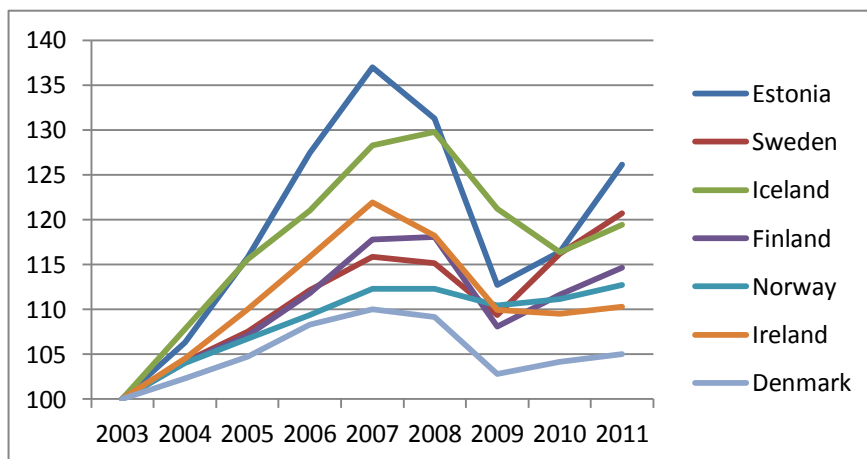
The extraordinary public deficits in many countries that emerged from 2009 left governments exposed to financial markets, and in 2010 and 2011 the markets turned against the governments of the smaller exposed countries of the Euro-zone in particular. Doubts emerged that governments were able to repay debts. The doubts increased bond yields and became self-reinforcing. This turn of events marks the third stage of the crisis, a public debt crisis. Governments have responded by increasing taxes and cutting expenditures in order to reign in budget deficits. This policy of fiscal consolidation, which continues to this day, tends to exacerbate the recession in Europe and the global economy.

This chapter tracks the development of the European and global economies. It shows indicators of the recession in the real economy (GDP, unemployment) and indicators of public sector deficits and public sector debt. It also indicates environmental performance in terms of emissions of main air pollutants and greenhouse gases (GHGs).

2.1 Economic development

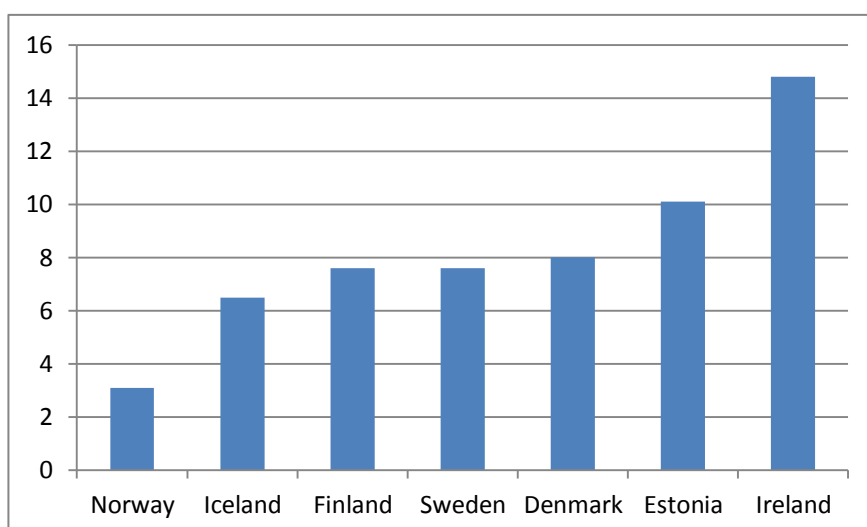
A clear and positive trend in economic growth was put to a sudden halt by the financial crisis in 2007. From 2003 to 2007, GDP increased in the range of 10 to 35% in the North European counties, see Figure . The countries generally faced negative growth the first two years after the crisis set in, and growth has since been significantly lower than before 2007. According to OECD data, unemployment rates in the Euro area increased from 7.5 in 2007 to about 11% at present. In June 2012, unemployment rates were 3–6% in the Nordic countries, and about 15% in Ireland, see Figure .

Figure 1 Gross Domestic Product (GDP) in Nordic countries, Estonia and Ireland. Volume indices, 2003=100



Source: Eurostat.

Figure 2 Unemployment in Nordic countries, Estonia and Ireland, %



Seasonally adjusted. June 2012

Source: Eurostat.

The development in these core economic indicators is closely related to financial balances. As seen from Table 1, overall financial balances significantly deteriorated within OECD countries from 2007. The Nordic countries, Estonia and Ireland are presented in the first lines of the table.

Table 1 General government financial balances. Deficit (+) or surplus (-) as a % of nominal GDP

	2007	2008	2009	2010	2011	2012	2013
Iceland	-5.4	13.5	10.0	10.1	4.4	2.6	1.4
Denmark	-4.8	-3.3	2.7	2.7	1.9	3.9	2.0
Sweden	-3.6	-2.2	1.0	0.1	-0.1	0.3	-0.3
Finland	-5.3	-4.2	2.7	2.9	0.9	0.7	0.0
Norway	-17.3	-18.8	-10.6	-11.2	-13.6	-15.1	-16.3
Estonia	-2.4	2.9	2.0	-0.3	-1.0	2.0	0.3
Ireland	-0.1	7.3	14.0	31.2	13.0	8.4	7.6
Greece	6.8	9.9	15.6	10.5	9.2	7.4	4.9
Italy	1.6	2.7	5.4	4.5	3.8	1.7	0.6
Belgium	0.1	1.0	5.7	3.9	3.9	2.8	2.2
Portugal	3.2	3.7	10.2	9.8	4.2	4.6	3.5
United Kingdom	2.8	5.0	11.0	10.3	8.4	7.7	6.6
France	2.7	3.3	7.6	7.1	5.2	4.5	3.0
Hungary	5.1	3.7	4.5	4.3	-4.2	3.0	2.9
Germany	-0.2	0.1	3.2	4.3	1.0	0.9	0.6
Spain	-1.9	4.5	11.2	9.3	8.5	5.4	3.3
Austria	1.0	1.0	4.2	4.5	2.6	2.9	2.3
Netherlands	-0.2	-0.5	5.5	5.0	4.6	4.3	3.0
Poland	1.9	3.7	7.4	7.9	5.1	2.9	2.2
Slovak Rep	1.8	2.1	8.0	7.7	4.8	4.6	2.9
Slovenia	0.0	1.9	6.1	6.0	6.4	3.9	3.0
Czech Republic	0.7	2.2	5.8	4.8	3.1	2.5	2.2
Switzerland	-1.7	-2.3	-1.0	-0.6	-0.8	-0.6	-0.6
Luxembourg	-3.7	-3.0	0.8	0.9	0.6	1.4	1.1
Australia	-1.8	0.8	4.5	4.7	3.9	2.2	-0.4
Canada	-1.4	0.4	4.9	5.6	4.5	3.5	2.4
Japan	2.1	1.9	8.8	8.4	9.5	9.9	10.1
Korea	-4.7	-3.0	1.1	-1.3	-1.8	-2.3	-2.8
New Zealand	-4.5	-0.4	2.6	4.2	8.2	4.4	2.9
United States	2.9	6.6	11.6	10.7	9.7	8.3	6.5
Euro area	0.7	2.1	6.4	6.2	4.1	3.0	2.0
Total OECD	1.3	3.4	8.1	7.5	6.3	5.3	4.2

Source: OECD.

<http://www.oecd.org/eco/economicoutlookanalysisandforecasts/economicoutlookannextables.htm>

Those OECD countries suffering the greatest deterioration in their public finances had typically experienced increasing external imbalances and booming credit and domestic demand in the run-up to the crisis, while the countries that suffered the smallest deterioration generally had displayed stable or falling macro-financial risks (European Commission 2010). Credit market and asset price evolutions have played key roles in this context by allowing excessive public expenditure growth during the booms, followed by large tax revenue shortfalls.

Table 2 General government net financial liabilities.% of nominal GDP

	2007	2008	2009	2010	2011	2012	2013
Iceland	-1.0	26.0	39.9	48.3	49.7	48.1	46.1
Denmark	-3.8	-6.1	-4.5	-1.7	3.5	7.4	9.2
Sweden	-22.5	-14.9	-22.4	-24.0	-21.1	-20.4	-19.9
Finland	-72.6	-52.2	-62.8	-65.1	-52.6	-52.2	-50.1
Norway	-138.9	-123.5	-156.7	-164.9	-160.9	-166.8	-174.6
Estonia	-28.9	-26.3	-29.6	-36.5	-33.4	-29.8	-27.7
Ireland	0.0	12.9	26.3	57.4	74.2	81.8	87.0
Greece	82.6	91.0	100.7	114.6	134.6	134.2	141.4
Italy	86.8	89.7	100.6	99.3	93.7	96.2	95.6
Belgium	73.1	73.5	79.6	80.1	81.6	82.4	82.0
Portugal	49.6	54.1	64.5	69.4	74.2	81.2	85.1
United Kingdom	28.4	33.3	44.1	53.8	68.3	74.4	78.4
France	35.7	45.9	52.0	57.4	63.0	66.3	67.6
Hungary	53.1	51.8	59.6	60.5	52.0	53.1	54.0
Germany	42.6	44.7	49.3	50.5	52.0	51.5	50.2
Spain	17.8	22.6	34.3	40.2	48.6	54.4	57.4
Austria	31.4	34.9	40.7	44.0	46.2	48.0	48.9
Netherlands	27.8	27.0	29.7	34.4	39.0	43.2	45.3
Poland	17.0	17.3	22.4	28.0	32.7	33.7	34.2
Slovak Rep	7.3	9.1	17.7	25.2	27.0	30.0	31.5
Slovenia	-16.9	-5.0	0.1	1.0	7.2	11.2	14.1
Czech Republic	-15.5	-6.7	-2.7	5.1	8.3	10.6	12.6
Switzerland	0.9	2.8	-1.8	-2.4	-3.1	-3.6	-4.2
Luxembourg	-55.0	-50.9	-55.8	-51.6	-48.2	-46.2	-43.5
Australia	-7.3	-7.6	-3.7	1.8	5.3	7.3	6.5
Canada	23.1	22.8	28.5	30.6	33.3	35.3	36.3
Japan	80.5	95.3	106.2	112.8	125.5	134.1	142.7
Korea	-40.3	-37.7	-39.0	-37.4	-37.2	-37.5	-38.1
New Zealand	-5.5	-5.0	-1.0	3.3	11.4	15.5	17.6
United States	48.0	53.6	65.7	72.9	80.1	85.3	88.3
Euro area	42.7	47.5	54.6	57.8	60.7	62.7	63.2
Total OECD	40.2	45.7	54.0	59.3	65.3	69.1	71.3

Source: OECD.

<http://www.oecd.org/eco/economicoutlookanalysisandforecasts/economicoutlookannextables.htm>

While the highest deficit amounted to 31% of GDP in 2010 and 13% in 2011 in Ireland, Norway had a budget surplus over the entire period. Although the problems of the Nordic countries should not be underestimated, these countries except Iceland are less affected by budgetary problems than the rest of the Europe.

In 2011, overall public deficits were reduced thanks to strong consolidation efforts. From 2010 to 2011 the average general government deficit in OECD fell from 7.5 to 6.3% of GDP. The improved budgetary positions in the Euro area were primarily due to lower expenditures (European Commission 2012).

In 2011, the government net financial liabilities amounted to 65% of GDP within OECD, see Table 2. A few countries, among them Norway, Estonia and Finland, enjoy negative liabilities. In general, debt as a share of GDP in the OECD countries is expected to increase, along with the financial deficits, in 2012 and 2013.

Economists debate what medicine is necessary and feasible to respond to the financial crisis. Both market-based and regulatory solutions have been suggested. Hagermann (2012) looks into instruments for fis-

cal consolidation in OECD countries. He points to many options for budgetary savings through improved efficiency, including health care, education, infrastructure, general public services, and transfer programmes. On the revenue side, reducing the scope and scale of tax expenditures remains one of the most promising means of boosting revenues while improving economic performance. Shifting taxation toward less inefficient tax bases also holds much promise, including raising the importance of both property taxation and environmental levies. He concludes that, even without quantifying all possible measures, the cumulative cuts in spending and increases in taxation could yield 6% of GDP on average across countries in consolidation, with somewhat more on the spending side.

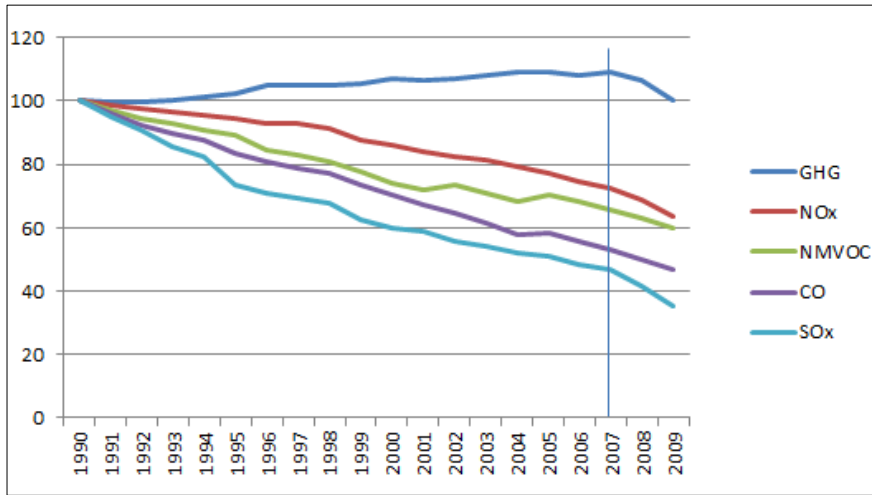
While some economists advocate fiscal stimulus to avoid further recession, other experts argue that such measures extend current account deficits and retard export growth. Fiscal stimulus is also restricted by the financial imbalances, and there is a great risk that higher public spending increases long term debt to an unsustainable extent. Increased public revenues are relevant both as a source of financing fiscal instruments and to reduce debt. It is then crucial to focus on revenue sources creating minimal efficiency losses. As will be discussed below, reducing environmentally harmful subsidies, including taxing environmental externalities fulfil these requirements. This corresponds to Hagermann (2012) and OECD (2012a) who point to relatively large opportunities for the greater use of environmental taxes and the broadening of income and indirect tax bases.

2.2 The environment

Obtaining a positive environmental effect is a core purpose of getting the environmental prices right. Over the last 20 years emissions to air have been reduced in OECD countries, see Figure 3. Until 2007, the average annual reduction rate was between 1.9 (NO_x) and 4.4 (SO₂) per cent. The exception is greenhouse gas (GHG) emissions, which increased by an average annual growth rate of 0.5 per cent.

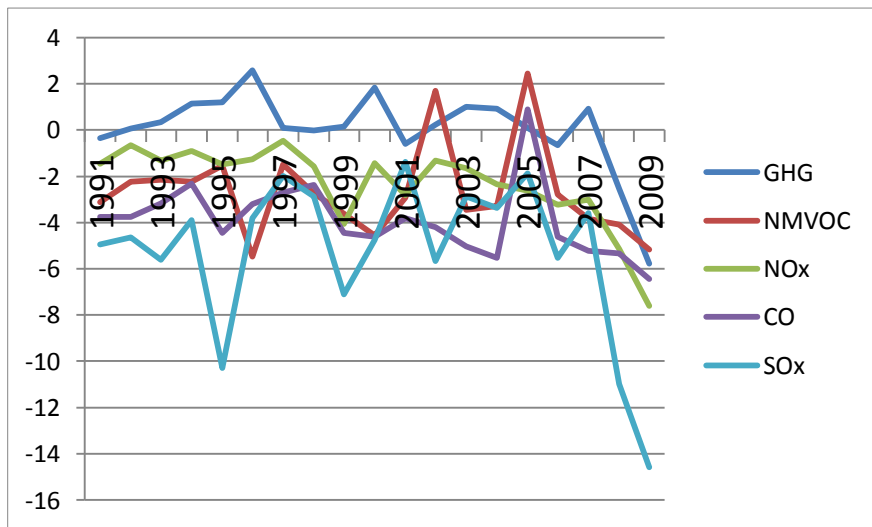
After onset of the financial crisis in 2007, emissions fell more, and even GHG emissions were reduced, see Figure 4. A common and reasonable explanation is the direct effect of the economic recession, which reduced production and consumption.

Figure 3 Emissions in OECD countries¹, 1990–2009, 1990=100



¹Except Chile, Ireland, Korea and Mexico for all emissions; also except Luxembourg for CO.

Figure 4 Annual changes in emissions in OECD countries¹, 2000–2009, %



¹Except Chile, Ireland, Korea and Mexico for all emissions; also except Luxembourg for CO.

In addition to a reduced scale of the economy, it is an interesting question whether stricter environmental policy contributed to lower emissions. Environmental policy is likely to have influenced the long term trends as seen in Figure 3. Berghäll and Perrels (2010) have reviewed the green stimulus programmes, and find that the global share of “green” in stimulus packages has been estimated at about 15% of a total of 3.1 trillion US dollar stimulus (see also Robins et al. 2009). “Green” is however a wide and unspecified concept, investments include e.g. renewable energy projects, energy efficiency, water and low carbon investments. The environmental effects from such programs are not straightforward. Nor is it possible to separate the instruments related to the financial crisis from status quo instruments.

Since implementation and adjustment to the instruments take time, the immediate policy effects after 2007 are most likely planned before the crisis. It is unlikely that environmental instruments implemented as response to the crisis have had significant effects so far, and difficult to single out what policies have been implemented due to the crisis. Hence, this report mainly emphasises the potentials for policy to meet the crisis by increasing public revenues from environmental reforms, rather than the possible effects of earlier responses to the financial crisis.

3. Principles for fiscal consolidation

Fiscal consolidation is aimed at reducing government deficits and accumulation of debt. Government deficits can be reduced by increasing taxes, or by reducing expenditures. In times of economic distress it is important to increase taxes and perform fiscal consolidation in the most efficient manner. But what is efficient? Here we briefly discuss principles of efficient taxation including fiscal taxation, environmental taxation and so-called efficient subsidies. We describe properties of an efficient economy. Environmentally harmful subsidies are said to occur if actual prices on environmental services are lower than what they should be in the efficient economy.

In related literature OECD (2012a) discusses an optimal policy mix to achieve fiscal consolidation, i.e., reduce budget deficits in the most exposed countries. One measure favoured by the OECD is to close tax loopholes and reduce tax exemptions, so-called tax expenditures. Another measure favoured by the OECD is to raise environmental taxes. DeMooij et al. (eds.) (2012) discuss carbon taxes and some other environmental taxes in the context of fiscal policy.

3.1 Efficient taxation and subsidies

In a competitive market with no externalities, monopolies or taxes the price of a particular economic good adjusts to ensure that all trades occur that benefit both the buyer and the seller. We may call this situation *efficient*.¹ The introduction (or increase) of a tax causes an (increasing) discrepancy between the willingness to pay and marginal production cost. This implies fewer transactions and an efficiency loss. The amount of efficiency loss depends on the elasticities of supply and demand for the taxed goods.

¹ Other terms could also be used, e.g., Pareto optimal.

Fiscal taxes

The purpose of *fiscal taxes* is to raise revenues for publicly provided goods. In order to minimize efficiency loss, fiscal taxes should be levied where they are least likely to change economic behaviour. Under simplifying assumptions, e.g., disregarding cross-price effects and distributional concerns, the fiscal tax on a good should be inversely proportional to the corresponding own price elasticity of demand (Ramsey 1927, Diamond and Mirrlees 1971). In practice this means that goods that are *inelastic in demand should be taxed harder*. Inelastic in demand simply means that demand for a good does not change much when its price changes. Certain food items are obvious examples.

For goods that are completely inelastic in supply, revenues can be raised at zero deadweight loss.² By extension, *goods that are inelastic in supply can be taxed harder*. One good that is close to inelastic in supply is land and this feature explains why economists often recommend land value taxes, also called property taxes, as a way to raise revenue.

In practice, efficiency loss is only one concern that fiscal taxes should care about. Another concern is fairness, often interpreted to mean that the relatively poor should be taxed less than the relatively rich. Goods that are inelastic in demand are sometimes used more intensively by the relatively poor. Again food is the obvious example. Considering both efficiency and fairness it is less clear how food and some other inelastic goods should be taxed.

Taxes and fees on negative externalities

The presence of negative externalities opens for taxes that reduce instead of increase the efficiency losses. Environmental damage is a typical example. The “first best” optimal correction for environmental damage in the marketplace is to levy a tax or fee equal to marginal cost of environmental damage. The purpose is to inform the market of the full cost of production (private cost plus cost to environment). Taxes or fees on environmental damage have three positive features: They generate revenues that strengthen public budgets, they increase economic efficiency and they reduce environmental damage (illustrated in Figure in Appendix).

The difference between environmental and fiscal taxes is that while environmental taxes imply a positive correction to market prices that increases efficiency, fiscal taxes imply a negative correction away from efficiency. That is, fiscal taxes generate efficiency loss, while environmental taxes generate efficiency gains. For this reason environmental taxes are attractive alternatives to fiscal taxes in balancing public budgets.

² This follows from the result of Diamond and Mirrlees (1971) that pure profits can be taxed away. Again it applies under simplifying conditions, in particular, it assumes that fiscal taxes are optimal and distributional concerns are disregarded.

Subsidies on positive externalities

The presence of positive externalities opens for subsidies that generate efficiency gains. Similarly to the case of negative externalities the first best correction of a positive externality in the marketplace is to set a subsidy rate equal to marginal value of the externality, with the purpose to inform the market of the external value of production. Examples of positive externalities are research and development (e.g. new technologies can be disseminated for use by other producers), network effects (the more people using a network, the better for others using the same network) and education (one person's knowledge level benefits society beyond the private individual utility).

Fiscal and environmental taxes on the same good

So far our discussion of efficient taxation has assumed that taxes/subsidies on externalities can be isolated from fiscal taxes. But quite often it is considered to impose fiscal and environmental taxes on the same good. This raises both theoretical and practical issues. Sandmo (1975, 2000) shows that the optimal tax on a good that is taxed both for fiscal and environmental purposes is not the sum of the fiscal tax and marginal environmental damage. Rather it is a weighted average of the fiscal tax and marginal environmental damage.³

Sandmo's results imply that in a situation of fiscal consolidation where the marginal utility of public income is high, the weight attached to the environmental component in the total tax formula becomes relatively low. On the other hand the weight attached to the fiscal component becomes high. In addition marginal environmental damage is not necessarily a constant proportion of quantity. In a situation of fiscal consolidation it is not clear whether the total tax on the environmentally harmful good increases or not.

In this report we mainly abstract from the so-called second best optimum condition introduced by Sandmo. However we note one practical implication: Faced with a tax wedge on, e.g., gasoline it is difficult for the analyst to determine what part of the tax wedge is environmental and what part is fiscal (see discussion in Bruvoll 2009). The tax wedge may consist of several individual taxes, and sometimes, but not always, the names of the individual taxes may tell us something about the intention of policy-makers. This difficulty in turn implies that it is difficult to assess

³ The optimal tax rate for a polluting good T equals $T = a TF + (1-a) MDC$, $0 < a < 1$, where the first tax element reflects the fiscal element and the second element reflects the Pigouvian marginal social damage and a reflects the tightness of the government's budget constraint or the marginal cost of public funds (Sandmo 2000). When decomposing the total revenue into its respective fiscal and environmental elements, each ascribed part ($a TF$ and $(1-a) MDC$) will be equal to or lower than the respective optimal fiscal and Pigouvian taxes (TF and MDC). As such, the higher the government's budget requirement, the lower the weight of the environmental element.

whether the environmental tax component is similar or not to environmental damage. In practice analysts make ad hoc assumptions such as assuming the entire tax is environmental (as in certain databases of environmental taxation), or none of it is.

Main objectives of taxes and subsidies

Table 3 summarizes the main objectives of taxes and subsidies. The purpose of fiscal taxes is to contribute to public revenue, in a way that also influences the distribution of wealth. Taxes and fees on environmental damage and other negative externalities aim to improve efficiency by increasing the price to full marginal cost. In addition they generate revenue, which may be helpful in a situation of fiscal consolidation.

Subsidies correct positive externalities by lowering the price down to social marginal cost. A second motivation can be to influence the distribution of wealth within the population according to political preferences.

Table 3 Main principles for taxes and subsidies

	Market failures	Budget effects
Taxes	Taxes on negative externalities: Correction of negative externalities	All taxes: Revenues contribute to finance public expenditure Redistribute wealth
Subsidies	Subsidies on positive externalities: Correction of positive externalities	All subsidies: Public spending to redistribute wealth

3.2 Environmentally harmful subsidies

The first best efficient economy is our reference point

So far we have discussed properties of an efficient economy. We now turn to environmentally harmful deviations from the efficient economy. In this work our reference point is the efficient, first-best optimal market situation where taxes and subsidies equal the marginal value of external damages and external benefits. We term all subsidies, lack of full cost pricing such as exemptions and reductions in environmental taxes relative to the optimum *inefficient subsidies*. Exemptions and reductions taxes compared to optimum are sometimes referred to as tax expenditures. Using this term inefficient subsidies consist of a) budgetary subsidies (public outlays) and b) tax expenditures. This is a fairly wide definition. More narrow definitions exist, e.g., only budgetary subsidies.

We follow Bruvold, Skjelvik and Vennemo (2011) and define *environmentally harmful subsidies* as inefficient subsidies that cause negative environmental effects. This definition is the widest possible. In the further report, we will focus on two main types of environmentally harmful subsidies which can directly influence public budgets: budgetary inefficient subsidies to environmentally damaging activities (chapter 4) and

lack of- and exemptions from taxation of negative environmental externalities (chapter 5).

Note that our reference point implies that subsidies on positive externalities are not counted as “environmentally harmful” whether or not they increase environmental burden relative to a twin economy of no subsidies. Our reference point also implies that subsidies on e.g., new renewable energy may in principle be counted as environmentally harmful on account of the fact that new renewable energy sources as a rule do generate some environmental damage relative to an efficient economy. If we had compared with a non-optimal “third best” economy of no taxes on e.g. CO₂, the conclusion might instead have been that subsidies on new renewables would have been environmentally beneficial.

Hence our choice of reference point is in principle not innocuous. However, the empirical evidence that we discuss in chapters to come is robust to the choice of reference point. For instance, we discuss subsidies in the form of government expenses on fossil fuel. These are real, environmentally harmful subsidies no matter how one looks at it.

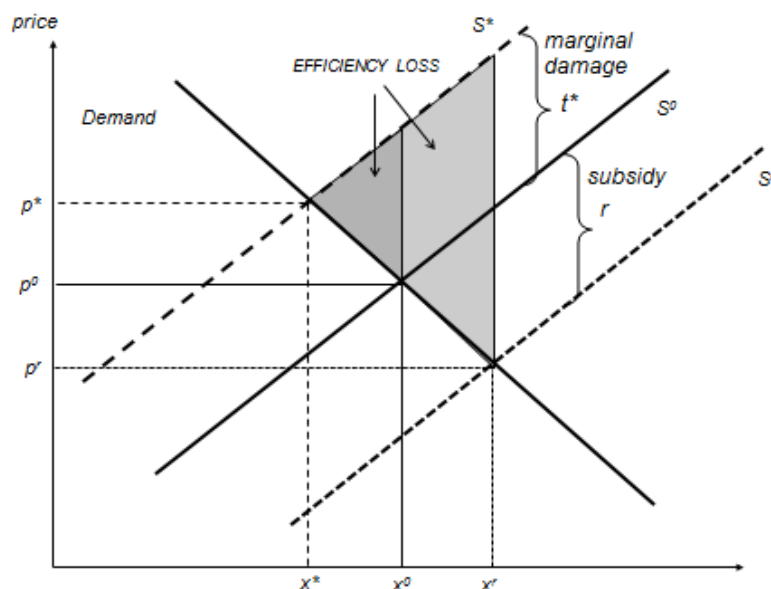
Subsidy on fossil fuel

As an illustration of our way of thinking we discuss a subsidy on fossil fuel, see Figure 5. The supply curve S^* represents the social cost curve of fossil fuel production, including both external costs and producers’ marginal costs. Hence the optimal solution is in output x^* at the price p^* .

In a situation where the external costs are not internalized, there is no environmental fee or tax present, the market solution is at x^0, p^0 . The lack of a tax of size t^* is a subsidy relative to the optimal situation. Even if there was a tax, but it was lower than t^* , there would be a subsidy.

We then consider a situation where the government subsidizes the purchase of each unit of fossil fuel by a rate r . The supply as perceived by consumers then shifts downwards (to S^r) and the price decreases (to p^r). The subsidy implies increased production of fossil fuel. As the price of fossil fuel falls, it also implies reduced production and lower incentives to invest in alternatives. The efficiency loss expands due to an increasing difference between marginal social production cost, S^* , and marginal willingness to pay (the *Demand* curve).

Figure 5 Environmentally harmful subsidies



In this market the full extent of the environmentally harmful subsidy equals the nominal subsidy r plus the environmental tax foregone, t^* ; $\text{subsidy} = r + t^*$. In chapters to come we will discuss examples of nominal subsidies on fossil fuel r (chapter 4) and carbon and environmental taxes foregone t^* (chapter 5).

3.3 Types of environmentally harmful subsidies

The literature categorizes environmentally harmful subsidies along different lines, see discussion in Bruvold et al. (2011). Bruvold et al. divide the subsidies into subsidies to environmental externalities, exemptions from taxation of negative externalities, and other environmentally harmful subsidies. The Institute for European Environmental Policy (IEEP) uses the categories on-budget and off-budget subsidies (ten Brink 2012). Table combines these two ways of thinking.

Examples of on-budget subsidies are direct subsidies to polluting activities, such as the diverse subsidies given to fuel oil consumption in developing countries, subsidies to the coal industries and current large subsidies to road transport (see Bruvold et al. for examples). Removal of such subsidies would strengthen public budgets. The revenue potential from removal on-budget environmentally harmful subsidies is our main focus in Chapter 4.

Off-budget subsidies cover subsidies of a more indirect nature, such as regulatory support mechanisms, income and price support, preferential market access and exemptions from governmental standards. The most important form however, is probably lack of externality pricing. Lack of externality pricing takes the forms of tax expenditures (exemptions from existing taxes) and total lack of taxation. Lack of externality pricing represents foregone government revenues, and is our focus in Chapter 5.

Other examples of environmentally harmful subsidies are direct transfers or different forms of tax expenditures to e.g manufacturing industries and agriculture, grants, guarantees and tax exemptions to fishing, and exemptions to resource pricing for water consumption. Such subsidies are harder to identify and to quantify, and are hence not part of the quantitative part of this analysis.

It should be added that a country may record significant tax expenditures, but still it may have a stricter environmental regulation than another country.

Table 4 Categorisation of environmentally harmful subsidies

	On-budget subsidies	Off-budget subsidies
Subsidies to negative environmental externalities	-Direct transfer of funds -Government provision of goods and services	-Preferential treatment -Income or price support -Tax expenditures
Exemptions from taxation of negative externalities		-Lack of full cost pricing

PART II: Potentials for green fiscal consolidation

4. Revenues from removals of subsidies to energy

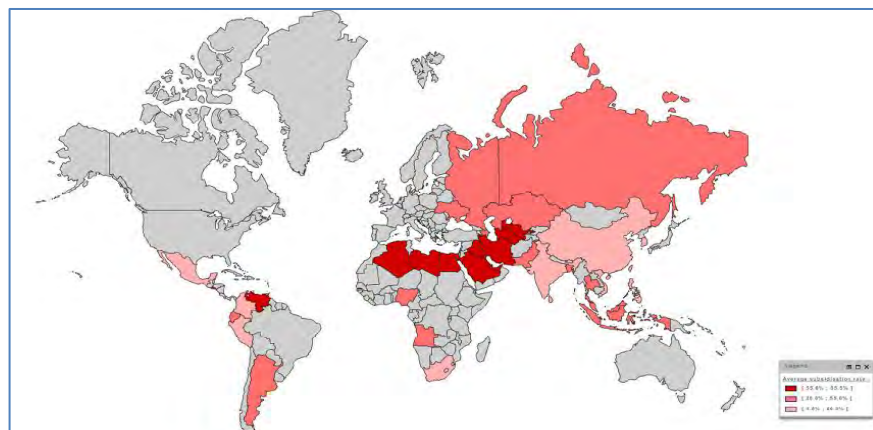
In this chapter we discuss the extent of budgetary subsidies to energy consumption and production, and in particular to fossil fuels. This is the dominating form of the identified and estimated environmental harmful subsidies around the world. We also discuss the potential revenue saved from reducing budgetary fossil fuel subsidies to zero.

4.1 The extent of environmentally harmful subsidies on fossil fuels

Bruvoll et al. (2011) surveyed environmentally harmful subsidies on fossil fuels based on IEA and OECD data available at the time. Since then the IEA, OECD, World Bank and OPEC have continued to collect and publish data. To our knowledge the most recent update on the topic is IEA et al. (2012). The estimates of IEA et al. are based on the price-gap approach. The price-gap approach compares domestic purchasers' prices of fossil fuels to the world market price. This yields an estimate similar to the entity r in Figure 5 of chapter 3.2.

The extent of subsidies on fossil fuels in different countries in 2011, i.e. the size of r , is indicated in Figure 6.

Figure 6 Fossil-fuel consumption subsidies as proportion of the full cost of supply, 2010

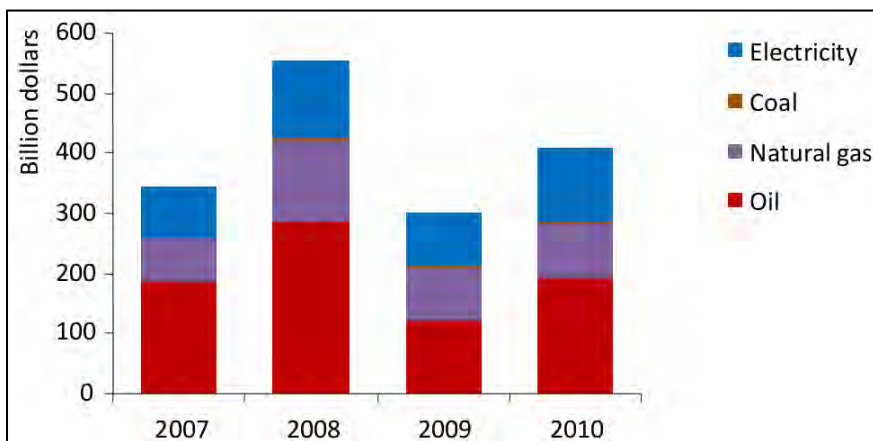


Source: 2011 OECD/IEA.

Figure 6 shows that fossil fuel subsidies are the heaviest in a belt of North African and Middle East countries. Most of these countries are significant producers of oil. Iran, Qatar, Saudi Arabia and Kuwait all have subsidy rates of 75% or more. Venezuela, another producer of oil, also has an average subsidy rate above 75% according to the IEA. The world leader in this particular ranking is Kuwait (86% subsidy).

According to the IEA, fossil fuel subsidies have fluctuated over the years. Subsidies increased in 2010 following a reduction in 2009 (Figure 7). In 2010 fossil fuel subsidies stood at USD 409 billion. The IEA argues that under current trends it could reach 660 billion by the end of the decade.

Figure 7 World subsidies to fossil fuel consumption



Source: IEA.

Observe from Figure 7 that it is primarily the subsidy to oil that fluctuates over the years. The fluctuation is proportional to the world market price of oil. In July 2008 the world market price of oil briefly stood at USD 147/barrel and the average for the year was USD 100. In 2009 the average price of oil fell to USD 60 during the economic crisis that year. In 2010 it rebounded to USD 75/barrel. In many countries that subsidize oil the purchasers' price is fixed in order to isolate consumers from price peaks. Then it is no wonder that the subsidy to oil is higher when the world market price is high. The paper by IEA et al. single out the Mexican Petroleum Revenue Stabilization Fund in particular. This fund is linked directly to world crude-oil prices.

4.2 The Nordic countries

Sachs (2006) reviews the economic and political performance of the Nordic countries compared to the English-speaking OECD countries and the continental western EU countries. He finds that the Nordic countries have relatively high rates of taxation compared to the other countries, and generally perform better when it comes to economic growth, income per person and incentives to work. He largely attributes this to the acceptance for industrial change, active labour market policies, public sector commitments to higher education, retraining and R&D etc.

It is also the case that the tax and subsidy systems of Nordic countries are closer to the ideal of an optimal system than is the case in some other countries. In general, the environmentally harmful emissions are subject to taxes or direct regulations, and the use of subsidies to energy consumption is sparse compared to many other countries. For instance, despite being rich in oil Norway has resisted the temptation to subsidize domestic prices of oil and petroleum products. The choice of not to subsidize petroleum in Norway was made soon after the first discoveries were made, and it has never really been challenged afterwards.

Remaining subsidies

Still, although the problem is small compared to many other countries, the Nordic countries do use environmentally harmful subsidies of the type r in chapter 3, i.e. subsidies financed over public budgets, to some extent. In Norway, the subsidies are typically related to support to transport, agriculture, forestry, transport and regional development. Several forms of transport support are given both to airports, roads and sea transport, which stimulate emissions to air and sea. Support to primary industries also stimulate emissions, and contribute to lower biodiversity.

Further, subsidies are given to stimulate energy production and saving. In Norway, NOK 1.1 billion was allocated to production of wind power in 2009, and significant subsidies are given to biofuels and heating projects. The introduction of the common Norwegian and Swedish green certificate market implies significant subsidies to new energy producers and to the industries exempted from certificate requirements.

Some subsidies to new renewable energy are reasonable on the ground that these energy technologies are immature and there are positive, external learning effects from their deployment. The remaining share is environmentally harmful compared to the first best ideal.

4.3 Recent efforts to reduce subsidies

While Figure 7 gives the impression of fairly persistent subsidies to fossil fuel there are in fact a concerted international effort underway to reduce those subsidies. When G20 leaders met in Pittsburgh, USA in 2009 they committed to rationalizing and phasing out over the medium term inefficient fossil fuel subsidies that encourage wasteful consumption. The commitment was reaffirmed at the 2010 and 2011 G20 meetings.

IEA et al. (2012) claimed that in recent years, a growing number of countries have realised or are pushing forward with reforms, in particular reforms to inefficient fossil-fuel subsidies that encourage wasteful consumption. They pointed out that of the economies identified by the IEA as having fossil-fuel consumption subsidies under the price-gap approach, almost half had either implemented fossil-fuel subsidy reforms or announced related plans since the beginning of 2010. The drivers behind this development, according to the IEA et al, are two: first, ongoing efforts to implement the commitments made by G20 and APEC leaders to phase-out and rationalise inefficient fossil-fuel subsidies and, second, high international energy prices that make subsidies a growing economic liability in some countries.

A forthcoming book by the World Bank discusses the experiences with phasing out energy subsidies in 20 developing countries. According to the IEA et al. (2012), phasing out subsidies in these developing countries has led to some success in the reduction of direct budgetary subsidies. For the sample of countries, the average subsidy recorded in the budget was reduced from 1.8% in 2004 to 1.3% of GDP in 2010. The reduction in subsidies is particularly remarkable for net energy importers.

4.4 Phasing out subsidies and public budgets

One of the drivers behind phasing out subsidies identified by the IEA et al. (2012) is “high international energy prices that make subsidies a growing economic liability in some countries”. This comment associates phasing out of subsidies with the burden that subsidies put on public budgets. In particular one would assume that the burden is heavy for oil importing countries. By contrast, oil exporting countries will on the whole gain from higher prices despite the burden of keeping domestic prices down.

It should also be recalled that successful phase out of subsidies to fossil fuels require that poor and vulnerable groups be compensated (Bruvoll et al., 2011). Some of the initial savings on public budgets must be expected to be spent on compensation to vulnerable groups.

With this caveats in mind Table shows the six countries that use the highest share of their GDP on fossil fuel subsidies. These six are in a class of their own, while several others follow from 6.6% of GDP and down.

Table 5 The main fossil fuel subsidizing countries relative to GDP

Country	Fossil fuel subsidies as share of GDP (%)	Budget balance (% , + pos, - neg)	Subsidy rate as share of price (%)
Uzbekistan	30.5	0.4	57.1
Iran	22.6	8.0	84.6
Turkmenistan	19.3	0.4	65.1
Iraq	13.8	-11.6	56.7
Saudi Arabia	9.8	14.1	75.8
Egypt	9.3	-9.8	55.6

Source: IEA, CIA Factbook and Vista Analysis.

In the top six countries dramatic shares of GDP are spent on fossil fuel subsidies, with Uzbekistan top of the league at 30.5 per cent. This indicates the burden of fossil fuel subsidies. However, the burden of fossil fuel subsidies shows no apparent correlation with the budget balance of the six countries. Hence it is difficult to argue that fiscal consolidation brought about by the financial crisis is a prime driver of efforts to reduce fossil fuel subsidies.

For example, Iran is a country that is taking steps to reduce its fossil fuel subsidies. According to the IEA Iran “significantly reduced energy subsidies in December 2010 as the start of a five-year program to gradually increase the prices of oil products to at least 90% of Persian Gulf FOB prices, natural gas prices to 65% and 75% of the average gas export price for residential and industrial users respectively, and electricity prices to full cost price.” Table shows that Iran’s economy certainly is burdened with fossil fuel subsidies, but when we look at the budget balance it seems that public finances are in good shape. Hence it is probably not the public finance situation that provides the impetus for reducing fuel subsidies in Iran.

4.5 Need for compensation

The core of the problem related to environmentally harmful subsidies is that the support benefits significant groups. Removing the subsidies normally provokes opposition from pressure groups and political parties. To raise the necessary political support, it has proven important to produce high quality, reliable information about the benefits and costs, in order to communicate the net benefits to the society (Bruvoll et al. 2011). To avoid new, inefficient subsidies, it is important to levy the compensation as close to the prioritized groups as possible.

Low income groups in developing countries are particularly vulnerable to fuel price increases. At the same time, high income groups benefit the most from the subsidies, due to positive income elasticities. There is however a range of instruments and examples of compensation packages used to alleviate the impacts of removing subsidies, targeting the political goals more efficiently than subsidies to environmentally harmful activities (see Bruvoll et al. 2011 for examples).

The motives for using environmentally harmful subsidies differ between developing / emerging economies and high income economies like the Nordic countries. The energy subsidies in the Nordic countries seem to be particularly formulated to support energy to the industries at low costs. Hence, alternatives for compensation differ from those directed at low income households.

4.6 Summary: extensive subsidies to fossil fuels

Subsidies in the form of government outlays are a small problem in the Nordic countries, but subsidies to fossil fuel consumption remains a huge problem globally. The size of the problem globally amounts to more than 400\$ billion. In Bruvoll et al. (2011) it is discussed how elimination of these subsidies could improve the environment and increase growth while the poorer segments of the population could be sheltered from higher cost of living at a fraction of the cost of the subsidies themselves.

In several of the countries that subsidize fossil fuel consumption there are efforts underway to reduce the subsidies. An important reason for the efforts is that fossil fuel subsidies amount to a big burden on the national economies.

However, there is less evidence to suggest that countries reduce subsidies in order to reduce public sector deficits. The fossil fuel subsidies pose efficiency losses on the economies, but at the same the public sectors are not necessarily run with deficit. Why this is so is difficult to ascertain, but one reason is obviously that petroleum exporters are subsidising fossil fuel consumption the most. These countries obtain significant public revenue from oil export, and they boost their public revenues when prices of oil are high. In petroleum exporting countries improved revenues and increased subsidies go hand in hand.

5. Revenues from environmental tax increases

This chapter discusses the revenue potential from increasing taxes on carbon and air pollutants to a level that corresponds with marginal environmental damage. In doing so the chapter indicates the size of environmentally harmful subsidies similar to t^* in chapter 3. It also discusses the revenue potential from auctioning emission allowances or quotas. We first discuss GHG policy in section 5.1 and present calculations of the potential revenues from carbon taxation (/auctioning of emission allowances) in section 5.2. In section 5.3 we study the revenue potential of air pollutants and in section 5.4 we discuss the potential and actual revenues.

Note that the calculations in this chapter do not take into account the potential reduction in the tax base. Higher taxes generally reduce emissions, and the environmental tax revenues will be correspondingly lower than our estimates. This effect will rely on the emission in question, and what policy is used before a tax reform.

5.1 Carbon taxes and trading systems in practical use

Carbon taxes are instruments to internalize the environmental costs of emissions. The tax sets a price on emissions, increases the costs of the production and consumption of fossil fuels, increases the relative profitability of non-polluting technologies, and changes the relative consumption of energy and other goods. The market minimizes the total abatement costs, and R&D in other technologies then becomes more profitable.

With carbon taxes, the level of emissions will be determined endogenously. Alternatively, emissions could be set exogenously by emission quotas. Under emission trading systems, total emissions as committed to in international agreements can potentially be regulated directly, and the permit price would equal the necessary tax to reduce emissions.

According to the literature, these two systems are a priori equally efficient. Optimal formulations would imply uniform taxes over sources and countries, and taxes equal to prices in emission trading systems. This is however far from reality, as demonstrated below.

Carbon taxes

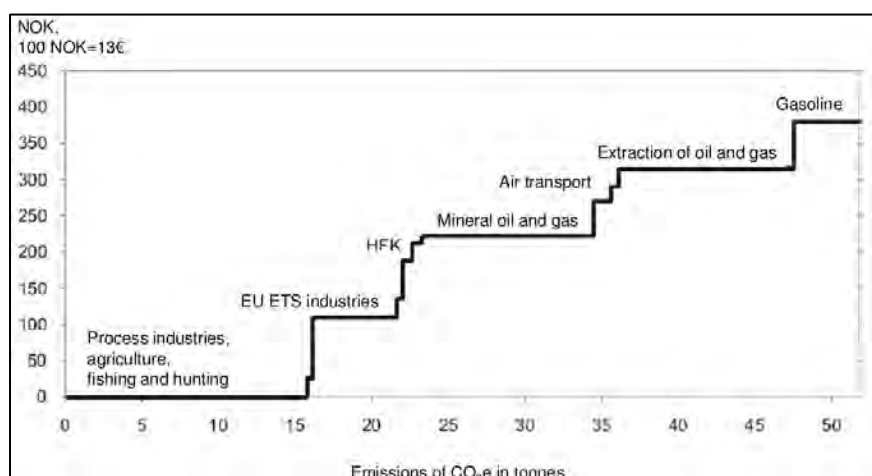
Carbon taxes have existed internationally for over 20 years, Finland being the first nation to adopt a carbon tax in 1990. Subsequently, the Netherlands (1990), Norway (1991), Sweden (1991) and Denmark (1992) implemented carbon taxes. After few new initiatives for almost a decade, the UK began its Climate Change Levy in 2001. In recent years, several new taxes have been introduced at the provincial or municipal levels in North America (Sumner et al. 2011).

Sumner et al. (2011) provides an overview of carbon tax policies and revenues in different countries. No country applies a flat, uniform tax rate as recommended by economic theory. Most commonly, carbon taxes are placed on gasoline, coal and natural gas. Further, certain industries are normally sheltered from carbon taxes or they are allowed to pay lower tax rates.

Sweden implements the highest rates with a carbon dioxide tax of EUR 118 per tonne of CO₂ in 2012. In Finland, the rates are differentiated between energy products used for heating and transport with a rate of EUR 30 per tonne of CO₂ and EUR 60 per tonne of CO₂ levied on transport fuels. Norway's tax on gasoline equates to EUR 52 per tonne CO₂. In Denmark, the tax is about EUR 21 per tonne of CO₂ and in Ireland EUR 20 per tonne CO₂.

In other words, the taxes vary highly between countries. They also normally vary between sources within each country. The Norwegian carbon taxes serve as examples of exemptions within a country. The taxes vary from zero for the energy intensive manufacturing industries and the primary industries, to over EUR 50 per ton for gasoline, see Figure .

Figure 8 Marginal emission costs in Norwegian emission sectors in NOK / ton GHG in 2011. Carbon taxes and emission permit price of NOK 115/ton



Source: Ministry of Finance (2011).

The permit price

The EU emission trading system (ETS) operates in the EU Member States plus Iceland, Liechtenstein and Norway. It covers CO₂ emissions from installations such as power stations, combustion plants, oil refineries and iron and steel works, as well as factories making cement, glass, lime, bricks, ceramics, pulp, paper and board. Nitrous oxide emissions (N₂O) from certain processes are also covered. The installations currently in the scheme account for almost half of the EU's CO₂ emissions and 40% of its total greenhouse gas emissions.⁴

The EU ETS price has varied widely, from EUR 35/ton CO₂ in 2005 and 2008⁵ to about EUR 8 in September 2012. The member states have auctioned only very limited quantities of carbon allowances. From the start of the third trading period in 2013 a larger share of the allowances is expected to be auctioned, but still the lion's share of carbon allowances will be allocated for free.⁶ There is significant revenue potential if the allowances are auctioned rather than allocated for free, see also illustration in Figure 15 in the Appendix.

5.2 Revenue potential from greenhouse gas pricing

We will illustrate the potential revenues from carbon pricing by assuming that all sources of greenhouse gas emissions in Europe face a uniform price. This implies a carbon tax or an emission trading system with auctioned permits (no grandfathering), which secures that the revenues devolve to the government and equal marginal emission costs.

As illustrated in Figure 5, the potential revenue from environmental taxation depends on the marginal cost of environmental damage. The marginal cost of environmental damage is hence crucial for the result. However, in an empirical analysis there is no clear answer to what is the correct level of marginal cost of environmental damage. Due to the nature of the problem of global warming, the estimates of marginal cost of greenhouse gas emissions are subject to particular uncertainty and variability. There are several approximations that can be used. One important indicator is the price of emission permits in a carbon trading market. This price can be interpreted as the politicians' marginal valuation of emission reductions versus other goods given by the restricted emission quota. Another approximation could be the carbon tax of different countries. However, since the carbon tax is highly differentiated within countries, it is not clear what tax level to use. Also, the highest tax rates are usually levied at

⁴ http://ec.europa.eu/clima/policies/ets/index_en.htm Land value taxatio

⁵ http://www2.lse.ac.uk/GranthamInstitute/publications/Policy/docs/PB_case-carbon-pricing_Bowen.pdf

⁶ http://ec.europa.eu/clima/policies/ets/auctioning/index_en.htm

tax bases with limited emission effect (Bruvoll and Larsen 2004). This indicates that the taxes are partly used for fiscal purposes, exceeding the perceived marginal damage (see discussion in 3.1).

In Table 6 below we first illustrate the revenue potential associated with the present permit price in the EU emission trading system, which in 2012 has been about EUR 8/ton CO₂e. Further, to illustrate the span given by different price levels, we illustrate the revenue potential given a price of EUR 50/ton CO₂e. Most studies in the literature estimate that in order to stabilize the global climate, prices must be significantly higher than observed in present trading systems. For instance, Nordhaus (2010) estimates that in order to stabilize the global climate at 2-degree Celcius warming it is necessary to have a carbon price of \$60–800 per ton carbon (about EUR 15–180 per ton CO₂) at different times of this century.

Table 6 also displays revenues from taxes for some of the countries with carbon taxes. The total carbon tax revenue from these countries amounts to about EUR 16 bill. If the same countries implemented a carbon tax of EUR 8 per ton or auctioned permits on all greenhouse gas emissions at a price of EUR 8 per ton, their total revenues would amount to some EUR 17 bill. Within these countries a flat rate of EUR 8 per ton would however imply a redistribution of revenues among the countries.⁷ In particular, revenues would be lower in a high tax country such as Sweden.

If we go further and assume an EUR 8 per ton auctioned permit (or tax) on all GHG gas emissions in the EU ETS member states, the revenue would reach EUR 38 bill. For countries with no current revenue from sales of emission quotas or taxes, the potentials are of course higher than for other countries.

Still a carbon price of EUR 8 per ton CO₂e has a limited potential for contributing to closing the budget deficits in Europe. As seen from Table 6, the potential revenue amounts to less than 0,5% of GDP for almost all countries. This is relatively limited compared to the financial challenges of the countries most hit by the crisis. Consider for instance Ireland. Its budget deficit in 2011 was 13 per cent. An EUR 8 /ton revenue stream from GHG emissions (in addition to the carbon tax in place already) would contribute 0.3% to closing that deficit. Similarly at EUR 8 /ton the revenue from GHGs would contribute 0.4% to the 9.2% budget deficit of Greece. Some countries that are in better financial shape are actually potentially more helped. In Estonia, an EUR 8/ton revenue stream from GHGs would contribute 0.9% of GDP and just about close the budget deficit of 1.0 per cent.

The EUR 50 per ton GHG alternative gives more promising results in terms of fiscal consolidation. For Iceland, a price of EUR 50 would cut in

⁷This thought experiment and the ones below assume there would be no substantial impact on emissions.

half the budget deficit of 2011, and for Greece, the revenue would amount to more than a quarter of the deficit. For the countries that have implemented carbon taxes, the revenue increases from EUR 16 to 105 bill.⁸ When all countries are considered the revenue potential is EUR 240 bill. That is around 3% of the combined GDPs of the countries. We also note by way of comparison with chapter 4 that it is about three quarters of current global fossil fuel subsidies.

Based on the analysis of Nordhaus higher prices than EUR 50 /ton are perfectly conceivable, although it may not seem realistic in the short run. A price of EUR 100/ton would close the deficit of Iceland in 2011 and halve the deficit of Greece. But it would not be decisive for Ireland in 2011.

As mentioned in the introduction to this chapter, the calculations do not take into account any the reduction in the tax base. To be able to estimate the net effect, the tax reform must be compared to existing policy. For example, a uniform tax in Norway may have significant emission effects compared to present policy. The Norwegian carbon taxes are levied on the emission sources with relatively low demand elasticities, while the industries, in which we expect the carbon tax to be most efficient in terms of downscaling of the production and reduced emissions, are exempted from the carbon tax. Due to the exemptions of elastic consumers, Bruvold and Larsen (2004) find a relatively low emission reduction effect of from carbon taxes in Norway (2.3% from the implementation of an on average EUR 20 /ton CO₂ tax). An earlier study by Jorgenson and Wilcoxon (1993) estimate a reduction in CO₂ emissions of 14 per cent, given a uniform tax that about corresponds to a carbon tax of EUR 20/ton CO₂. In Nordhaus (2010) the impacts are at the high end of a 10–20% interval. As a rough approximation, given the baseline and based on CGE analyses, we may expect a price of EUR 50 /ton to reduce emissions 10–20% compared to the baseline, hence the revenue potential is 10–20% lower than if emissions were unchanged.

Also note that the impact of taxes is illustrated on 2009 emission data, not on an estimated future baseline. Estimates of marginal effects of CO₂ prices and quotas on the tax base are hard to find, since the carbon tax in practice is formulated as a tax on different forms of fossil energy goods.

Keeping this in mind, our calculations indicate substantial revenue potentials from a system with carbon taxes and/or auctioned emission permits covering all greenhouse gases within reasonable prices, considering what prices are necessary to meet the GHG challenge.

⁸ This thought experiment assumes that the present taxes are exchanged for a uniform price on all GHG emissions. An alternative approach would have been to add the price/quota income to the current tax income of 16 bill Euro.

Table 6 Potential revenue from greenhouse gas emissions

	Mill. tons CO ₂ e ¹⁾	Actual revenue-bill. EUR ²⁾	Potential revenues EUR 8/ton CO ₂ e		Potential revenues EUR 50/ton CO ₂ e		Net liabilities as a% of GDP ³⁾	Financial balance as a% of GDP ⁴⁾ (surpl (-), deficit (+))
			revenue bill. EUR	% of GDP ³⁾	revenue bill. EUR	% of GDP ³⁾		
Iceland ⁵⁾	4.6	0.0	0.0	0.4	0.2	2.3	49.7	4.4
Denmark	62.3	0.7	0.5	0.2	3.1	1.2	3.5	1.9
Sweden	60.0	3.3	0.5	0.1	3.0	0.8	-21.1	-0.1
Finland	66.3	0.5	0.5	0.3	3.3	1.8	-52.6	0.9
Norway	51.3	0.9	0.4	0.1	2.6	0.7	-160.9	-13.6
Estonia	16.8	0.0	0.1	0.9	0.8	5.7	-33.4	-1.0
Ireland	62.4	0.3	0.5	0.3	3.1	1.8	74.2	13.0
Austria	80.1		0.6	0.2	4.0	1.3	46.2	2.6
Belgium	124.4		1.0	0.3	6.2	1.7	81.6	3.9
Czech Rep	132.9		1.1	0.6	6.6	4.0	8.3	3.1
France	522.4		4.2	0.2	26.1	1.2	63.0	5.2
Germany	919.7		7.4	0.3	46.0	1.8	52.0	1.0
Greece	122.5		1.0	0.4	6.1	2.5	134.6	9.2
Hungary	66.7		0.5	0.4	3.3	2.8	52.0	-4.2
Italy	491.1	1.2	3.9	0.2	24.6	1.5	93.7	3.8
Luxembourg	11.7		0.1	0.2	0.6	1.4	-48.2	0.6
Netherlands	198.9	3.2	1.6	0.3	9.9	1.6	39.0	4.6
Poland	376.9		3.0	0.8	18.8	4.8	32.7	5.1
Portugal	74.6		0.6	0.3	3.7	2.1	74.2	4.2
Slovakia	43.4		0.3	0.5	2.2	2.9	27.0	4.8
Slovenia	19.3		0.2	0.4	1.0	2.5	7.2	6.4
Spain	367.5		2.9	0.3	18.4	1.7	48.6	8.5
Switzerland	51.9		0.4	0.1	2.6	0.6	-3.1	-0.8
U. Kingdom	570.1	0.9	4.6	0.3	28.5	1.6	68.3	8.4
Revenue in countries currently using carbon taxes	2089	15.7	16.7	0.2	104.5	1.4		
Potential revenue in all countries of the emission trading system	4800 ⁶⁾		38.4		240.0			

¹ 2009 data. Source: OECD, <http://stats.oecd.org/Index.aspx?QueryId=27912#>.

² Sources: Denmark, Finland, Netherlands, Sweden, United Kingdom: Sumner et al. (2011), Estonia: Kralik, France: http://www.nytimes.com/2010/03/24/business/global/24iht-carbon.html?_r=1, Ireland: Andersen et al. (2010), Italy: Martini (2007), Norway: Norwegian Ministry of Finance (2011), Iceland: Icelandic Ministry of Finance (2011), Italy: Numbers from 2001.

³ GDP: 2011 data from IMF database.

⁴ 2011 data. Source: OECD.

⁵ 2009 data.

⁶ 2010 Data. Source EEA (2012).

5.3 Revenue from potential taxation of air pollutants

There is currently considerable analytical work carried out in the European Union to analyze the impacts of an extension and tightening of the Gothenburg Protocol, with associated emissions and air quality targets in the European Union. A representative example is Amann et al. (2011).

On behalf of the European Commission Amann et al. (2011) discuss the emission reductions that are necessary to achieve the environmental objectives of the Thematic Strategy for Air Pollution in 2020; how these emission reductions are cost-effectively distributed across EU member countries; and

what the marginal cost of emission reduction would be in each member country. All percentage reductions are relative to the year 2000.

Since emissions originating in different locations have different impacts on the targets, the marginal cost of emission reduction is far from uniform across countries and sources. Table 7 indicates the country specific marginal costs for SO₂, NO_x, PM_{2.5}, NH₃ and VOC. Please note that Table 7 does not indicate present or planned environmental taxes in any of the countries. It indicates marginal costs.

Table 7 Marginal costs of abatement (EUR /ton pollutant) in order to cost-effectively achieve the environmental targets of the Thematic Strategy on Air Pollution. EU27

	SO ₂	NO _x	PM _{2.5}	NH ₃	VOC
Denmark	2271	1335	0	6691	0
Sweden	6490	1205	0	6661	1
Finland	1800	721	276	5975	0
Estonia	0	707	0	1513	0
Ireland	100	299	976	895	1
Austria	0	970	0	478	0
Belgium	534	501	0	2000	0
Bulgaria	193	0	0	281	1
Cyprus	696	355	1362	1199	248
Czech Rep	503	390	19	1223	0
France	294	302	27	504	0
Germany	634	523	0	882	1
Greece	0	294	54	1726	1
Hungary	193	74	19	352	1
Italy	0	443	0	1642	12
Latvia	569	555	19	1030	0
Lithuania	696	474	0	3669	0
Luxembourg	0	848	0	1101	12
Malta	142	0	1642	10	0
Netherlands	0	534	96	1542	0
Poland	549	359	82	607	0
Portugal	0	158	54	439	1
Romania	196	0	19	125	1
Slovakia	0	256	19	558	1
Slovenia	0	0	0	501	76
Spain	280	371	15	1214	0
UK	420	518	82	990	12
Average of marginal costs	613	452	176	1623	14

Source: Amann et al. (2011, table 3.9). Updated to 2011 price level by Vista Analysis.

We note that the NH₃ is the most stringently abated air pollutant in this cost-effective scenario, the reason being that NH₃ has a potent acidification effect while there are few cheap abatement options.⁹

Given that the environmental targets of the Thematic Strategy for Air Pollution are optimal (equate marginal benefit and marginal cost) the numbers given in Table 7 may be taken to indicate marginal environ-

⁹ Amann et al. (2011) do not give details of how the social cost of NH₃ abatement in European agriculture is evaluated.

mental damage of emissions of air pollutants. Consistent with chapter 3 we may then associate the numbers in Table 7 with optimal environmental taxes and any divergence downwards from these taxes may be considered environmentally harmful subsidies.

Table 8 Cost effective allocation of emissions in 2020, EU27. 1000 tons

	SO ₂	NO _x	PM _{2.5}	NH ₃	VOC
Denmark	11	81	19	48	74
Sweden	28	91	19	37	120
Finland	41	123	21	26	90
Estonia	16	16	7	7	20
Ireland	27	68	8	87	49
Austria	19	94	13	48	111
Belgium	77	165	19	70	128
Bulgaria	132	68	33	58	79
Cyprus	5	13	1	4	5
Czech Rep	106	150	24	58	148
France	199	568	201	487	720
Germany	328	706	81	469	870
Greece	113	227	27	41	139
Hungary	59	85	20	51	102
Italy	234	678	80	301	776
Latvia	4	22	14	10	48
Lithuania	14	27	7	36	50
Luxembourg	1	17	2	5	7
Malta	3	3	0	2	3
Netherlands	32	170	16	119	156
Poland	450	425	91	287	341
Portugal	63	102	51	57	170
Romania	145	156	106	143	301
Slovakia	42	57	9	17	56
Slovenia	17	27	5	15	30
Spain	299	689	77	280	630
UK	220	640	52	234	673
Sum	2685	5468	1003	2997	5896

Source: Amann et al. (2011) table 5.4, 5.7, 5.10, 5.13, 5.16. Scenario *TSAP targets others at MID case*.

It is interesting to calculate the potential revenue from removing these subsidies, i.e. implementing emission taxes equal to the marginal cost estimates of Table 7 across Europe.¹⁰ In doing so we must be careful to associate the emission taxes with the emission quantities that generated the abatement costs in the first place. Recall that we are calculating emission taxes that bring about the exactly right allocation of emissions such that the environmental targets are met. Using other emission quantities would have consequences for the prices/taxes and *vice versa*. The emission quantities consistent with Table 7 are given in Table .

¹⁰ We note in passing that only national taxes or fees will do, tradable emission quotas would not be helpful here. Tradable emission quotas tend to equalise marginal abatement costs across the trading area, but that would be far from optimal according to the suggestions of Amann et al. (2011).

Table 9 Potential revenue from optimal emission taxes/fees on pollutants in year 2020. Million EUR .

	SO ₂	Nox	PM _{2.5}	NH ₃	VOC	Total revenue
Denmark	25	108	0	321	0	454
Sweden	182	110	0	246	0	538
Finland	74	89	6	155	0	324
Estonia	0	11	0	11	0	22
Ireland	3	20	8	78	0	109
Austria	0	91	0	23	0	114
Belgium	41	83	0	140	0	264
Bulgaria	25	0	0	16	0	42
Cyprus	3	5	1	5	1	15
Czech Rep	53	59	0	71	0	183
France	59	172	5	246	0	481
Germany	208	370	0	414	1	992
Greece	0	67	1	71	0	139
Hungary	11	6	0	18	0	36
Italy	0	301	0	494	10	805
Latvia	2	12	0	10	0	25
Lithuania	10	13	0	132	0	155
Luxembourg	0	14	0	6	0	20
Malta	0	0	0	0	0	0
Netherlands	0	91	2	184	0	276
Poland	247	152	7	174	0	581
Portugal	0	16	3	25	0	44
Romania	28	0	2	18	0	49
Slovakia	0	15	0	9	0	24
Slovenia	0	0	0	8	2	10
Spain	84	256	1	340	0	680
UK	92	331	4	232	8	668
Total	1149	2390	42	3446	24	7051

Source: Vista Analysis.

Finally we multiply the numbers of Table 7 and Table 8 in order to estimate the potential revenue from optimal environmental taxes on pollutants (Table 9). This is equivalent to the revenue potential of removing harmful environmental subsidies on the air. Please note that the table indicates the revenue potentials, not the actual revenues from present taxes.

The total revenue potential across all pollutants and countries equals EUR 7 billion. Germany is the country with the largest potential, almost EUR 1 billion. In practice countries obtain some revenue from taxes and fees on pollutants even today. Also, some of the emissions, such as VOC and NH₃, are difficult to tax directly from a practical point of view (the implementation problem). The additional revenue compared with today will therefore be lower than EUR 7 billion.

From this we draw the conclusion that optimal emission taxes on pollutants give revenue that is significant, but still relatively small compared to greenhouse gas taxation. Of course, if the potential for greenhouse gas related revenue for some reason is limited to prices far below EUR 10 /ton the revenue potential from pollutants would be *relatively* larger. But we see no particular reason why the long run price of CO₂ should be below EUR 10.

5.4 Need for compensation

As for subsidies to energy production and consumption, lack of full cost pricing benefits significant groups. Increasing environmental taxes is always controversial due to opposition from pressure groups. The losing parties are sources of emissions of GHG gases and other pollutants, i.e. mainly the transport sector and the industries. The transport sector comprises most groups, including households, the public sector and business sectors. In other words, carbon taxes on transport fuels are mainly a redistribution of revenues, in addition to the obvious effect reducing emissions. This may be one of the reasons why high carbon taxes are commonly accepted in the countries that have implemented these taxes. Hence, the transport sector and households will be least affected by uniform and higher tax rates. The carbon intensive industries are the main sectors benefiting from carbon tax exemptions in present carbon tax regimes, and will be the main losers in a system with environmental tax increases.

If compensation is given, this will reduce the net revenue potential to the public. To avoid new, inefficient forms of subsidies and public expenses, it is important to identify what interests lose, and whether compensation is needed according to political preferences (cf. Table 3). Compensation, which is principally new subsidies, should be levied as close to the prioritized groups as possible.

One example of the contrary is the EU decision to allow compensation of major power consumers for the price of carbon when purchasing electricity. This is equivalent to a subsidy to electricity consumption, while the subsidy would more effectively hit the target if given as a lump sum to the prioritized industries, or as support to local communities if the political goal is to support rural settlement etc.

Generally, the need for compensating low income groups seems lower in the case of increasing environmental taxes, compared to reducing subsidies to energy consumption (chapter 4).

5.5 Potential and actual revenue from environmental taxation

We mentioned above that taxes on air pollutants may be difficult to implement from a practical point of view since emissions of e.g., VOC and NH₃ are difficult and costly to monitor. It may be difficult to monitor emissions from stationary (or “point”) sources such as factory chimneys, but it is all the more difficult to monitor and tax emissions from small and/or mobile sources (“non-point”) such as restaurants, motor vehicles and agriculture. The difficulties and expenses of monitoring emissions obviously deducts from potential revenue. It also deducts from potential

additional revenue that countries to some extent rely on environmental taxes and fees even today. On the other hand there are certainly emissions and discharges outside of these pollutants that may generate revenue if they become subject to taxation.

Similar issues emerge when considering taxes and fees on greenhouse gases. For instance, some of the non-CO₂ pollutants may be difficult to monitor in practice. However, the main issue with respect to taxes and fees on GHGs is whether countries are interested in spending the revenue on reducing their public sector deficits. In fact so far EU member countries have shown a preference for giving away initial tradable emission quotas to the main current emitters. In principle giving away tradable quotas is equivalent to auctioning the quotas and then handing over the revenue to the exact same buyers of quotas. We should consider the system this way although there is no auction taking place in practice. In other words, handing over tradable quotas is a way of spending revenue.

Obviously spending revenue by handing over quotas does not contribute to lower budget deficits. We may then ask whether the financial crisis has made it more likely that revenues are (auctioned and) spent on lowering deficits rather than (hypothetically auctioned and) handed back to polluters?

Everybody is entitled to their opinion on this question. Our sense is that there is currently considerable sympathy for the argument that in times of financial distress firms and power plants across Europe should not be burdened with the cost of paying for their allocation of quotas. In a sense we are in the paradoxical situation that precisely because GHG taxes have the potential to make a fairly substantial contribution to budget deficits there arises an opposition to such a contribution.

Of course the argument that businesses should be spared the cost of CO₂ quotas ignores the point that if budget deficits are to be reduced, substantial revenue must be collected from someone (or expenses lowered, which is just as difficult). The EU intends to gradually auction more quotas from 2013 onwards. Still the resistance to letting firms and power plants pay a price for their initial allocation of quotas will in the end reduce the feasible potential of CO₂ and GHG pricing to reduce public sector deficits.

5.6 Summary: GHG emissions is the main revenue source

In a European context the potential revenue from environmental taxes and fees on air pollutants is modest compared to the challenges of financial consolidation facing the continent. The potential revenue from auctioning permits and carbon taxes is much larger, but a carbon price of EUR 50 per ton CO₂ is necessary to make significant impacts on budget deficits. Imposing a carbon price of EUR 50 per ton CO₂ on the

budgetary situation of Europe in 2011 we observe that half the deficit of Iceland would be covered, and a quarter of the deficit of Greece. In Ireland the revenue would make up 10–15% of the (admittedly very large) deficit of 2011, but in Estonia it would turn a 1% budget deficit into a 5% surplus. By comparison the potential revenue from a carbon price of EUR 8 per ton CO₂, similar to the current level, is fairly modest. In all countries considered it would matter less than a percentage point for budgetary deficits.

Given that countries in actual fact spend almost all the revenue from CO₂ quotas on the firms that emit CO₂ in the first place it is probably the case that the revenue available for general budgetary purposes is smaller than the potential revenue. Some emissions are difficult and costly to monitor, this also reduces actual available revenue. Finally, increasing environmental taxes may lead to call for compensatory measures at the individual (not just firm) level. Such calls may arise when environmental taxes fall disproportionately on the poorer segments of the population.

PART III: Case studies

6. Iceland

6.1 Implications of the financial crisis for public finances

In the years from the privatisation of Iceland's largest banks in 2003 and leading up to the financial crisis of 2008 the banks and the financial sector in Iceland had grown enormously; at their collapse the banks' combined balance sheet was about tenfold the GDP of Iceland. The international financial crisis and the collapse of Iceland's banks in October 2008 therefore had an immediate and extremely severe impact on economic activity: there was a sharp contraction in output and unemployment shot up. Even though the international financial crisis had a negative impact on most countries, its consequences for Iceland were unusually harsh, in particular compared to its Nordic neighbours, although not as drastic as in the Baltic countries (see Chapter 2).

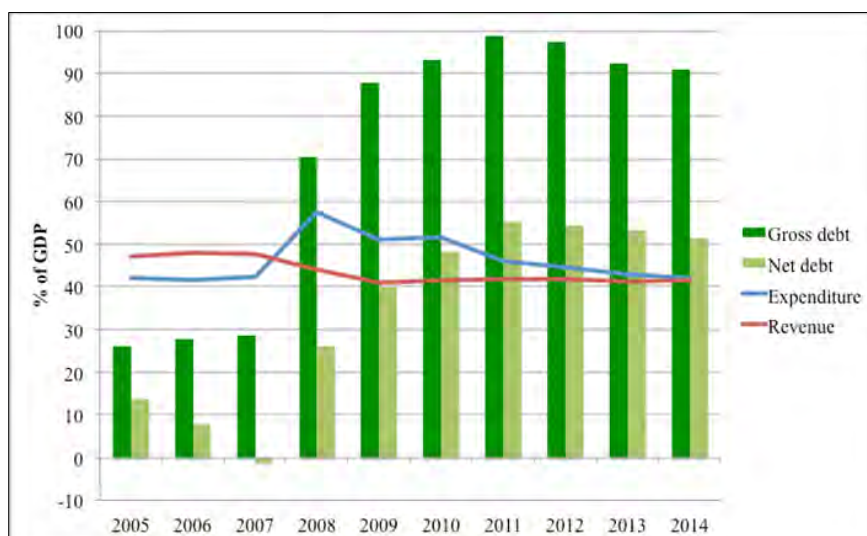
Iceland was hit by a balance of payments crisis at the time of the banking crisis and sought assistance from the International Monetary Fund (IMF, "the Fund") (Baldursson 2011). The country subsequently entered into a program with the IMF and received external financing from the Fund as well as Nordic neighbours and Poland. As could be expected, public finances suffered immediately as a result of the crisis. Apart from the direct gross fiscal cost of the crisis public revenues contracted abruptly along with falling output at the same time as large expenditure posts, such as unemployment benefits, rose. Public debt increased by leaps and bounds and the surpluses of the pre-crisis years turned into large deficits.

Naturally, consolidation of public finances was an important part of the economic plan put into effect as a part of the IMF program.¹¹ Initially a very ambitious – and painful – goal was set of improving the government primary balance by 16% of GDP in 2010–2013, or by about 4% of GDP on average each year. However, as the dust settled after the crisis it became clear that the direct fiscal costs of the crisis would be lower than expected and consequently, the goal for improving the primary balance was relaxed to 10–11% of GDP and the target year for surplus postponed by one year (Icelandic Ministry of Finance 2011). Current plans

¹¹ Other important parts of the plan dealt with restructuring of the banking sector, including reform of the insolvency framework, and monetary and exchange rate policy.

are in broad accordance with this: the proposed central government budget for 2013 has a small deficit for 2013 and a surplus for 2014; overall surplus for general government is, however, now projected to be reached by 2015 (IMF 2012).¹²

Figure 9 Government Finances in Iceland



Numbers for 2012–2014 are projections.

Source: Eurostat, Statistics Iceland, IMF (2012), author's estimates.

Economic activity in Iceland has been on a recovery path since 2011. Unemployment has dropped along with the pickup in growth and stood at 6.5% in June 2012. These developments – which have been supported by an improvement in external competitiveness following depreciation of the krona – have reinforced the fiscal consolidation effort. But the underlying improvement is primarily a result of policy actions, both on the expenditure and the income side of the government budget. By various measures, during the years 2009–2012, annual expenditure was cut by a cumulative 8% of GDP whereas income measures – mainly in the way of increased taxes – amounted to 6% of GDP (Icelandic Ministry of Finance 2011). At the same time unemployment and other welfare expenditures increased and some tax bases contracted, yielding lower revenues. As indicated by Figure 9, the burden of consolidation has fallen on the expenditure side – revenues are about the same percentage of output in 2012 as in 2010 while expenditures have fallen considerably as a proportion of GDP. The net result is the aforementioned 10–11% improvement in primary surplus.

¹² Central government accounts for approximately 70% of general government operations in Iceland.

Although fiscal consolidation has been a successful component of Iceland's IMF program the country still faces substantial problems: gross public debt is still very high, banking sector restructuring has progressed much slower than originally envisaged, inflation is still too high and the capital controls put in place during the collapse are still in place. These problems notwithstanding, Iceland concluded its program with the IMF in August 2011. The sovereign reentered international capital markets in 2011 and again in 2012, issuing long-term bonds to refinance some of the loans extended through the IMF program.

6.2 Environmental and resource taxation in Iceland

While Iceland has used economic instruments in resource policy for many years – the individual tradable quota (ITQ) system in fisheries being the prime example – the country does not have a tradition of using such instruments for environmental policy purposes. This began to change in the late 1990's, which saw the introduction of various environmentally related fees and taxes (Daniel et al. 2011).

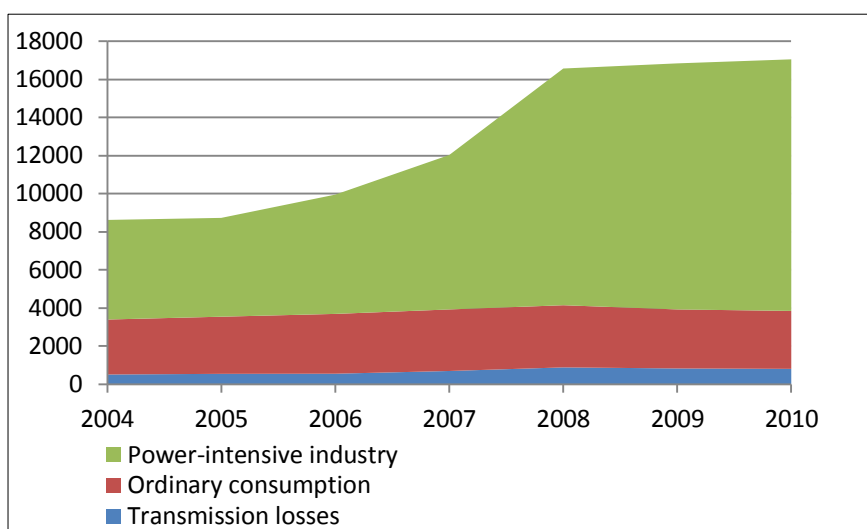
The fish stocks in Icelandic waters have historically been the most important natural resource in Iceland. Nevertheless, user fees for the right to utilise this resource have been very low and amounted to only 0.07% of GDP in 2009. See Section 6.6 for further discussion of fees for fishing rights.

Taxes on energy have been lower, as a share of GDP and of total tax revenues, in Iceland than in most other Nordic and Baltic countries. The main reason for this is that electricity and geothermal heating have been exempted from taxation until recently and energy taxes have mostly been levied on fossil fuels for road transportation. Moreover, these taxes have traditionally been regarded as fiscal instruments rather than having an environmental purpose. In particular, a substantial portion of taxes on fuels are earmarked for the construction and maintenance of the country's roads.

Here it may be noted that electricity generation is a major industry in Iceland with 17 TWh generated per year. This amounts to about 55 MWh per capita. This may be compared to annual electricity generation per capita in Norway, which is approximately 27 MWh and the European average is 7.5 MWh. Some 80% of the electricity generated in Iceland is sold directly to energy intensive industries, mainly aluminium and ferrosilicon producers, which now account for over 40% of Iceland's goods exports. Figure 10 shows that the fall in economic activity has reduced demand for electricity from "ordinary" consumers, i.e. households and non-energy intensive firms: this part of the market peaked in 2008 and then contracted by 7% over the next two years. For most ordinary consumers the price of electricity fell in real terms between 2008 and 2010 so the drop is entirely due to the contraction in economic activity. Over-

all, however, electricity consumption increased due to increased demand from energy intensive industry.

Figure 10 Electricity generation and consumption in Iceland, GWh



Source: Statistics Iceland.

The economic crisis of 2008 had a substantial negative impact on energy taxes. Also, a related tax category – transport taxes – which had been an important fiscal revenue item at 2.4% of GDP collapsed to a fraction of the pre-crisis level, 0.6% . The reason for this is that most of the taxes on energy and transport are imputed on consumption of fossil fuels and as excise duties on imports of cars.

When the economic crisis struck in 2008 consumption in general contracted sharply along with lower incomes, higher inflation and increased risk awareness, which led to a higher propensity to save. Furthermore, the exchange rate collapsed so prices of imported goods – including fuel and cars – skyrocketed in terms of the domestic currency, the Icelandic krona.¹³

Given these developments, two economic effects, the income (or activity) effect, and the price effect, therefore pushed in the same direction, viz. towards lower consumption of imported goods, including energy goods and durable goods such as cars. The consequence was a large drop in the imports of these goods and a corresponding fall in the related tax revenue.

¹³ The world price of oil fell between 2008 and 2009, but there was still a considerable rise in the domestic price of oil due to the depreciation of the krona.

6.3 Recent changes to environmental and resource taxation

An interesting question is whether Iceland has sharpened their environmental policy after the crisis set in. It is generally difficult to conclude whether such policy changes are responses to financial crisis, or part of a general policy development. Still, the trends in recent development reveal trends in the political priorities in Iceland. To some extent this has already been reflected in limited use of green instruments in fiscal consolidation.

Beginning in 2010, there have been several changes to environmental and resource taxation in Iceland. These changes include the following:

- New energy taxes on electricity and hot water.
- A carbon tax.
- Changes to vehicle taxes, taxing emissions rather than weight.
- A steep rise in fishing fees.

We discuss these changes and their implications below. There have also been other changes in related legislation, which have not affected the public budget so far, but have potential fiscal and environmental effects. These include participation in the EU ETS, implementation of the polluter-pays-principle for environmental damage, and a framework for taxation of oil extraction. Of these we shall restrict our attention to the issue of the EU ETS, since it is intimately related to the potential for more wide-ranging carbon taxation. Principles on leasing of renewable energy resources located on government lands – these include most unexploited hydro- and geothermal resources – have also been enacted but remain to be implemented.

6.4 Changes to taxation of carbon, energy and vehicles

As explained in section 3.1, it is in practice difficult to separate environmental taxes and fiscal taxes. Carbon taxes are clearly directed at carbon emissions (c.f. t in Figure 5), while energy taxes are often combinations of fiscally and environmentally motivated taxes. It is a complicated task to make this division for each country, and we therefore discuss environmental taxes and taxes closely related to the environment together.

Taxes on electricity and hot water and a tax on fossil fuel carbon content were introduced in the Act on Environmental and Resource Taxation (Act no. 129/2009) and were first imposed in 2010. As it stands the act has a sunset clause and will be rendered invalid at the end of 2012. In the recent budget proposal for 2013, however, it is announced that

the sunset clause will be removed in the fall session of Parliament, thereby making the act a permanent piece of legislation.

The carbon tax on fossil fuel was initially (i.e. in 2009) determined so as to be equivalent to a carbon price amounting to approximately 50% of the prevailing price in the EU Emissions Trading System (EU ETS) prior to the introduction of the tax or EUR 14 per ton of CO₂. The ratio was raised to 75% in 2011. The price effect of the carbon tax is modest for most consumers. For example the tax corresponds to approximately 2.5% of the price of fuel (petrol and diesel oil) for most passenger cars. There are substantial exemptions from this tax; international aviation is exempt as is the international maritime transport sector. Furthermore, the tax is only levied on fossil fuel so emissions of CO₂ and other greenhouse gases from energy intensive industry are exempted. These sectors are, however, already included or will be included in the EU ETS from 2013. However, the revenue potential is notable, given that all GHG emissions were subject to full taxation. According to Table 6, a tax of 50 EUR per tonne CO₂e could potentially contribute with a revenue equivalent to 2.3% of GDP.

There are two types of taxes on motor vehicles: a bi-annual road tax and an excise duty on purchases of vehicles. Until 2011 these taxes were based on vehicle weight or engine size. They are now based on estimated carbon emissions so these taxes may now be regarded as a form of carbon taxation. Although there is likely to be a positive correlation between car size and carbon emissions the reform makes the connection to carbon emissions unequivocal. The changes are approximately revenue neutral so the overall amount of taxes levied was not changed when they were implemented. The excise duty differentiates substantially between vehicles. Thus, a car which emits 81–100 gCO₂/km (e.g. a VW Polo), carries a 10% excise duty, while car emitting 201–225 gCO₂/km, (e.g. the Toyota Landcruiser), carries a duty of 55% .

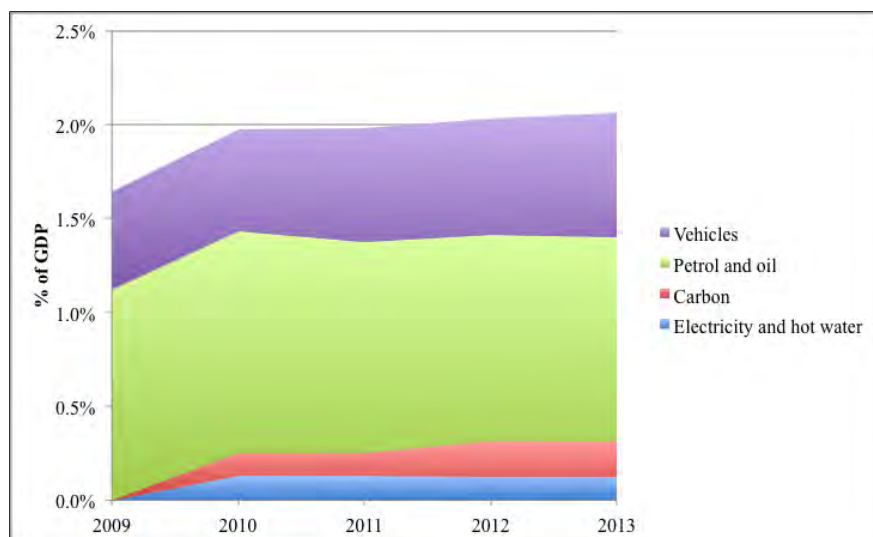
Taxis and rental cars are taxed much lower than other vehicles – less than half the normal rate for cars that have high emissions and zero for the low emissions categories. Exemptions for rental cars are to be removed in steps, beginning in 2013.

The electricity tax is approximately EUR 0.75 per MWh at current exchange rates and the tax on hot water is 2% of the retail price. The electricity tax amounts to approximately 1% of the retail price of electricity, but is a considerably higher proportion of the price to energy intensive customers, or 3–4%. This rate of taxation is approximately in line with minimal excise duties on electricity in European member states, which are EUR 1 for households and EUR 0.5 for industry. The European legislation does, however, allow for lower effective rates to energy intensive industry.

Hot water is an important energy bearer in Iceland and of great economic value. Almost all houses are heated with hot water heated by geothermal energy and distributed from a central source in each municipality. Some 25 PJ (7 TWh) of geothermal energy are used for heating each year.

Prices of electricity and heating to households are low in an international comparison. The new electricity tax in Iceland is also very low in such comparison, especially for households. In the Nordic countries, electricity taxes for households range from EUR 17/MWh in Finland – more than twentyfold the Icelandic rate – to almost ten times that rate in Denmark (IEA, 2010). As for industry, electricity tax rates in Sweden are similar as in Iceland, but several times higher in other Nordic countries. It is difficult, however, to compare rates for industry between countries since exemptions frequently apply for energy intensive industries. It should also be kept in mind that in most countries the electricity tax is thought of as an environmental instrument for reducing emissions. As noted above, in Iceland that rationale is much weaker since electricity and heating is almost exclusively based on renewable energy sources.

Figure 11 Energy and vehicle taxation 2009–2013



Source: Central government accounts and budget proposal for 2013.

The revenue effect of the reform of taxation of energy and vehicles is shown in Figure 11. It turns out to be quite modest. Taxation of electricity and hot water yields about 0.1% and carbon taxation approximately 0.2% of GDP in revenues. The bulk of the taxation of energy – about 1.1% of GDP – comes from excise duties on petrol and oil; the share of those taxes is unchanged at 1.1% of GDP. The share of taxes imposed on vehicles rises somewhat, from 0.5% to 0.7% of GDP, but this is likely to be a volume effect due to increased sales of cars; new car sales dropped to virtually zero after the 2008 crisis but are slowly picking up again.

Even if the revenue effect of the reform of energy and carbon taxation is limited the reform may have some behavioural implications. It is, however, too early to tell whether the new taxes have affected behaviour in any appreciable way. As noted above the direct price effects of elec-

tricity, hot water and carbon taxes for retail consumers – including most Icelandic firms which are overwhelmingly small- and medium sized – are to raise prices by 1–2.5% . Given the low short-term elasticities typical for energy consumption such a price effect will have a small effect on demand. The changes in taxation of vehicles in combination with higher fuel prices – to a large extent driven by higher world market price of oil – could, however, affect the choice of vehicles, leading consumers to choose more fuel-efficient cars. The longer-term effects, over the next decade or so, as the vehicle fleet is renewed could therefore turn out to be substantial. But it is too early to tell whether this will be the case.

The effect of the tax reform on large industrial firms – power intensive producers – is likely to be negligible. Emissions from industrial processes are not subject to the carbon tax so there will be no effect in that regard. Power intensive producers are, however, subject to the EU ETS from 2013.

6.5 Fees for fishing rights

Fishing has long been the main export industry of Iceland. Even if energy intensive industry and tourism have grown enormously over the last decades, fishing still holds first place. The sector is very profitable and yields large economic rents, not least because Iceland's fish stocks have, by and large, been successfully managed. With the collapse of the krona in 2008 and rising prices of food in world markets, fishing and fish processing became considerably more profitable than had been the case before 2008 when the Icelandic krona was much stronger than it is now.

Economic rents in the fisheries sector are created by limiting total allowable catch for each species by a system of individual transferable quotas (ITQ system) and setting total allowable catches for the species, ideally in such a way that total economic yield from the fishery is maximized.¹⁴ These quotas were allocated for free to firms operating at the time when the present system was established in 1991.¹⁵ While the system has been successful in that the fish stocks are managed in a sustainable way and the fisheries sector is highly profitable, it has also led to contention over the distribution of rents and also on grounds of equity and fairness.¹⁶

A fee for fishing rights was first imposed in 2003. The fee is not an instrument for controlling the utilization of the marine resources – that is

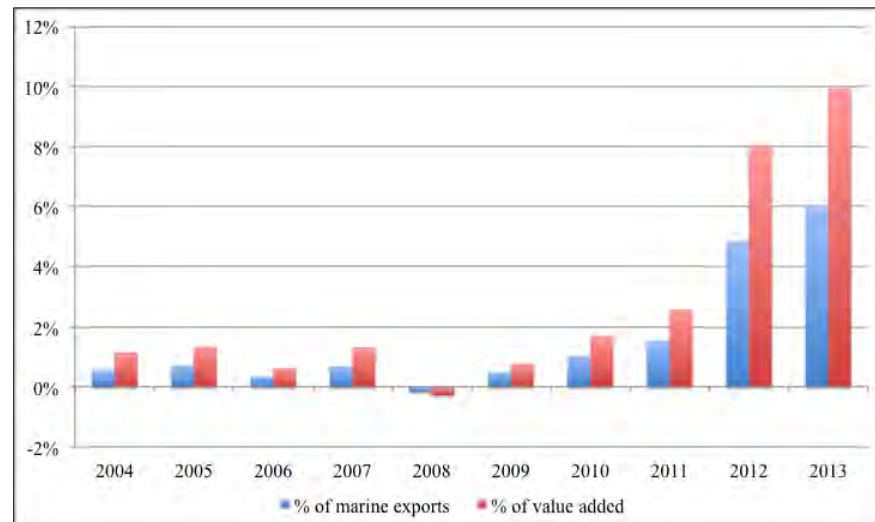
¹⁴ While the principle of maximising the economic value of fish stocks has not been implemented systematically, it is the case with the most important fish stock, i.e. the cod stock.

¹⁵ The precursor of the present system dates back to 1984 and the allocation in 1991 was mostly by grandfathering based on catches in 1981-1983.

¹⁶ Needless to say, opinions are divided as to what constitutes a fair and equitable system.

the role of the ITQ system. Rather, the grounds for the fee are based on the idea that the state should collect a reasonable fee from the fishing industry for its access to the nation's fishing grounds. Indeed, the fee is counted with asset revenues rather than taxes in the government's accounts. The fee is calculated as a percentage on (imputed) operating surplus at fishing firms. The fee started out at 6% of operating surplus and was to rise in steps to 9.5% in 2009. Appreciation of the Icelandic krona subsequently had an adverse effect on profitability in fisheries and, after pressure from the industry, the rate was instead lowered to 4.8% of operating surplus in 2007.¹⁷

Figure 12 Revenues from fee for fishing rights. Shown as a percentage of marine exports and value added in fishing and fish processing



Source: Central government accounts and budget proposal for 2013, author's estimates

After the economic crisis the need for almost non-distortionary sources of public revenue (see the discussion of fiscal taxes in chapter 3) became acute at the same time as profits in the fisheries soared. A new law was passed in 2012 (Act no. 74/2012) where the fishing fee is raised substantially. Initially the fee is to equal 50% of imputed rents, but is to rise in steps to 65% of imputed rents. For cod, the most important species, this would have implied a fishing fee of ISK 60.4 (EUR 0.37) per kg in 2010. Even if the fee is calculated so as to equal half the imputed resource rent it only amounts to approximately 20% of the market price of cod quota. However, as shown in Figure 12 the fee, which rose threefold

¹⁷ This shows up as a negative fee for 2008 in Fig. 9, since the fishing industry got a rebate of the fee in that year, having paid too much in 2007.

from 2011 to 2012, and is set to rise further in 2013, will have a substantial impact on profitability in the fishing industry. It also contributes appreciably to the public purse, accounting for 0.8% of projected fiscal revenues in 2013.

The fishing-rights fee is highly contentious and it has been argued by the industry that it will lead to widespread bankruptcies among fishing firms. If this were to be the case the fee could no longer be considered to be non-distortionary. Time will tell who is right – the industry or the government.

6.6 Possibilities for increased revenues from environmental taxation

In this section we focus on the taxation of carbon emissions which seem the most relevant pollutant as regards potential for increased use of environmental taxation.¹⁸

As indicated in Table 6 a uniform tax on the emission of greenhouse gases of EUR 8/ton CO₂ – about half that now levied on emissions of fossil fuels – would yield revenues of approximately 0.3% of GDP. This is almost 50% more than current revenues from the non-uniform carbon tax. A uniform carbon tax of EUR 50/ton CO₂ levied on all emissions in Iceland would yield revenues of 2.0% of GDP. However, while taxation of greenhouse gases could undoubtedly be increased, these calculations are not realistic at present: over 40% of Iceland's emissions come from aluminium production and other energy intensive industries which fall under the EU ETS. Hence, emission permits will to a large extent be allocated gratis to these firms. When and if permits will be auctioned to a greater extent they could become a fiscal revenue resource, see the discussion in chapter 5.5. Meanwhile, a carbon tax will only be levied on about half of Iceland's emissions.

It is possible to collect more revenues through the carbon tax by broadening the tax base: assuming a flat tax of EUR 14/ton of CO₂ – the same rate as is levied on fossil fuels now – would raise revenue, but only marginally, from 0.2 to 0.27% of GDP. The tax rate could be raised as well of course but there are likely to be political limits there: a large part of emissions stem from road transport which is seen to be heavily taxed already. An appreciable rise in CO₂ taxation would probably have to be matched by lowering excise duties on fuel. The net revenue effect would therefore be smaller.

¹⁸ As noted above, even after the introduction of taxes on electricity and heating these are still low in Iceland. Undoubtedly there is increased scope for collecting more of necessary tax revenues from this tax base. But as noted above taxes on electricity and heat are largely a fiscal instrument. Geothermal energy would be taxed to some extent with a general tax on greenhouse gases.

Due to the large share of energy intensive industry in greenhouse gas emissions and since the sector falls under the EU ETS it is important to note that Iceland is a party to the UN FCCC and acceded to the Kyoto Protocol in May 2002. Earlier that year the government adopted a climate change policy with the aim of curbing emissions of greenhouse gases so they do not exceed the limits of Iceland's obligations under the Kyoto Protocol. Iceland is not a member of the European Union, and is therefore not bound by the emissions limits of EU member states. Iceland is, however, a member of the European Economic Area and has therefore adopted the EU ETS into its legislation. Until recently no Icelandic firms had emissions large enough to bring them under the EU ETS. This is changing, however. In particular, from 2012 aviation is subject to the EU ETS and from 2013 energy intensive industry in Iceland – mostly aluminium producers – will also be subject to the ETS.

The direct cost to existing firms in Iceland will, at least initially, be limited: emission allowances covering the majority of emissions will be issued to aviation firms and energy intensive industry for free. Based on emissions from these sectors and recent market prices of emission allowances, the total market price of these emissions may be estimated to be approximately EUR 16–20 mn. This corresponds to about 0.2% of GDP at current exchange rates. Naturally, it is a higher percentage of value added in these two sectors, or 2.5–3%. Even if there is no direct cost, the firms will take the opportunity cost of holding emission allowances into consideration. They will therefore have incentives to limit their emissions so that they can either sell allowances or escape buying additional allowances when they expand their operations. The EU ETS will therefore function as an environmental policy instrument for the sectors involved even if it will not initially affect the government budget.

There is some uncertainty as to what the future holds in store as far as Iceland's implementation of its obligations under the UN FCCC and the Kyoto Protocol is concerned. Recently it was decided that Iceland, along with Croatia, would take on a joint commitment with EU Member States during the Second Commitment Period of the Kyoto Protocol. This means that Iceland will not be subject to an individual target in the next Commitment Period, but would be part of an extended EU "bubble". The commitments under the Second Commitment Period are to be quantified and formally decided upon at COP-18 in Doha, but Iceland's inclusion in the "bubble" has already been decided upon in principle. This arrangement should prevent a possible clash between two multilateral regulatory frameworks for Iceland's emissions – the EU ETS commitments vs. the national commitments of Iceland under Kyoto. Iceland, however, is not a party to the joint commitments of the

EU member states on limitations of emissions of greenhouse gases outside the ETS.¹⁹ This issue will be discussed in the EU accession talks currently underway. Iceland's current Action Plan on limiting emissions is intended to deliver net emission cuts that should fulfil the likely target set for Iceland under EU and EEA policies until 2020. The exact numbers and legal formulation of these targets are still subject to some uncertainty, both within the UN FCCC and Iceland's future status with regard to the EU (Icelandic Ministry for the Environment, 2012).

6.7 Iceland – a summary

The government that has brought most of the aforementioned changes about is a coalition between two political parties, Social-democrats and Left-greens, which came into power in May 2009. As is the custom, the government issued a policy declaration at the outset with its agenda for the four-year term. The declaration contains a chapter on fiscal policy, which, however, does not mention environmental taxation. There is also a chapter on environmental issues which has many ambitious goals e.g. of reducing greenhouse gas emissions by 50–75% by 2050. Moreover, the declaration states that emission allowances are to be priced and made tradable. Willingness to levy environmental fees on tourism is also expressed. It may therefore be said that even if there is no explicit mention of environmental taxation the declaration gives an indication of a willingness to use market instruments in environmental policy.

It is also an indication of environmental motivation for the Act on Environmental and Resource Taxation and Iceland's participation in the EU ETS that these policies are seen as the two most important items in the government's strategic plan to reduce the emissions of greenhouse gases (Ministry for the Environment 2012).

The motivation for using environmental and resource taxation to a greater extent is, however, also likely to have been pragmatic, *viz.* the need for raising more public revenue to help consolidate public finances with as little adverse effect on the distressed economy of Iceland as possible. It is well known that if well executed, such taxation can yield a double dividend: it can lead to environmental benefits and raise public revenues without the economic costs associated with raising taxes on labour and capital. In Iceland's case there were therefore both political and economic arguments for relying in part on environmental and resource taxation in the necessary fiscal consolidation.

¹⁹ These are spelled out in the so-called "Effort Sharing Decision".

As noted above, the burden of the fiscal consolidation has fallen largely on the expenditure side. However, environmental and resource taxation has certainly played an important role in closing the budget gap, helping to stabilise fiscal revenues. It has also been helpful that the environmental and resource taxes do not cause appreciable reduction in economic activity and therefore carry a smaller cost in that regard than traditional taxes on income or value added.

Environmental taxation in Iceland is likely to follow trends in Europe. For example, it is unlikely that Iceland will tax its families or industries more for emissions of greenhouse gases than is generally done in Europe. As Iceland's energy resources –renewable hydro and geothermal, and potentially also oil and gas – rise in value, taxation of these resources is, however, likely to become a much more important source of fiscal revenue.

7. Estonia

7.1 Implications of the financial crisis for public finances

The Estonian economy has gone through rapid changes in the last decade. During 2000–07 the Estonian GDP growth was in average about 8% annually. The living standard increased considerably – the GDP per capita compared to EU 27 member states increased from 45% in year 2000 to 68% in 2007 (Eurostat, 2012). During this period the inflation was considerably low, unemployment decreased, wages increased, consumer confidence improved, especially when Estonia became the member of the European Union in 2004.

Since 2004 the speed up of the economic growth was based more and more on internal market oriented branches, particularly construction and real estate development, supported by easier access to commercial loans. As a result the private sector loan per GDP increased from 42% in 2002 to 110% in 2008, approximately 80% of household loans were housing loans and approximately 1/3 of investments of non-financial enterprises were in buildings and constructions (Estonian Ministry of Finance 2010). By the end of the year 2007 the share of construction and real estate sectors was as high as 24% of the GDP (in current prices) (Ross, 2011).

The first signs of slowing down of the economy occurred in late 2007 and in 2008 when the private real estate investments and local consumption started to decrease due to more stringent loan terms and reduction in consumer confidence.

In autumn 2008 the international financial and economic crisis culminated, magnifying the negative impact of intra-state real-estate and consumption boom. This resulted in rapid decrease of export volumes, especially in the sectors of chemicals production, metal production, forestry, etc. At the same time the access to external capital became even more problematic. As a result, in 2008 GDP decreased by 3.7% compared to the previous year. The economic recession was in its peak in 2009, the GDP decreased as much as 14.3 per cent, annual average unemployment rate increased almost 2.5 times compared to that of year 2008 to 13.8 per cent.

The economy then faced the period of rapid adjustments. This resulted in lower employment, decrease of wages, but on the other hand improved competitiveness in the foreign markets. In late 2009 first signs of economic recovery appeared with GDP increasing again by 2% in 2010.

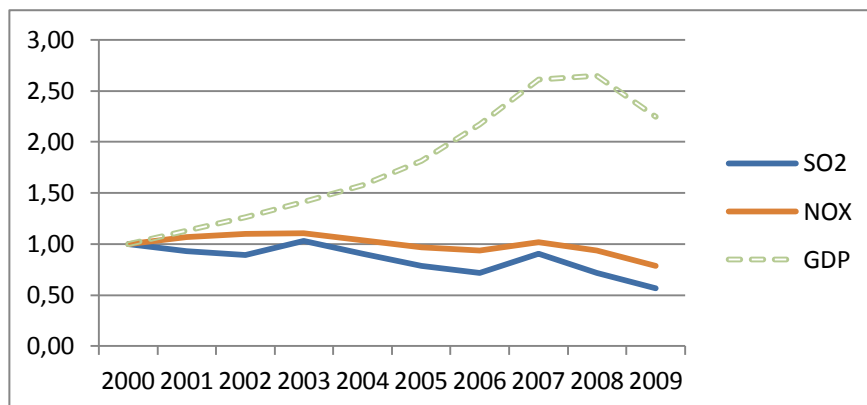
7.2 The impact on environment

Economic development during the last decades has had considerable impact on environmental status in the country. Economic restructuring and major environmental investments during the last 20 years (as a result of more stringent environmental regulations and implementation of environmental taxes and charges) have reduced emissions to air and water. At the same time generation of waste and mining of the most important construction minerals (such as sand, dolomite, gravel etc) have increased. Extraction of oil shale – the main source of energy for local electricity production increased during the years of rapid economic development. Oil-shale based energy production with to a large extent out-dated and inefficient production technology is the major source of environmental impact in the country. For example, Estonia's per capita CO₂ emissions from electricity and heat production were almost 8.5 tonnes in 2009, compared with 3.8 tonnes for the OECD as a whole (IEA 2011).

The public environmental investments have been conducted mostly in water and waste sector with the assistance of the EU funding. During 2005–10, the environmental protection related investments and expenditures from EU and Estonia's state funds accounted for approximately 500 million EUR, of which financing of water sector investments accounted for approximately 50 per cent. Additionally, private sector has used own financing to invest into environmental protection facilities, modernised their production processes etc.

Figure describes the reduction in SO₂ and NO_x emissions during 2000–09. It shows that the air pollution has decreased during the period even though the GDP increased considerably. In 2007 the economic development was in its peak and the local electricity production from oil shale increased almost 30% compared to the previous year, resulting in increases in sulphur and nitrous oxide emissions. During the years of crisis the air emissions decreased, largely due to general decrease in economic activity and to lower demand and production of oil-shale based electricity.

Figure 13 Air pollution in Estonia during 2000–09 (2000 = 1)



Source: author's calculations based on the Statistics Estonia data.

Presently the quality of outdoor air in Estonia is generally good; problems persist with fine dust emissions. The quality of ground water has improved, except in the oil-shale mining areas. Mining activity was high in the pre-crisis years, when the amount of primary energy produced from oil shale increased and resource demand for construction was high.

7.3 The fiscal crisis and environmental policy

The effect of financial crisis on environmental status can be seen from two perspectives. Firstly, financial crisis directly reduced environmental impact through the decrease of domestic production and consumption, which has direct effects on resource use and pollution levels. For example, electricity production from oil shale decreased during 2007–09 approximately 33 per cent, which reduced emissions to air (see Figure 13) and water, as well as demand for oil-shale extraction. Secondly, financial crisis induced changes in environmental policy, which resulted in behavioural change of the economic actors.

The effect of the fiscal crisis on environmental policy seems to most clearly occur in the short term perspective. This means that no considerable changes in long-term environmental policy objective were made and sustainable development goal remained at the forefront in the political agenda. The general goal of increasing environmental taxation and finding ways for cutting environmentally related subsidies was already agreed before the financial crisis. The crisis and the necessity to balance the budgets had the most effect on the timing of introducing the new tax rates and abolishing the environmentally harmful tax exemptions. The exact effect of environmental tax changes on emission loads and natural resource use is difficult to determine. Even though the charge rates are

still in several cases relatively low, they are assumed to make the use of natural environment more efficient.

One policy change that took place in 2009 was the change in the earmarking principles of the environmental charges and electricity excise duty, which resulted in bigger share of these tax revenues used for general government purpose, instead of specifically earmarking for environmental projects. At the same time also the limit was set to the share of environmental charges transferred to the local government budgets. The amount of “without-address” tax revenue to state budget was approximately 36 million EUR in 2010. Such policy changes affect emissions indirectly, by foregone environmental investments.

Difficult financial situation in 2008–09 often raised the question of defining and reviewing the financing priorities and the importance of the environmental issues compared to other objectives. In many occasions lack of sufficient funding resulted in reduced or postponed environmental expenditures and investments by the state and municipalities and in companies. For example, the state reviewed the public institutions budgets twice in 2009 and as a result, final budget of Ministry of the Environment was 15.4% lower compared to that one adopted initially (Estonian Ministry of the Environment 2010). The amount of direct grants from the state financed Environmental Investment Centre environmental programme was 29.8 million EUR, almost 40% smaller in 2009, compared to the previous year (Kralik et al. 2012). In the same period, the financing of environmental projects from EU Cohesion fund increased from 34 to 54 million EUR, with state’s co-financing decreasing from 25 to 10 million EUR (Kralik et al. 2012).

Due to budgetary constraints and problems in co-financing environmental projects, often financing offered by the state for certain investments remained unused. This happened for example in waste management sector, where the municipalities could not apply for state support for closing the old landfills, due to lack of co-financing. Environmental protection investments of municipalities fell from EUR 31 million in 2009 to EUR 11.3 million in 2010. In several cases the state started to support such measures that the local governments were due to difficult financial situation not able to provide anymore. For example, the capability of local governments to develop waste collection and management systems decreased considerably and the state started to grant financial support for managing local waste collection stations and collecting dangerous waste from households.

7.4 Fiscal policy and state budget – principles and development

The aim of the Estonian fiscal policy has been to keep the central government budget balanced in the mid-term perspective. Additional fiscal motivation for maintaining balanced budget was the objective to meet the requirements set by the Maastricht agreement, necessary to join the EUR zone and adopt the EUR as a currency. The general government budget position was during 2002–07 in surplus, especially due to favourable economic environment and rapid economic growth, which resulted in increased revenues. Mostly this surplus came from state budget, but also from social security funds (see Table 10). In local government sector the expenditures usually exceed revenues.

Table 10 Budget position of the general government sector

	2007	2008	2009	2010
General government budget position, EUR million (+ surplus, -deficit)	384	-481	-278	37
...Central government	365	-409	-116	-78
...Other government sector				
.....local governments	-73	-108	-68	33
.....social security funds	91	37	-94	82
General government budget position,% of GDP	2.4	-2.9	-2.0	0.3
...Central government	2.3	-2.5	-0.8	-0.5
...Other government sector				
.....local governments	-0.5	-0.7	-0.5	0.2
.....social security funds	0.6	0.2	-0.7	0.6

Source: author's calculations based on the Statistics Estonia data.

In 2008 the economic recession resulted in deficit of general government budget of 2.9% of GDP, mainly due to considerable decrease in private expenditure lower than expected. The costs exceeding revenues were also partially resulting from additional obligations taken in the period of economic growth – for example the pensions were increased by 5% in 2009.

The general government debt in Estonia was on the lowest level in the EU – during 2007–09 the total general government debt increased from 3.8% to 7.2% of GDP. The financial assets of general government decreased in 2008 from 12.2% to 9.7% of GDP, but still the financial asset value exceeded the government debt by 60% in 2009.

Taxes form the highest share of the state revenues. In 2009 taxes and social contributions accounted for 82% of general government revenues. The tax-to-GDP ratio increased from 2007 to 2009, mainly due to increases of VAT (from 18 to 20 per cent) and increased excise duty rates.

Table 11 Structure of tax revenues,% of GDP

	2007	2010	% change
Indirect taxes	13.5	14.2	5
...VAT	8.9	8.8	-1
...excise duties and consumption taxes	3.6	4.3	19
... other taxes	1	1.1	10
Direct taxes	7.4	6.8	-8
Social contributions	10.5	13.1	25
TOTAL tax-to-GDP	31.4	34.2	9
Cyclically adjusted TOTAL tax-to-GDP	27.1	36.8	36

Source: Eurostat (2012).

The share of direct taxes in total tax revenue has fallen considerably during 2005–10 from 23% to 20% and is one of the lowest in EU. Social security contributions accounted for almost 40% of total taxes in 2010, forming a considerable source of revenue of the government budget.

According to the Ministry of Finance estimates, the budget consolidation measures taken during the years of economic crisis, were equal to 4% of GDP in 2008, more than 9% in 2009 and almost 3% in 2010 (Ross 2011). Approximately 2/3 of the budget consolidation measures applied during the period, were on the expenditure side (including operational budget cuts and measures in pension, social security etc) and 1/3 of the measures were on the revenue side (including tax and non-tax revenues).

During 2010 and 2011 the state sold the greenhouse gas emission allowances (AAUs) in accordance to the UN Kyoto agreement, which increased the government revenue by EUR 135 million EUR in 2010 and EUR 165 million in 2011 (Estonian Ministry of Environment 2012). Ministry of Finance has estimated that about 70% of budget consolidation measures taken were long-term and 30% measures with one-time or short period effects (Ross 2011). Besides state tax changes, other fees and charges increased, for example, the renewable energy fee paid by the electricity consumers increased from EUR 30.3 to EUR 60.7 per MWh. This revenue was used for compensating efficient cogeneration and energy production from biofuel.

7.5 Environmental charges during 2005–10

By introduction environmental taxation in 1991, the state established the direct connection between environmental policy and state budget. This integration of different policies became even stronger in 2005, when the Government agreed on the basic principles of adopting the ecological tax reform (ETR) in Estonia. The reform expected to encourage innovation, as well as stimulate economic development through production process efficiencies and energy saving.

Along with the increased taxes on consumer goods and services, the personal marginal income tax rate was planned to reduce one percentage point per annum and to “freeze” the general tax burden at the same level

as in 2003 at 33.3% of GDP. In practice, the gradual decrease of the personal marginal income tax rate took place until 2009 when the further rate reduction was postponed due to budget consolidation needs.

During the first years of applying pollution and natural resource charges, the rates were set at a fairly modest level and they were increased gradually almost every year. In doing this, policy-makers aimed to support the development of the local economy and domestic consumption. There was a considerable increase in most of the environmental tax rates in 2006. For example, the CO₂ pollution tax rate increased by 39% and the CO and SO₂ charge rate by 100 per cent. The environmental taxes further increased between 2007 and 2010, see Table 12.

Table 12 Changes in environmental tax rates per tonne during 2007–2010 for selected pollutants, %

Emissions to water	
BOD ₇	58
P	116
N	73
Emissions to air	
SO ₂	88
CO	60
particulate matter	88
NO _x	58

Source: Environmental Charges Act, Regulations based on this act.

The rates in Table 12 correspond to the tax r in Figure 5. Analogous tax rate increases took place in natural resource taxation, e.g. mineral extraction (oil shale, dolomite and limestone) and water abstraction.

Resulting from increased tax rates, rapid economic development and increasing environmental impact, the revenue from environmental charges increased considerably in 2005–07. In 2009 the revenue from environmental charges were reduced even though the charge rates increased. This was partly due to lower economic activity – reduced taxable emissions and lower number of natural resources extracted, but also stemming from considerably lower tax revenue from waste taxation, due to fulfilling of the technical requirements when depositing certain oil-shale wastes (previously the basic tax rate was increased 5-times on such depositing, now only basic rate applied).

Considering the difficult situation in the economy and the goal of meeting the criteria necessary for introducing EUR -currency (including inflation criterion), the Government decided in early 2009 not to increase taxes and charges in near future. However, partly due to budget consolidation needs it was decided that most environmental charge rates should increase again.

Revenues from pollution and natural resource charges are to a large extent earmarked i.e. used to invest into environmental protection related projects, helping to reduce and avoid pollution and impairment related to environmental resource management. Since 2010 the share of

earmarked environmental tax revenues decreased and more finances became available for general budgetary needs.

7.6 Energy taxation during 2005–10

Energy excise duties apply in Estonia on fuel products and electricity. Fuel excise duty applies on motor and heating fuel, solid fuel, natural gas and similar products. Excise duties on fuels were also set at a modest level initially in order to take into account the economic situation in the country. Electricity excise duty applies since 2008 when the requirements of EU energy taxation directive were met and in order to avoid double-taxation the existing CO₂ pollution charge on electricity production was reorganised as an electricity excise duty.

Revenues from energy excise duty are transferred to state budget. The level of the fuel excise duty revenue determines the level of state expenditures to road construction and maintenance. Electricity excise duty is presently used for general state budget purposes.

As shown in Table 13, energy taxation far outweighs pollution taxes and natural resource taxes.

Table 13 Tax revenues related to pollution, energy and transport in Estonia, million EUR

	2007	2011	% change
Total government revenue	5844	6264	7
Pollution, energy and transport tax revenues	359	481	34
--- pollution charges	44	34	-23
--- natural resource charges	29	42	45
--- fuel excise duty	278	361	30
--- electricity excise duty	0	34	-
--- package excise duty	0	0	-
--- car registration fee	5	6	20
--- heavy goods vehicles tax	4	4	0
Share of total government revenues, per cent	6	8	33

Source: Kralik et al. (2012); author's calculations based on data from Statistics Estonia, Ministry of Finance and Ministry of Environment.

Since 2008 the energy taxation levels in Estonia are in accordance with the EU energy tax directive and after additional duty rate increases in 2009 and 2010 now exceed by far the EU minimum tax rates. Since 2011 oil shale used for heat production is taxed with excise duty.

Table 14 Fuel and electricity tax rates 2005-10, EUR per unit

Fuel	Unit	2005	2010	EU minimum tax rate
Petrol (unleaded)	1,000 litres	288	423	359
Diesel	1,000 litres	245	393	330
Light heating oil	1,000 litres	44	111	21
LPG (gas used as motor fuel)	tonne	100	125	125
Shale derived fuel oil	tonne	15	15	15
Solid fuel (coal, coke)	upper calorific value GJ	0.30	0.30	0.15
Natural gas as heating fuel	1,000m ³	101	23	10
Electricity	MWh	3.201	3.2	0.5–1

Source: Alcohol, Tobacco, Fuel and Electricity Excise Duty Act
1) 2008

During 2007–11 the revenues from fuel excise duty increased mostly due to the higher duty rates, even though the consumption of motor and heating fuels decreased because of economic recession.

7.7 Environmentally harmful subsidies

Environmentally harmful subsidies have not been systematically defined and quantified in Estonia. However, some estimates can be made using data from the public information sources. The majority of easily identifiable subsidies covers reduced rates or exemptions from energy taxes, determined by the Act regulating excise duties (cf Table 4). The foregone revenue from excise duty reduction for diesel and light heating oil used for special purposes (such as agriculture, fishing etc) constitute the largest fraction, accounting for EUR 92 million in 2010. The other exemptions from fuel and electricity taxation have been in average EUR 5–8 million in total during 2008–2010.

Full exemption from water abstraction charge applies presently in case of water-energy production, irrigation and fish farming. There is no data for the potential subsidy amount available. There have also been discussions over the potential subsidies given to the oil-shale based electricity production in the form of 1) applying too low environmental tax rates on pollution and natural resource use, that do not cover all the external costs; 2) applying lower tax rates than in other sectors, or 3) granting the carbon emissions quotas under the EU-ETS to companies for free, but until there is no comprehensive study conducted, there is no reliable estimation of the subsidy actually granted and therefore these subsidies are not discussed further in the present study.

Further, several on-budget state grants contribute to increase the use of fossil fuels for energy production. These include environmental investment or other development support for private companies producing shale-derived fuel oil or oil-shale based electricity and heat. Such direct project grants have not been big – during 2006–2011 approximately EUR 9 million in total.

Additionally feed-in premium is paid to companies for using peat and retort gas in co-generation plants, however, for financing this measure, electricity consumers pay additional fee per kWh of electricity consumed.

Based on limited data available, the amount of environmentally harmful subsidies on fossil fuel production and consumption during 2005–2010 can be estimated to EUR 50–100 million annually, which is 0.36–0.7% of the country's GDP. However, the actual value of subsidy is potentially higher.

Abolishing environmentally harmful subsidies has been part of the wider tax reform program. Environmentally harmful subsidies have been abolished in most cases both, in environmental and fiscal causes. During 2005–2010 several exemptions from fuel excise duties and VAT have been reformed:

- In 2007 reduced VAT rate (5 per cent) on district heating and on household consumption of solid fuels was abolished and the standard rate applied – the additional expected revenue from this measure in 2007 was EUR 10 million, *i.e.* 0.08% of GDP (Estonian Ministry of Finance 2006).
- In 2008 excise duty exemption for shale oil used in district heating and households was abolished – additional revenue in 2008 was EUR 1.3 million (Estonian Ministry of Finance 2007).
- In mid-2011 fuel excise duty exemption for biofuel was revised – as a result exemption continues for biofuels entirely produced from biomass *i.e.* biogas, and wood products. Biodiesel and bioethanol were taxed with the standard excise duty rates of diesel and petrol. The additional revenue from biofuel tax changes was marginal due to low levels of bioethanol and biodiesel use.
- In 2012 fuel excise duty exemption was abolished for light fuel oil and special purpose diesel used in agricultural vehicles in forestry, mining or construction works. This was the first phase in reforming the tax exemptions of the fiscally marked fuel, which presently accounts for the considerable share of foregone revenue in the form of excise duty exemptions. The expected increase in state budget revenue in 2012 was EUR 27.8 (0.1% of GDP) million.

Until now, government has more focused on raising environmental tax rates than on abolishing environmentally harmful subsidies and the few subsidy cuts have only had limited effect on budget consolidation. However, the government has stated that the reform of fuel excise duty exemptions will continue and the subsidies system will be reviewed in the coming years.

7.8 Estonia – a summary

After a high growth period in Estonia since 1990s, the country suffered severely from international economic crisis. But due to conservative fiscal policy, Estonia has relatively low fiscal deficit and public debt. During the years of crisis several budget consolidation measures were taken to keep the government revenues and expenditures balanced, and the fiscal policy has proven successful compared to most other countries hit by the crisis.

Some changes in the environmental policy

The overall picture is that there were no major changes in the environmental policy objectives during the years of crisis. The principles of the ecological tax reform – increasing of environmental taxation and finding ways for cutting environmentally related subsidies was already agreed before the financial crisis, in 2005. However, the necessity to balance the budgets had direct effect on the timing of introducing the new tax rates. Therefore, it was decided in 2009 that due to the budget consolidation needs most environmental charge rates continue increasing during 2010–2015 and the earmarking of environmental charges was reduced while bigger environmental tax revenue share became available for general budgetary purposes. Further, during 2010 and 2011 the state sold the greenhouse gas emission allowances, which increased the government revenue by EUR 135 million in 2010 and EUR 165 million in 2011. This revenue was not used to balance strengthen budget, but to finance renewable energy measures. Abolishing environmentally harmful subsidies has also been part of a wider tax reform programme. This has helped slightly to balance government budget and reduce costly tax exemptions, as well as stimulate more sustainable energy use.

The lack of sufficient financing during the crisis reduced environmental protection expenditures, especially in municipalities, and this had negative implications on environmental status. On the other hand, due to decrease in local production and consumption, the pressure on environment also decreased.

Significant consolidation potentials in carbon taxation

Estonia has faced positive financial balances the last years, while the OECD forecasts indicate deficit in the near future years, see Table 1 and Table 2. The potential in carbon taxation is however significant, if levied at all sources – between 1 to 6% of GDP at a tax of EUR 8 and 50/tonne CO₂ respectively, see Table 6.

There is also good potential for increasing other pollution and resource charges. Further, the amount of environmentally harmful subsidies on fossil fuel production and consumption are estimated to EUR 50–100 million annually, which is 0.4–0.7% of the country's GDP. This leaves a good potential for increasing future revenues/cutting expenses as a buffer against future economic threats.

8. Ireland

8.1 The financial crisis

Ireland faced a continuous GDP growth from 1983 and up to 2007, with an average annual growth of 7% from 1994 to 2007. Growth was initially well-founded and genuine progress left Ireland with one of the most structurally sound economies in the OECD, and before the crisis Ireland had success in national debt reduction from more than 50% in 1998 to 26% in 2006 (Andersen et al. 2010).

In 2008 the banking crisis hit Ireland with a following deep recession. GDP in real terms fell by over 5% from 2008 to 2009 and is still below the 2008 level in 2012 (Convery 2012). With the burst of the housing bubble, the Irish banking system suffered financial losses of historical proportions, and put pressure on the fiscal position. Ireland effectively lost access to sovereign bond markets.

Since 2008, net expenditure exceeded net tax receipts. General government net financial liabilities grew from balance to 74% in 2011, and are expected to increase further in the years to come (see Table 2). Tax revenues fell by over 23% from 2008 to 2009, but have later regained the 2008 level, mostly due to increasing income taxes (Convery 2012).

Addressing the financial crisis will require a combination of cuts in government expenditure, and increases in taxation, amounting in total to in the order of EUR 10 to-15 billion. The government has called on financial assistance from the IMF, EU and ECB in support of its economic adjustment programme. Financial pledges have been made to cover the fiscal deficit, bank recapitalisation costs and debt maturities. The government is preparing a 4 year budget in consultation with the European Commission (Andersen et al. 2010).

The latest report from OECD Economic Outlook (OECD 2012b) points to expanding employment at the end of 2011 for the first time since the crisis began. Due to the narrowing of macroeconomic imbalances, house prices and construction activity are still falling and household debt remains high. Staying the course of deficit reduction is considered important because the public debt outlook remains vulnerable to downside risks.

Budgetary consolidation in 2012 is taking the form of durable savings in health, social protection, education and capital spending. Indirect taxes have been raised while, at the same time, tax relief is providing a shield from austerity to low-income and part-time workers, small businesses, homeowners and mortgage borrowers.

8.2 Environmental policy

Environmental taxation is already used in Ireland. One example is the plastic bag levy, which immediately reduced the use of such bags by over 90% after its introduction.²⁰

More importantly, Ireland has also introduced a CO₂ tax after the crisis set in. Ireland has introduced energy-carbon taxes for all energy products not covered by the EU-ETS, transport fuels from 2009 and fuel from heat from 2010. The carbon tax in Ireland started out at a rate of EUR 15/tonne CO₂. The argument was that at the time being this was close to the market price of carbon within the EU-ETS, and that the price was a good and bearable introduction to the carbon tax. In 2012 the rate was raised to EUR 20/ tonne CO₂, while the EU ETS price has fallen to some EUR 8/tonne CO₂. The estimated yield is EUR 400 million in 2012 (Convery 2012).

Also, approximately 28% of total Irish greenhouse gas emissions fall within the scope of the ETS (Environment, community and local government 2011). About 100 companies, mainly power stations and high energy users, participate in the Emissions Trading Scheme in Ireland. The new phase from 2013 onwards includes a greater emphasis on auctioning of allowances and harmonised rules for free allocation.

Emissions from agriculture, transport, waste, light industry, commercial and residential fall outside the ETS. These sectors account for approximately 72% of total Irish emissions. Table 15 illustrates the amount of carbon taxes in the light of GDP, total taxes income and income taxes. At present level, the revenues contribute a relatively limited share of total taxes. But as shown in table 6, if revenue was collected from all GHG emissions, and at a tax of EUR 50/tonne CO₂, the revenue would amount to 1,8% of GDP.

The base for taxation on cars was changed in July 2008 from engine size to CO₂ levels, and an air travel tax came into force in 2009. Specifically, the tax payable on the purchase of cars (called Vehicle Registration Tax) went from 14% of market value for the most carbon efficient vehicles (<120 g/km) to 36% for the least efficient (>225 g/km); the annual road tax went from EUR 104 to EUR 2,100 for the equivalent emission categories. The average carbon efficiency of the new car fleet improved dramatically, falling from 164g/km in 2007 to 133 gm/km in 2010. (Hughes-Elders, 2010)

The government which came into power in 2007 was a coalition of Fianna Fail and the Green Party. The latter had included the introduction of a carbon tax in the programme for government which the two parties

²⁰ <http://www.eea.europa.eu/articles/cutting-deficits-and-protecting-the-environment>

agreed, so the decision to have a carbon tax preceded the onset of the crisis in 2008. However, the willingness to proceed in 2010 was helped considerably by the fact that the budgetary crisis had emerged in 2009. The concern for fiscal consolidation is certainly an important argument used for the subsequent further increases in the tax level from EUR 15 per tonne of CO₂ in 2010 and 2011 to EUR 25 in 2012.

Taxes levied at energy products have also been increased since 2008. Such taxes are basically fiscal taxes, and it is difficult to single out environmental tax revenues from taxes related to energy, transport etc. in the statistics. Also, the land fill tax was introduced in Ireland at a rate of EUR 19 per tonne. It was increased to EUR 50 per tonne in 2011, and to EUR 65 per tonne from July 2012. But as we see from Table 15, the total revenues from such taxes have been significantly reduced since 2007, despite higher tax levels for energy products. This probably reflects lower economic activity while it hardly means *lower* emission tax levels. On the other hand, we cannot deduct that a heavier environmental policy has increased revenues from other emissions than CO₂.

Table 15 Tax revenues in Ireland, mill EUR

Year	2007	2008	2009	2010	2011	2012
Total GDP, real terms		166,8	157,7	156,5	158,7	159,7
Total Tax Income		40,8	33,0	31,8	34,0	36,4
Income Tax		13,2	11,8	11,3	13,8	15,3
Carbon tax revenue in % of GDP				246,0 (0,16%)		400,0 (0,25%)
Environmental, resource, transport and energy taxes ¹⁾	4,7	4,5	3,8	3,7		

Source: Convery (2012), Eurostat Data base.

1) The sources included in the Eurostat "Environmental taxes."

8.3 The potential for increasing environmental taxes

Despite the fact that the potential revenues from environmental taxes are relatively limited compared to the financial challenges, cf Chapter 5, important initiatives are made to restructure the economy towards getting the prices right in Ireland. The European Environment Agency (EEA) has focused on Ireland to pilot environmental tax reforms in combination with reducing their extensive budget deficits, and a particular case was conducted to estimate the revenue potentials from an environmental tax reform (Anderson et al. 2010). We use this study to illustrate the potential for Ireland.

Table summarizes the potential of new environmental taxes as estimated by Andersen et al., cf. the rate r in Figure 5. The revenue from these taxes amounts to about 0,6 bill EUR in 2013. This would contribute to about 5% of the EUR 10 to-15 billion cuts in government expenditure/ increases in taxation needed to meet the financial crisis. The amount corresponds to 0.33% of GDP in 2011. Also recall Table 1

and Table 2, forecasting a net financial liability of 87% of GDP and a governmental deficit of 7.6% of GDP in 2013. For comparison, the total tax revenue was about EUR 45 billion in 2009.

Table 16 Potential revenues from increasing environmental taxes in Ireland, mill EUR

Charge category	2013	2014	Comment
Water abstraction levy	64	85	Applying Danish rates, assuming marginal damage cost
SO ₂	88	118	Applying Danish rates
NO _x	233	311	Applying Swedish rates
GHG-nitrogen	68	90	15 EUR /tonne CO ₂ -eq
Air travel tax	55	55	Assuming no carbon tax
CO ₂ tax, offshore	63	85	Applying Norwegian rates
Environmental tax revenue	571	744	
In% of GDP ¹⁾	0,33%	0,43%	

¹⁾ Data from 2010. GDP amounted to EUR 172 billion

In addition, fiscal taxes and charges totalling about EUR 930 million are specified in Andersen et al. These additional taxes include user charges (for water supply and discharge), taxes on packaging, fiscal transport taxes (registration taxes), taxes on energy (excise duties, electricity, energy taxes), not environmental taxes, cf. the discussion of fiscal versus environmental taxes in section 5.²¹ Although methane from agriculture is up to 30% of Irish greenhouse gas emissions it is not included in the environmental tax system.

Ireland also considers introducing a land value tax. Andersen et al. (2010) estimate a significant potential of EUR 2–3 billion.

The most realistic tax/charge in terms of both revenue raising and environmental impact is to charge domestic users for water. These users have been exempt the tax for decades. This is included in the programme agreed between Ireland and the Troika (IMF, European Commission, European Central Bank) as a condition of support funding, and in any event has a strong logic in terms of government income and the efficient use of resources.²²

²¹ Such taxes, as fiscal taxes and charges in general, most likely contribute to reduce the environmental pressure and to increase public budgets. However, it is debatable whether they increase efficiency. For instance, if energy use is subject to carbon taxes or the emission trading system, energy and transport taxes are double counting if included in the environmental tax revenues. Taxes on packaging are not related to specified externalities, and user charges are meant to cover economic costs, not external costs.

²² The case is made by Convery and Scannell in: <http://www.publicpolicy.ie/wp-content/uploads/Consultation-on-Water-Policy-150312.pdf>

8.4 Reducing environmentally harmful subsidies

OECD (2011a) and CER (2011) have identified a range of sources for reducing environmentally harmful subsidies in Ireland. These form potential sources for fiscal consolidation in addition to increasing environmental taxes.

The *subsidy to peat production* takes the form of a levy to support the higher cost purchases of electricity generated from peat (OECD 2011a, CER 2011). The mechanism has been approved by the European Commission through to 2019. The costs recovered through the levy equate to the additional costs of the power purchases over and above the cost of electricity purchased at market prices. The scheme also applies to certain renewable energy sources. For the 2011/2012 levy period the levy amounts to EUR 92.12 million (CER 2011), which is limited to 0.05% of GDP.

The upstream oil and gas sector in Ireland attracts a specific corporate income-tax rate of 25 per cent, as compared to the 12.5% rate that applies to most other sectors (OECD 2011a). Full *deductions are, however, allowed for exploration, development, and field abandonment costs* in the year in which they are incurred. Unclaimed deductions can be carried forward for an unlimited amount of time. In addition, the Irish government does not levy any royalties, nor does it participate in projects. No estimates of the revenue foregone due to this provision are available.

A *reduced rate of VAT* (13.5 per cent) is applied to sales of certain fuels in Ireland (OECD 2011a). Eligible products include coal, peat, natural gas, electricity, kerosene-type jet fuel, dyed diesel, and hydrocarbon oils used for domestic or industrial heating purposes. The on-road use of gasoline, diesel, and LPG remains taxed at the standard 21% rate. No estimates of the revenue foregone due to the reduced rate of VAT are available.

Households are largely *exempt from paying toward operating costs of water supply and wastewater services*. There are also no taxes on water supply or on water effluent. Introducing a national scheme of user charges for water services would free up about EUR 1 to 1.2 billion i.e. approximately 2% of total tax revenue (Andersen et al. 2010) or about 0.7% of GDP.

Finally, taxes are partially exempt on *diesel for the agricultural sector* (Andersen et al. 2010).

In total, these tax reforms have only limited budgetary potentials, to the extent that estimates of revenue foregone exist.

8.5 Ireland – a summary

In 2008 the banking crisis hit Ireland with a following deep recession. GDP in real terms fell by over 5% from 2008 to 2009 and is still below the 2008 level in 2012. The Irish banking system suffered financial losses of historical proportions, and Ireland lost access to sovereign bond markets. General government net financial liabilities grew from balance to 74% of GDP in 2011, and are expected to increase further in the years to come.

New carbon taxes

The financial crisis has supported the introduction of a carbon tax in Ireland and planned water charges, addressing externalities and resource costs, and de facto reforming implicit subsidies. The carbon tax started out at a relatively low level in order to give time for adjustments, and has later increased far beyond the market price in the EU ETS. Energy taxes have also increased since 2007. But all together, revenues from energy, transport and environmental taxes have been reduced, due to negative economic growth.

Consolidation potentials in carbon taxation

The potential in reducing budget expenses to environmentally harmful subsidies seems limited, given existing data. Further reforms on pollution taxation are discussed in Ireland, presenting pollution tax potentials of 0.3–0.4% of GDP. This is however a small contribution to the governmental financial deficit, forecasted to 7–8% of GDP in 2012–13, and the total net financial liabilities of about 80% of GDP.

The carbon tax seems to be the most relevant pollutant of influential contribution to the budget. If levied at all sources, and at a rate of EUR 50 per tonne CO₂, this could contribute with a revenue equal to 3.1% of GDP. About 100 companies participate in the EU ETS in Ireland. The new phase from 2013 onwards includes a greater emphasis on auctioning of allowances and harmonised rules for free allocation. Auctioning of allowances and additional taxes equalling marginal costs across sectors both maximize the potential revenues and secure efficient fulfilment of emission reductions.

9. Samandrag

Den internasjonale økonomiske krisa har medført store underskot i offentlege budsjett og auka offentleg gjeld. Miljøavgifter og inntekter frå omsettelege utsleppsrettar er potensielle kjelder for offentlege inntekter, samtidig som dei bidreg til å rette opp marknadsimperfeksjonar og auke økonomisk effektivitet.

Generelt er miljøavgifter for låge og utslepp for høge og det er for mange unntak frå verkemiddel i forhold til kva som er optimalt. I nokre land er miljøskattane negative, det vil seie at miljøskadelege gode og tenester er subsidierte. For eksempel reknar ein med at subsidiar til fossil energiforbruk vil vokse mot nærmare 660 mrd USD i løpet av dette tiåret. I enkelte land utgjer slike subsidiar 20-30 % av BNP.

Gitt dei doble utfordringane knytte til prising av miljøskader og konsolidering av offentlege budsjett ser denne rapporten på følgjande:

- Kor store er dei potensielle provenya knytte til auka miljøavgifter og reduksjonar i budsjettmessige miljøskadelege subsidiar i forhold til dei offentlege budsjettunderskota?
- I kva grad har landa nytta høvet til å reformere miljøpolitikken som ledd i den økonomiske krisa?

I analysen deler vi miljøskadelege subsidiar i to grupper; indirekte miljøskadelege subsidiar i form av at forureinarane ikkje betaler for utsleppskostnadane, og direkte finansiell støtte over offentlege budsjett til miljøskadeleg forbruk og konsum.

Provenypotensialet i Europa er størst i prising av klimagassar

Vi finn at brorparten av potensialet i miljøprising ligg i ei riktigare prising av utslepp av klimagassar. Vi har sett på optimal prising av utslepp til luft for komponentane SO₂, NO_x, PM_{2,5}, NH₃ og VOC med utgangspunkt i marginalkostnader knytte til å oppnå politisk sette utsleppsmål i Europa. Estimerte marginalkostnader tilsvarer optimal avgift. Det potensielle provenyet i Europa, gitt disse kostnadene, tilsvarer 7 mrd. Euro i 2020. Dette er eit stort beløp, men samanlikna med samla BNP i landa, og også samanlikna med budsjettunderskota, er det likevel ein liten del.

Potensialet for inntekter frå karbonprising er langt høgare. Vi har teke utgangspunkt i ein pris på 50 euro/tonn CO_{2e} for europeiske utslepp i 2009. Dette gir eit potensielt proveny på 240 mrd euro, tilsvarande halve budsjettunderskotet for Island og Portugal og ein fjerdedel av underskotet for Hellas (2011). For samanlikning vil det potensielle provenyet frå ein

karbonpris tilsvarande 8 euro/tonn CO₂e (om lag prisen i EU ETS) utgjere mindre enn eit prosentpoeng for budsjettunderskota.

Provenyet avheng naturlegvis av kva pris ein reknar som rett, og om tildelinga av utsleppsrettar er gratis eller auksjonert. Utslepp som ikkje er dekkja av EU ETS må påleggast avgift. Dette vil venteleg føre til motstand frå interessegrupper. Motargumentet er at underskota uansett må dekkast, og ved å nytte instrument som betrar den økonomiske effektiviteten, vil den samla byrden bli lågare og ikkje større.

Vi konkluderer med at dei potensielle offentlege inntektene er vesentlege i eit system med karbonprising og/eller auksjonerte utsleppsrettar som dekker alle klimagassar, og innanfor eit avgiftsnivå som er nødvendig for å møte krava til strenge utsleppsreduksjonar.

Lite teikn til auka miljøskattar eller reduksjonar i miljøskadelege subsidiar som følgje av finanskrisa

Til tross for potensialet vi finn i karbonprising, finn vi ingen klare tendensar til generelle auke i miljøavgifter eller auka inntekter frå kvotesystemet som følgje av finanskrisa så langt. Likevel, når vi går i detaljar på enkeltland (Island, Estland og Irland), finn vi auke i provenygenererande instrument etter 2007, slike som karbonskattar og auka forureiningsavgifter. I Island er ein karbonskatt introdusert og skattlegging av motorkøyretøy er endra for å reflektere karbonutslepp. Island ser ut til å vri avgifter mot naturressursar og turisme og harmoniserte klimapolitikken mot andre europeisk land. Det er likevel ikkje gitt at disse endringane har kome som følgje av finanskrisa.

I Estland er det overordna bildet at det ikkje har vore store endringar i miljøpolitikken som følgje av finanskrisa. Auken i miljøskattlegging og strategiar for å redusere direkte miljøskadelege subsidiar var bestemt før krisa. Likevel har behovet for å balansere offentlege budsjett hatt direkte effekt på tidspunktet for å innføre nye avgiftssatsar og bruke auksjonerte utsleppsrettar. Utfasing av miljøskadelege subsidiar har også bidrege til å balansere budsjettet.

I Irland har finanskrisa truleg vore viktig for introduksjonen av karbonavgifta og andre miljøavgifter som verkemiddel for å balansere dei offentlege budsjetta. Ei karbonavgift blei introdusert med relativt låge satsar, og har seinare vore justert mot marknadsprisen i EU ETS. Likevel er bidraget til budsjettunderskotet moderat.

Til tross for samanfall i tid mellom finanskrisa og endringar i miljøpolitikken, er det vanskeleg å identifisere i kva grad politikkenringane er følgje av krisa, eller ville vore planlagt uansett. Mange av endringane var allereie planlagt eller sette i gang før finanskrisa. Vi fann heller ingen teikn til reduksjonar i direkte miljøskadelege subsidiar. Slike subsidiar er mest vanlege i utviklingsland, og potensiala i europeiske land er meir begrensa.

Gratis tildeling av utsleppsrettar er det same som å auksjonere rettane og så gje provenyet tilbake til forureinarane. Fri tildeling er med andre ord ein måte å bruke provenyet på. EU vil auksjonere ein større del av kvoten frå 2013, men likevel vil majoriteten av utsleppsrettane bli delte

ut gratis. Vi finn få eller ingen teikn til at kravet til auksjonering har auka som følgje av dei offentlege budsjettunderskota. Tvert i mot har EU bestemt at statane kan kompensere kraftkrevjande industribedrifter for auken i energiprisar som følgjer av kvotesystemet. EU nyttar generelt reguleringar i miljøpolitikken som alternativ til avgifter, som for eksempel IPPC direktivet, LCP direktivet og BAT direktivet. Andre system er finansiert utanfor offentlege budsjett, som grønne sertifikat og feed-in tariffar. Det har heller ikkje vore seriøse forsøk i USA om auke i miljøavgifter i samband med finanskrisa.

Nokre land reduserer direkte subsidie, men truleg ikkje på grunn av offentlege budsjettunderskot

Mange land subsidierer miljøskadeleg forbruk, spesielt konsum av fossil energi. I nokre land utgjer slike subsidiar svært store delar av BNP, i Usbekistan 30 %, i Iran 23% og i Turkmenistan 19% av BNP. Nokre av disse landa, inkludert Iran, har gjort grep for å redusere subsidiane. Men samtidig har disse landa vore mindre ramma av finanskrisa, og dei offentlege budsjetta er i betre stand enn i Europa og USA. Reduksjonen i miljøskadelege subsidiar er først og fremst eit steg i retning av meir effektiv prising, og truleg ikkje respons på svake offentlege budsjett.

Politikk anbefalingar

Gitt fordelane med auka miljøeffektivitet og finansielle effektar, anbefaler vi ein breiare bruk av miljøskatlegging som del av løysinga til finanskrisa. Vi konkluderer med at provenyopotensialet er vesentleg, spesielt for utslepp av klimagassar. Dette krev eit system med karbonskattar og/eller auksjonering av utsleppsrettar for alle utslepp. Ved sidan av å prise eksternalitetar anbefaler vi også å fase ut dei direkte miljøskadelege subsidiane. Begge strategiane vil bidra til å balansere budsjetta, og til riktigare prisar og dermed auka miljømessig og økonomisk effektivitet.

Kolkraftverka og den energiintensive industrien har størst fordelar av indirekte subsidiar gjennom manglande miljøskatlegging i dagens politikregime, og vil tape mest i eit system med riktigare prisar. Om avgifter blir følgt opp med kompensasjonsordningar for industrien, vil den positive effekten på budsjetta bli mindre. For å hindre nye, ineffektive subsidieordningar, er det viktig å identifisere kva grupper som tapar, om det er grunnar til at disse gruppene skal støttast, og korleis ein kan gjere det mest muleg direkte og effektivt.

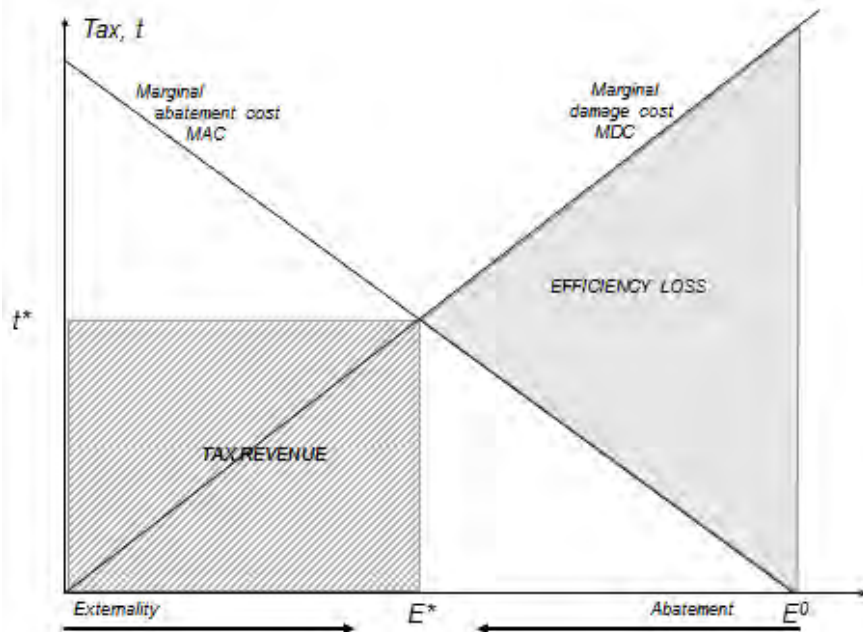
Kompensasjonsordningar er i prinsippet nye subsidiar, og disse bør legast så nær opp til dei prioriterte gruppene som muleg. Tidlegare erfaringar viser at endringar i miljøpolitikken bør følgjast opp med tydeleg informasjon om dei samfunnsmessige fordelane og kostnadene ved reformene.

Appendix

Environmental taxes

The purpose of *environmental taxes* (Pigouvian taxes) is to internalize environmental externalities into markets (Pigou 1920, Sandmo 1975). According to economic theory, an optimal environmental tax should be levied directly at the externality and equal the marginal damage cost of the pollution.²³ The optimal use of environmental taxes is illustrated in Figure 14. In the general case, marginal damage costs (*MDC*) increase with increasing emissions, while marginal abatement costs (*MAC*) increase with higher abatement, i.e. decreasing emissions. The optimal emission level, minimizing the total abatement costs, occurs when marginal damage costs equal marginal abatement costs. This is when the tax, *t*, is set optimal, $t^* = MDC = MAC$. If *MDC* is constant, $t^* = MDC$. This is relevant when the regulation is not likely to influence marginal damage costs, e.g. local/national greenhouse gas emissions instruments.

Figure 14 Optimal taxation of externalities



²³ For polluting goods, total taxes should vary according to the externality rule and the elasticity of demand by taking into account the additivity theorem in Sandmo (1975, 2000). Importantly, the optimal taxes will not simply be the sum of the fiscal tax and the MDC, rather a weighted average of the tax computed under the Ramsey inverse elasticity rule and the Pigouvian marginal social damage.

Environmental taxes have two important features. First, they influence factor use, as the costs of factors generating negative externalities increase. Consequently, emissions are reduced (E^0-E^*), and the *efficiency loss* (the difference between marginal damage costs and marginal abatement costs) is eliminated. Second, the tax revenue (t^*E^*) principally compensates the society for the negative costs of remaining damages. Hence, like fiscal taxes, environmental taxes contribute to the public budget, but they also improve economic efficiency and reduce environmental costs. Importantly, taxes higher than t^* *reduces* efficiency, as the efficiency loss is higher than zero. Taxes higher than t^* still make sense, not as environmental instrument, but to create revenue. These revenues are thus to be defined as fiscal tax revenues (Bruvoll 2009).

The tax should be defined as closely to the externality as possible, i.e. in most cases in terms of environmentally damaging emissions. A practical approximation can be to levy the tax at the quantities of goods causing the emission. For example, since the CO₂ emissions and the use of gasoline are proportional, carbon taxes on petrol can be levied at the energy use, rather than the emissions.

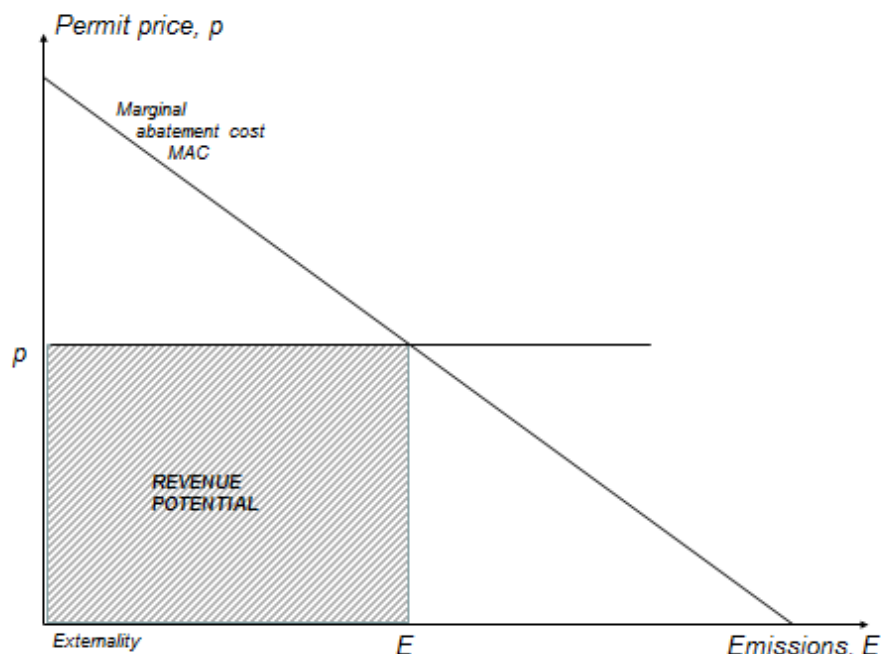
Principally, the partial effects of all taxes are reduced environmental pressure, as they slow down economic activity. This underlines the importance of a clear theoretical underpinning for the calculation of environmental taxes and tax revenues. In the further discussion of practical examples, it may be difficult to separate revenues from fiscal taxes and environmental taxes and to avoid double counting of the environmental revenue, since the taxes are levied at the same tax bases. The optimal level of the Pigouvian tax is another core parameter open for discussion.

Auctioning versus grandfathering of emission permits

Emission trading systems markets are in principle equivalent to environmental taxation when it comes to economic mechanisms and efficiency gains. But when using taxes, the emission level is uncertain and given in the market, while emissions are given and the marginal abatement cost (the allowance price) is determined in the market in trading systems.

An important practical difference is that emission trading opens for grandfathering of permits. In contrast to environmental taxes, polluters don't pay for their emissions in a grandfathering regime, cf. Figure 15. In Figure 15, we assume the emission market is restricted to E , leaving an allowance price p . The potential revenue in this market is given by the shaded area.

Figure 15 Revenue from auctioning of emission permits



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Ved Stranden 18
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www.norden.org

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The financial crisis and fiscal consolidation in green budgets

This project adds insight into the potential contribution to fiscal consolidation from environmental tax and subsidy reforms, i.e. strengthening public budgets while at the same time improving economic efficiency and the environment. The report contributes with own calculations for potential revenues from environmental taxes and discusses the financial crisis and environmental tax policy responses in Iceland, Estonia and Ireland as case studies.

The analysis has been carried out during the period July 2012 – December 2012 by Vista Analysis AS, Norway, Reykjavik University, Iceland and PRAXIS Center for Policy Studies, Estonia. The project was commissioned by the Nordic Council of Ministers.

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