GLOBAL UTMANING

Carbon taxation

- a forgotten climate policy tool?

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Global Utmaning (Global Challenge) is an independent Swedish think-tank.
We are a qulified network from organisations, business and academia focusing on solutions for global issues regarding economy, environment and democracy.

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Project Manager: Carl von Essen

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1. Preface

The climate challenge is so serious that all possible policy measures need to be considered. Currently however, there tends to be a focus on regulations and emissions trading as the main ways of reducing carbon emissions. The use of taxation seems to be ignored or forgotten. This might owe to several misconceptions:

There seems to be a perceived competition between carbon taxation and emissions trading. But quite to the contrary, taxation and emissions trading can complement each other since they are designed for different purposes and suit different sectors of the economy. The EU trading scheme ETS only covers 46 % of the economy. Taxation could (and does in several countries) cover remaining sectors in a complementary way.

Another misconception is that a carbon tax has to be applied in a uniform global manner. This is of course desirable but unrealistic in the short run, possibly also in the long run. Carbon taxation (as most forms of government policy) has to be adapted to the national circumstances.

A third problem is that carbon taxes often only are considered for financial purposes, but not for affecting the behavior of households and industry. For example, in the discussions preceding the Copenhagen Summit 2009, there have been government proposals of a uniform global carbon levy of 2 USD/ton CO_2 to raise revenues for climate adaptation in poor countries. Such a tax would raise considerable sums but would have little or no effect on consumer's behaviour.

By now there is ample evidence that carbon taxes work. Several developed countries have implemented carbon taxes for over a decade, often as part of an environmental tax reform, shifting the tax burden from taxation of labour to taxation of carbon and energy. As shown in this report, these measures have had a positive impact on CO_2 emissions and the economy at large.

There is also interesting research into the effects of carbon taxation in developing economies. As shown in the report these taxes, apart from being environmentally friendly, also have a positive welfare effect in terms of affecting the income distribution in a progressive manner.

Global Utmaning (Global Challenge) is an independent Swedish think-tank concerned with democracy and sustainable development aiming to influence public opinion in major global issues.

Our report describes theory and research on carbon taxation as well as interesting developments such as the current revision of the EU's energy tax directive. The report is based on contributions by Staffan Laestadius, professor of Industrial Economics at the Royal Institute of Technology in Stockholm, Fredrik Jonsson and Henrik Kjellberg, energy tax experts at PricewaterhouseCoopers who have contributed with technical information on taxes in section 3, 5, 7 10 and annexes; Knut Rexed, former State Secretary at the Swedish Ministry of Finance.

We are very grateful for their contributions and hope that the report will stimulate further discussion of this highly relevant and urgent matter.

Kristina Persson	Carl von Essen
Chairperson	*Secretary General*

2. Ten Principles on Carbon Taxation

Introduction:
What it is all about: significantly higher prices on fossil fuels and CO_2 emissions

In this policy paper Global Utmaning *("Global Challenge")* – a Swedish based think tank - argues that it is possible and necessary to use the momentum created by the Copenhagen summit to reach an agreement on a taxation and emission permits package forceful enough to steer the world economy – and our life styles – away from the climate catastrophe we are now facing.

The challenge:
The speed of climate change is increasing – mitigation efforts cannot be delayed

Climate Change is now – 2009 – even faster than was concluded in the IPCC reports from 2007. The CO_2 content in the atmosphere has now (November 2009) reached the level of 386 ppm which is 1.9 ppm more than one year ago. In fact the average annual increase during the last decade (1.875) is twice the annual increase identified during the first decade of observations at the Mauna Loa observatory (0.81) three decades ago. And the Arctic ice sheet becomes smaller and smaller for every year following a clear trend: 2007 was all time low for the summer season ice sheet. Glaciers develop along a similar trajectory: in fact the speed of meltdown is increasing. Also the global temperature is increasing; here we can identify that the temperature increase itself is increasing. The last decade is the warmest ever recorded.

If mankind continues along the trajectory we have entered upon since about 200 years we will – with large probability – face a global temperature increase of approximately 6°C during this century. The consequences of that – of which there is a growing consensus among scientists as well as policy makers – are catastrophic.

The diagnosis:
Human addiction to carbon must be broken

The primary cause behind this rapid deterioration of the global climate is human addiction to fossil fuels. Since 1820 at least (the first year from which we have data) mankind has increased its use of fossil fuels from 220 to 11000 Mton/year. Although we have – after World War II – reduced the use of fossil fuels per unit of production due to energy efficiency measures, and although world population has increased dramatically, we have as a whole – and the trend is clear and stable - increased our per capita use of fossil fuels (from 0.21(1820) to 1.71(2003) tons/year). And some countries use more fossil fuels – and emit more CO_2 – than others.

Obviously the fight against global warming must – as its point of departure – have a significant and fast reduction of CO_2 emissions – and thus, of course, of the use of fossil fuels – as its main target. There is a growing agreement among scientists that the goals for this reduction must be situated in the domain of approx. 90% around the year 2100. To reach that goal it seems necessary to reduce global emissions with approx. 50% until 2050 which – if the developing countries will have a chance to develop their economies – probably makes it necessary for the OECD area to reduce its emissions with approx. 80% before 2050. In fact many scientists argue for stronger mitigation paths than that.

Reductions of that magnitude among OECD countries can not, however, be implemented in a few years time and thus be postponed to the distant mid-century. A large part of those reductions must in reality have been achieved – harvesting the low hanging fruits in the industrial transformation – around 2030, say 40-50%. The immediate short term goal for 2020 – just a decade away – should consequently be set in the domain of 20-30% to avoid efforts close to panic in the decades that follow. Unfortunately very few countries

have declared ambitions – and still less are prepared to sign international agreements with that content – to reach this short term goal and thus prove that they have serious ambitions as regards the transformation to come.

The tools for mitigation:
A variety of taxes, cap and trade systems and regulations can be combined in many ways – there is not only one best solution

The *toolbox* for reducing our addiction to fossil fuels primarily contains tools based on increasing the costs of using these fuels. In addition we can, with moral and/or legal actions, convince and force actors to change their behaviour. But such activities are always easier to succeed if they are accompanied by changes of relative prices which point in the desired direction.

In short we can identify the following tools:

1. Taxes on energy
2. Taxes on CO_2
3. Taxes on fossil fuels
4. Taxes on equipment (ownership, buying/selling) which emit CO_2
5. Legal restrictions on CO_2 emissions combined with fees on emission permits (a cap and trade system)
6. Regulations of systems and their performance
7. Subsidies on activities or systems with good performance (directly or indirectly)

The tax (cap and trade) base can be
- on extraction
- at certain points along the value chain
- on final consumption

These tools can be implemented on
8. National level after an unilateral decision.
9. National level following an international agreement.
10. International level also following an international agreement.

We live in a globalized world: there must be a certain level of synchronization and harmonization on taxation models and the level of taxes. Otherwise:
- countries may be losers without achieving the necessary contribution to a better climate
- firms may be losers without necessary contributing to a better climate
- good or second best technologies may give way to worse performing technologies
- weak actors (e.g. poor people and countries) may face difficulties to adapt and end up as losers.

Reaching agreements on this in Copenhagen (or later) is a gigantic task, since:
- some countries have a larger historical CO_2-debt than others
- there is an enormous variety between countries as regards the lock in into carbon addiction as regards industrial activity and life styles.
- there is a large variety as regards national taxation systems and price incentives in existing systems (which may have to be abandoned but will change the historical rules of the game)
- some countries have been more ambitious in their recent climate policies – how will that be evaluated in future agreements?

However, Global Challenge argues that these technicalities cannot be allowed to dominate the climate change agenda. In addition we are convinced that many combinations of tools and techniques can lead in the right direction. We therefore suggest – instead of getting stuck in the details – 10 fundamental principles for the global taxation system:

10 principles on global taxation and price incentives to be agreed upon by the international community

1. *Relative prices on all energy use must increase significantly.*

The transition away from CO_2 emissions in general and fossil based emissions in particular in a global and growing economy necessitates a general decrease in energy demand. The main – and only – road to that goal is to increase energy prices in general. *Illustration*: to facilitate a transformation to the small electric cars of the future – when many coal based power plants are closed down – other energy users may contribute in reducing their demand on the power grid.

2. The price level must within a few years – and helped by policy - approach a level approximately twice the price level of today.

To have a radical effect on energy use – the cheap availability of which hitherto has been taken for granted – price increases have to be significant. In addition, the cost level of the bulk of the foreseeable sustainable energy alternatives as well as of CCS technologies indicate that energy prices have to double to create competitive space for these solutions. *Illustration*: US calculations indicate that electricity from CCS (Carbon Capture and Storage) based coal power plants will cost approx 0.114 USD/KWh. And for off-shore wind power electricity to be competitive, oil prices have to exceed 100 USD/barrel (today 78 USD/barrel, December 09) and electricity prices to be approximately €100/MWh (which is up to twice the current price level in many countries).

3. *Subsidies on all forms of energy must be phased out.*

Many countries subsidize fossil fuels; others subsidize alternatives, i.e. non fossil fuels. The reasons behind these policies may differ. Energy subsidies and primarily those on fossil fuels must be phased out rapidly. Distributive goals (eliminating poverty problems) as well as transition goals (promoting non fossil fuels) are possible to obtain also within the framework of increasing energy costs. *Illustration*: if the goal e.g. is to help poor families with children it is more efficient to give them money directly (or to reduce their taxes if they are taxed) than to subsidize energy which is used by everyone and relatively more by the rich.

4. *Taxes and cap and trade based emission permits are complementary and both tools probably necessary.*

We argue that both these instruments can and probably have to be used in parallel and complementary to each other. *Illustration:* individual allocation of permits has – as experienced by the EU policy – resulted in an overallocation to the traditional polluters. As a consequence the cap and trade market collapsed and emission prices approached nil. When the system is expanded and renewed it is important that all historical CO_2 emitters like steel plants and airlines are forced to pay for their future emission permits.

5. *Two types of taxes – CO_2-taxes and fossil taxes – make it possible to combine the struggle against CO_2 emissions with the conservation of biomass.*

Climate change abatement has contributed to the global struggle for biomass and added to the already strong deforestation of rain forests in Brazil and Asia. To avoid that biofuels substitute for food use of biomass CO_2 taxes should include biofuel emissions. In addition bio-based CO_2 emissions are not by definition CO_2-neutral as long as deforestation continues. Although fossil fuel taxes – which may be added to the CO_2 taxes on fuels – will contribute to reduce CO_2 emissions their function will as well be to reduce the dominating role of fossil fuels in global energy use. *Illustration*: countries can e.g. use an equivalent sum of money as the collected tax revenues to stimulate replantations on biomass. That will increase the efficiency of biofuel policy and reduce the struggle for biomass. This system can be implemented on national as well as on international level.

6. *Taxes and income from cap and trade systems must normally – to become legitimate - on the one hand be allocated to national governments and on the other be redistributed to the national taxpayers to contribute to climate change abatement.*

Revenues from climate change related taxes and cap and trade systems have to be collected by national governments. Although the credibility of governments differs, these taxes will probably face higher acceptance than various international bodies as receivers of GHG fees. To increase legitimacy for the tough policy which here is argued - and of which many actors are scared – it is important to redistribute the tax (and permits) income to taxpayers. That can be done in a way which promotes further climate change abatement and compensates for unintendend consequences of the policy. *Illustration:* Drastically increased fuel prices make it expensive to drive cars. A general tax reduction of the same amount will keep the average taxpayer on a break-even and those who change their car driving will be winners. Financing transport-related infrastructure investments with taxation income will be still more efficient.

7. An exception to this is the levy of global taxes (or emission permits) on international air and sea transport bunker fuels.

International transports are free of taxation and represent approx 5% of global CO_2 emissions. An international agreement to tax them may create funds that can be transferred to developing countries for climate change related projects. As this tax base is totally new it serves the double function of meeting the demands from developing countries for financial support for

their transformation without eroding any hitherto existing tax system.

8. To create time for adaption governments may decide upon and publish policy trajectories showing how prices/taxes will develop. Actual price and tax changes can follow with some delay.

The years ahead of us may be tough. Both individuals and firms have based their life-styles/activities on large energy (and fossil fuel) consumption. To give time to reformulate strategies and to adapt it is probably more important to decide upon the policy trajectories (paths) which will be followed than to impose a high initial tax rate. If such long term decisions are taken by countries – whether based on international agreements or not – and made credible the impact will be significant also if the first steps of tax increases are relatively small. This policy has been adopted by Sweden – although we argue that the path decided upon probably is not high enough. *Illustration*: It can e.g. be agreed within the EU to increase gasoline taxes with €0.1 every half year for the coming 5-6 years; that will, roughly, double European fuel prices during that period. People will then be given time to change habits – and cars. And the automotive industry will have time to adapt.

9. *Regulatory policies and special taxes may be needed to compensate for general taxes and cap and trade systems.*

Higher energy prices are the goal of the taxes/permits we discuss here. No actors should be given free cards from that. This policy may create enormous funds (rents) among some actors; water and nuclear power owners are among them. To increase legitimacy and efficiency in the policies it may thus be necessary to combine these general taxation policies with more focused taxation and regulation efforts. *Illustration*: special nuclear taxes can be introduced or (in some cases) increased and parts of the increased resources can be spent on security funds for that particular industry. Low cost water power owners may become extremely rich which may create reactions among those who face doubled electricity prices unless they are forced to invest their income in new energy systems. This has in fact been implemented in Sweden (see annex 1)

10. Global harmonization is important – but must not and can not – be complete before action takes place

Bad harmonization will cause leakages, i.e. if one country follows a taxation policy which differs significantly from what other countries do, firms may relocate their activities and new forms of trade will appear. This problem will be reduced if international agreements show that countries agree on the long term goals and take steps in the same direction although not necessarily in the same speed. If long term taxation strategies are roughly the same it is less important that countries do not follow identical paths or are exactly on the same level of policy implementation. Firms will not fundamentally redistribute their heavy investments if they know that the same or similar changes will take place all over the world although at different speeds.

Taxation: from something we normally want to avoid to a tool for survival

If we want individuals and firms to change their behaviour and activities – which will include changing life styles for many people – the policy instruments must be based on incentives and signals through the price system. In short: bad behaviour (for the climate) must be priced significantly higher than good behaviour (for the climate). And the tool box we have discussed here is basically what we have.

Important now is that we can agree globally to use these instruments. The challenge is that they have to be used to a much higher extent than what people and politicians hitherto have imagined. That will most likely create tensions. These must in turn be reduced with policies to support structural change – to induce the transformations of industries, technologies and life styles which must be the aim of a policy with intentions to reduce human impact on the climate. Important in the short perspective is to develop clear incentives for the transformation process to start immediately. In this way, a measure that in the short term might be seen as a threat, can in the long term turn into something positive.

In fact we have to follow such a path.

3. Theories Underlying Environmental Taxation

Instruments of environmental policy can be either institutional instruments, "command and control" instruments, or market-based instruments. Examples of institutional instruments are governmental provision of information, governmental appeals to polluter conscience, court action, governmental establishment of property rights, and bargaining. The latter refers to the so called "coase theorem", i.e. the idea that a social optimum can be established through, bargaining between polluter and victim. Command and control concern regulation. Market-based instruments are taxes, subsidies and tradable permits.

There are several theories that can be used for environmental taxes. It is important to know and understand economic theories, as these may influence the framework of environmental taxes. The choice of theory may have an effect on the tax rate, tax base, the subject, rules and administration with respect to compliance; and the freedom to determine how the revenue from the environmental tax will be used. The following theories are briefly described below:

- Polluter-pays principle
- Precautionary principle
- Least-cost abatement
- Double dividend theory
- The Porter hypothesis
- Microeconomic approaches.[1]

Polluter-pays principle (PPP)

The interpretation of the PPP has evolved in several ways since the early 1970s. The PPP originally related to paying for the cost of pollution abatement, in line with legal requirements. However, its meaning was subsequently extended so that polluters could be made liable for the cost of administrative measures taken by authorities in response to pollution.

Accordingly, under the waste framework Directive 75/442, EU Member States need to have in place a system of charges to cover the costs of waste disposal. The new water framework Directive 2001/60 also provides a legal basis for charging for the environmental and financial costs of water use. This principle indicates the polluter should pay. An environmental tax that serves to implement the PPP would presumably be based on a governmentally determined goal for environmental protection. A tax would be designed that allocates the costs to the polluter. The amount of costs determines the formula for the tax rate.

Precautionary principle

This principle is based on the common-sense adage that it is better to be safe than sorry. The precautionary principle is a moral and political principle which asserts that if an action or policy might cause severe or irreversible harm to the public or to the environment, in the absence of scientific consensus that harm would not ensue, the burden of proof falls on those who would advocate taking the action, The principle implies that there is a responsibility to intervene and protect the public from exposure to harm.

Least-cost abatement

When a government relies on the theory of least-cost abatement, it tries to determine how a specific environmental standard can be achieved at the least cost for the private sector. The starting point is the question as to the level of abatement desired. All other decisions are based on this starting point.

The principle sets the tax rate according to the level that will yield the desired amount of change in behavior. The calculation takes into account the prevention

1 Bakker, Anuschka (ed)

and control costs that an entity is likely to incur if it changes its behavior, "Least cost" implies that the marginal cost of abatement is equalized over all polluters. This will not in general involve equal abatement effort by all polluters. Where abatement costs differ, relatively low-cost abaters will undertake most of the total abatement effort.

Double dividend theory

The double dividend theory assumes that an environmental tax will generate an environmental benefit. The determination of whether the environmental tax is linked to a clearly defined environmental goal depends on which of the above or below-mentioned theories is used to design the environmental tax. A Pigouvian tax could be a starting point. Economists who create models of the double dividend theory usually begin with the premise that the first dividend is achieved through internalization of external costs under the Pigouvian models and then modify the Pigouvian assumptions to recognize economic ramifications of using the tax revenues for tax relief, which may achieve the second dividend.

The Porter hypothesis

According to the Porter Hypothesis, environment regulations can induce efficiency and encourage innovations that help improve commercial competitiveness. The hypothesis was formulated by the economist Michael Porter and suggests that strict environmental regulation triggers the discovery and introduction of cleaner technologies and environmental improvements, the innovation effect. This makes production processes and products more efficient. The cost savings are sufficient to overcompensate for both the compliance costs directly attributed to new regulations and the innovation costs. See Wagner, 2003 for a reveiw of the validity of the hypothesis.

Microeconomic approaches

A theory proposed by micro-economists is the theory of market failure. The theory that prices charged for goods are commonly too low because they do not include implicit costs, such as for injury of health, that the goods entail. Market failure results in a higher-than-appropriate level of production and consumption. The idea is to impose a tax on the output of such goods that is equal to such implicit costs. A second theory is that it is possible to structure a tax on polluters that would be high enough to encourage them to pay the money needed to appropriately reduce their pollution in lieu of paying tax.

Another concept that micro economists brought was the idea of "Pigouvian taxes", meaning tax on production. Pigou introduced the notion that government should use taxation to equalize the private and social net product costs in instances where private producers impose costs or disservices on others. The idea is that at a certain point it is cheaper for companies to solve the problem at the source than to pay taxes. The Pigouvian principle seeks to internalize external costs. Consequently, it sets the tax rate according to the net marginal external environmental costs of the environmentally damaging activity or product; in other words, the marginal costs of the environmental damage to society that exceed the private costs that have already been paid by the private sector. If the cost for avoiding pollution is less than the amount of tax (Le. the marginal costs of the environmental damage), the rational taxpayer will avoid the pollution.

4. Effects of Carbon Taxation

Although only a limited number of countries have enacted carbon taxes, there are numerous studies on their effects. This section briefly describes the research regarding the effects of carbon taxation in terms of curbing CO_2 emissions, distributional effects on households and effects on industrial competitiveness.

Carbon emissions

All Nordic countries[2] have had carbon and energy taxes for several years. An overview by Speck et al 2006 concludes that in all the analysed countries the taxes have been effective in reducing CO_2 emissions:

- In Denmark, a study found that industrial CO_2 emissions declined by 23 percent during the 1990s, after adjusting for both growth and market-induced industrial restructuring (Enevoldsen, 2005, p.173).
- A Norwegian study estimated that average CO_2 emissions per unit of GDP have been reduced by 12 percent between 1990 and 1999 (Bruvoll and Larsen, 2004, p.501).
- In Finland, a study estimated that CO_2 emissions would have been 7 percent higher in 1998 had the energy taxes remained at the 1990 level.
- In Sweden, the overall CO_2 emissions would have been 20 % higher in 2010 if taxes had remained at the 1990 level, according to the Fourth National Report on Climate Change in Accordance with the UN Framework Convention on Climate Change. When comparing taxes with other policy instruments such as emissions trading the report states that "energy and carbon dioxide taxes are the instruments which have provided the greatest individual effect on emissions in the residential and service sector and are also expected to do so in the future".

It should be noted that the emission reductions can also be affected by other policies or industrial restructuring. A few studies have attempted to measure precisely the effect of taxation. Reductions in CO_2 emissions directly attributable to carbon-energy taxes are in the order of 2–3 percent over a 10-year period. Some studies ascribe greater effect directly to the taxes. An econometric analysis estimated that the Danish taxes on CO_2, SO2 and energy reduced total industrial CO_2 emissions by 9–11 percent between 1992 and 2000, compared with a business-as-usual scenario (Enevoldsen, 2005, p.218). On the other hand, a study of energy taxes in Norway, estimate that energy taxes in Norway contributed with a 2.3 percent reduction in CO_2 emissions over the period.

Economic growth and competitiveness

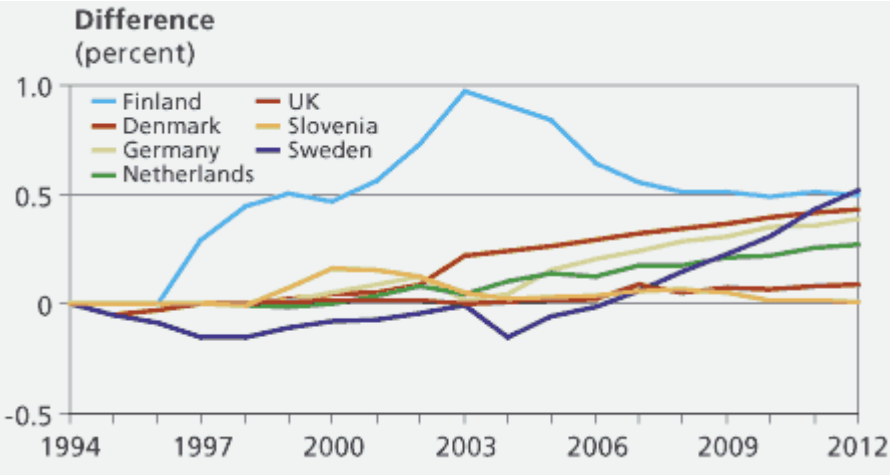
One of the most extensive studies on the effects of carbon tax is the COMETR project (Competitiveness Effects of Environmental Tax Reform; http://www2.dmu.dk/cometr). The project has made a thourough analysis of the seven EU countries that have carried out environmental tax reforms, i e shifting the tax burden from taxation of labour to taxation of carbon and energy (initial year of tax reform in parenthesis):

- Sweden (1991)
- Denmark (1993)
- Netherlands (1996)
- Finland (1997)
- Slovenia (1997)[3]
- Germany (1999)
- UK (2001)

COMETR has attempted to isolate and analyse the effects of these countries' tax reform on several variables including competitiveness, fuel demand, GDP, price effects and consumer price index. According to COMETR the tax reforms have resulted in a modest but significant positive effect on economic growth (up

2 Iceland does not tax energy used for heating and electricity but has a fuel tax.

3 Slovenia has not introduced a green tax reform but has adjusted energy taxes in the industrial sector to CO2-content.



The effect of environmental tax reform (ETR) on GDP, measured as the difference between economic growth in seven EU countries which have implemented ETR, and a reference case without ETR. On average, ETR increased growth with up to 0,5 %. Source: COMETR/Cambridge Econometrics.

to 0,5 per cent comparing to a business-as-usual scenario during a 17-year period). The tax reforms' contribution to growth owes to a more efficient use of energy, while wage costs were lowered, in other words, the project found some support for the Porter hypothesis.

The COMETR project also analysed competitiveness effects on sectors of medium to high energy intensity (meat, pharmaceuticals, paper, cement, steel, glass). In general the effects on competitiveness were found to be rather small. Unit production costs increased with less than 1 %. The study asserts that "While there is some evidence for a decline in competitiveness in selected countries/sectors, there is no consistent pattern and it is not possible to conclude that the reform was a significant contributing factor"[4].

Distributional effects: regressivity in developed countries

The effects of carbon and energy taxes on household income have been studied since the early 1990's. Most research has focused on the distributional effects of carbon taxation in developed countries, since it is in developed countries that carbon taxes have been implemented/discussed. The studies generally conclude that a carbon tax is regressive, in other words it imposes a relatively greater burden on the poor than on the rich. See for example Callan et al 2008 for an overview.

Regressivity is due to low-income households in developed countries devoting a larger share of their income to carbon intensive goods such as heating and electricity. Callan et al 2008 show that the richest decile in Ireland emits only 37 % more carbon dioxide than the poorest decile, while the richest decile's disposable income is eight times higher.

Some studies have found a neutral or progressive effect of carbon taxing: Tiezzi (2001) simulates the effect of a carbon tax in Italy (which only was in force during 1999). According to this study the welfare effect was progressive, because the tax mainly affected transport fuels, which in most developed economies are linearly related to household income, as compared to heating fuels, where spending is less correlated to income.

Regressivity can be mitigated by revenue recycling, e g a tax shift whereby poor households are compensated for the carbon tax. This has been the aim of several countries' green tax reforms over the last years.

Irrespective of regressivity, it is worth noting that the public acceptance in the European countries applying carbon taxes and environmental tax reform in general is high.

4 (COMETR Summary Report, WP3, Ekins/Salmons, p 32)

Progressivity in developing economies?

During the last decade an increasing number of studies have analysed the distributional effects of carbon taxes in developing countries, and several of these reports conclude that there is a neutral or progressive effect.

One of the more interesting studies concerns Indonesia (Yusuf and Resosudarmo, 2007). They simulate three scenarios in terms of revenue recycling: 1) No revenue recycling, 2) A reduction in the sales tax for all commodities 3) A uniform lump-sum transfer to all households. (A reduction of the income tax rate was considered but not simulated for both modelling reasons and because income tax collection in Indonesia is low with respect to population coverage.)

The simulations show that a carbon tax in Indonesia would affect urban households more than rural, and in rural areas the welfare effect would be more progressive than in urban areas. In urban areas the effect is relatively neutral in the case of scenario 1 and 2 (no recycling and tax rate reduction), while the effect is more progressive in the scenario with lump-sum transfers.

Progressivity is linked to the traits of a developing economy: abundant unskilled and prevalently rural labour are employed in less energy-intensive and less capital-intensive sectors. A carbon tax will stimulate a factor reallocation from energy-intensive sectors into less energy-intensive sectors such as agriculture, which would have favourable distributional consequences in developing countries like Indonesia.

Boyce et al (2005) simulated the effects of carbon charges in China. They concluded that the tax was progressive even without revenue recycling, the reason being that the mix of products bought by rich people in China is on average more carbon intensive than the product mix bought by poor people. This, in turn, was related to the differences between urban and rural expenditure patterns. The lowest income decile of the population devotes 2,1 % of their total expenditures to carbon intensive products, while the richest decile spends 3,2 %.

There is a need to further analyse the distributional effects of carbon and energy taxes in developing countries, but these studies suggest that there is a case for green tax shifts in developing countries, not only for environmental reasons but also from a distributional viewpoint.

It should be underlined that analyses of *historical* reactions to CO_2 taxes (the price elasticities) may underestimate the *future* reactions to such taxes. The reason for this is that people´s preferences may shift when they realize that climate change is a real threat and that they have to change their habits. An isolated small tax increase may thus have a marginal impact on fossil fuel demand, while a (initially small) tax increase in a clear and convincing context of climate change mitigation might initiate a process of transformation.

Conclusions

- Carbon and energy taxes can be environmentally efficient in terms of reducing carbon emissions.
- A green tax shift can have a small positive impact on GDP.
- Their effect on income distribution tends to be regressive in developed countries
- ...and seems to be progressive in developing countries
- A careful selection has to be made when combining ETS, taxes and other policy instruments
- It is necessary to adapt tax policy to country-specific situations.
- The tax should be introduced at a low level and gradually increased, and the tax hikes should be announced well in advance, in order to allow for adaptation by households and industry.

5. The European Union's Energy Tax Directive

One of the most promising current developments regarding carbon taxation is the possibility of a revision of the European Union's Energy Directive.

Below is a brief overview of the developments in the Union with respect to environment and taxation. The most important developments in Europe are:

1. Greening of the tax system. In the last few years a trend can be seen of governments moving from direct taxation to indirect taxation.
2. Emissions trading. The Kyoto Protocol and its mechanisms have also been used by EU member states and, as a result, the European Union approved the Emissions Trading Scheme Directive.
3. Energy Tax Directive. The directive provides the framework for taxation of energy in Europe. For a more detailed description of the framework, see below.
4. Renewable energy. EU Member States are currently the global leaders in the development and application of renewable energy. On 9 December 2008, European leaders agreed on a proposed directive on renewable energies, including bio fuel targets.
5. EU state aid framework. Tax incentives must be compatible with EU law. If a tax incentive is not drafted correctly, it could be considered as state aid.

The current energy tax directive

These are the main characteristics of the current energy tax directive (from 2003):

- Energy products are taxed if they are used as fuel or for heating, but not those used for other purposes (raw materials, chemical reductions or in electrolytic or metallurgical processes, dual use).
- Electricity input is taxed, but not energy as input to electricity generation. Energy inputs to district heating are not taxed, while energy inputs for heat generation are taxed. Energy use for certain industrial or commercial purposes is taxed at reduced minimum rates, in particular in stationary engines and for agricultural purposes, compared to the taxation levels applicable to fuel used in motor cars. Specific provisions apply concerning the taxation of commercial diesel. This is done in order to limit the distortions of competition with which road hauliers are confronted, and to reduce the tax gap between non-commercial diesel and petrol.
- Lower tax rates on business use of energy products and electricity than on non-business use are possible. Many general and special allowances to apply other exemptions or reduced levels of taxation are foreseen as long as they are not detrimental to the proper functioning of the Internal Market and will not result in distortions of competition.
- Energy products used for international air transport or maritime transport within Community waters are obligatorily exempt.
- Renewable energy sources, energy used for combined heat and power (CHP) generation and CHP-electricity, as well as energy used for the carriage of goods and passengers by train, metro, tram or trolleybus may be exempt from the tax.
- The tax burden on energy intensive firms may be limited (having energy costs of at least 3 % of the production value or energy tax amounts to at least 0,5 % of the added value).
- Taxes in the case of firms that have entered into commitments or where tradable permit schemes are implemented (down to zero in the case of energy-intensive businesses and down to 50% in the case of other businesses) may be reduced. The directive also sets the minimum levels of taxation for certain energy products.[5]

5 Kohlhaas, M; Schumacher, K; Diekmann, J, Cames, M; Schumacher, D

Problems with the current energy tax directive

The directive does not ensure a desirable degree of consistency in the treatment of the basic fossil energy sources and electricity. When comparing the energy content of the various products, minimum levels of taxation vary substantially according to the product concerned. For example the most favourable treatment is being reserved to coal. Another effect is that some businesses can be better off compared to others depending on the energy source.

There is also a growing market for renewable fuels. Their tax treatment under the current directive still relies on rules developed at a time when these fuels were on a small scale basis without major market significance. Taxation of renewable fuels is based on volume and the rate applicable to the fossil product replaced by the renewable product concerned.

Also, the lower energy content of renewable fuels is not taken into account, and using the same tax rate normally leads to a comparatively higher tax burden for the bio-fuel. Currently member states have to rely on favourable tax treatment permitted under Article 16. As a result renewable fuels are singled out as an energy source whose standard tax treatment is not adapted to their characteristics and in whose case any adaptation to these characteristics can only take the form of optional de-taxation.

Taxes on energy are levied under the current directive in the same way whether or not, in a particular case, the limitation of CO_2 emissions is ensured through the Community scheme under Directive 2003/87/EC. As a result, Community mechanisms intended to limit such emissions may overlap in certain cases and may be completely missing in others. Both situations are undesirable, because of the ensuing cost-efficiency losses and/or distortions on the internal market.

The price signal the directive gives via its minimum levels of taxation is not properly related to the need to combat climate change. For example, the terms of the directive are not well adapted to ensure the proper functioning of the internal market in circumstances where member states resort to CO_2-related taxation in order to reduce CO_2 emissions. This also applies to the taxation of motor fuels, where an explicit CO_2 price signal visible to transport users as part of fuel taxation would help member states to use fiscal means in order to reduce CO_2 emissions.

Discussions about a revised energy tax directive

László Kovács, EU Commissioner for Taxation and Customs Union, addressed the issue of a revised tax directive at a speech in November 2009 (the conference "What taxation for a low carbon economy?").

He noted that taxing CO_2 would be a cost-effective way to reduce CO_2 emissions not covered by the EU Emission trading system. He was in favour of the new directive as a framework for CO_2 taxation, where the current energy tax base should be split in two parts, where one part would depend on the energy content while the other would depend on the CO_2 emissions. This could lead to a tax and price advantage to the renewable fuels over the fossil fuels. Also, the emissions trading system and the CO_2 taxation should fit together, without any overlapping or loopholes.

The new energy tax directive has also been discussed with EU Finance Ministers, and as László Kovács noted in his speech above, there is "a growing interest in the in CO_2 taxation" and the discussion with the Finance Ministers was "rather constructive and promising" and they called for appropriate EU-wide framework rules.

At the above-mentioned conference, a representative from the corporate sector, Chris Lenon from Business Europe spelled out their concerns regarding the new EU tax directive. He stated that five key issues need to be addressed during the revision of the directive:

1. There should be no taxation of installations covered by ETS (Emission Trading Scheme).
2. There should be no taxation of emissions covered by equivalent measures at the national level.
3. A revised carbon tax should mirror the free allocation of emission allowances under ETS.
4. It should be possible to use offset mechanisms such as the Clean Development Mechanism, just as this is possile for installations covered by ETS.
5. It is necessary to minimise the administrative burden for companies.

6. Carbon taxation in selected countries

This section describes carbon and energy taxation, and related environmental policy instruments in a selected number of countries. It is based on a global overview by IBFD and Price WaterhouseCoopers[6].

Brazil

Direct taxation

In Brazilian income taxation there are no specific fiscal incentives to promote investments in energy-efficient or environmentally friendly assets. There is however a general tax incentive involving tax credits on acquisition of assets related to technology innovation that may be applicable to investments in energy-efficient and environmentally friendly assets.

Emission rights

There is as yet no limitation on the right to emit gases in order to reduce the pollution created by economic activities in Brazil. Current Brazilian emission rights' trading is limited to their exportation to interested Companies abroad.

Indirect taxation

The Brazilian indirect tax framework is formed mainly by taxes levied on the manufacturing and importation of goods, the physical movement of goods and on the rendering of services. The excise tax is a federal tax levied on the manufacturing process and on the importation of goods. When items are transformed or processed, additional excise tax is payable on the finished product but a credit is allowed for the tax paid on the purchase of raw materials or component parts used for production. The excise tax is based on the value at sale.

As a general rule, no indirect taxes are imposed on the production of energy, fossil fuels or electricity. However, the circulation of these products may be considered a good for value added tax purposes.

There are several tax incentives in the alcohol sector, varying from state to state, that reduce the calculation basis of value added tax in operations with alcohol, as well as offering presumed credits in some operations and tax deductions. There are no other specific fiscal incentives to promote investments in renewable energy initiatives. However, there are indirect tax incentives to reduce the tax burden of economic sectors, such as alcohol and biodiesel, aiming to reduce Brazilian dependency on petroleum derivatives.

China

Direct taxation

China's tax regime is evolving with the country's economic development. In 2007, China's National People's Congress passed the long-anticipated Corporate Income Tax (CIT) Law. Under the new CIT regime, preferential tax treatment can be perceived as one of the most effective methods to arouse environmental awareness of businesses and to change their behaviour toward a more environmentally friendly direction. For instance, a "credit against tax payable" treatment is granted to investments in certain environmental protection, energy and water conservation equipment. Moreover, a "3-year exemption and 3-year 50% reduction" of corporate income tax has been granted to income derived from qualified environmental protection, energy and water conservation projects.

Emission rights

Trading of emission rights is at its infancy in China. The first emission trading exchange in China only started to operate in September 2008.

Indirect taxation

The principal indirect tax in China is turnover tax, such as VAT. There are specific indirect taxes that are applicable to the energy sector. Upstream activities, such as the exploitation of crude oil, natural gas and

6 Bakker, Anuschka, IBFD, 2009.

coal, are subject to resource tax. Downstream activities, such as the manufacturing of product oil, are subject to consumption tax.

Resource tax is imposed on e.g. crude oil, natural gas and coal. The types of product oil that are subject to consumption tax include gasoline, diesel, naphtha, solvent oil, aviation kerosene, lubrication oil and fuel oil.

According to information received at the prospect of the Copenhagen talks, China is about to introduce a carbon tax, that would impose a per-unit tax on the CO_2 content of fossil fuels.

United Kingdom

Direct taxation

UK taxable business profits include tax depreciation deductions, known as "capital allowances", at various defined rates. There are no specific tax credits or exemptions for such investment. Instead, expenditure on specific categories of energy-efficient or environmentally friendly assets attracts enhanced capital allowances at 100%. Some of these assets are e.g. combined heat and power facilities, solar thermal equipment, water efficiency plants and cars with very low CO2 emissions.

Additional tax relief in the form of enhanced deductions against income is given for certain expenditure on the remediation of contaminated land. Private landlords are entitled to a tax deduction for the cost of installing certain energy-saving insulation in let residential property.

Emission rights

Trading of emission rights does occur in the United Kingdom. A normal business that seeks to be carbon neutral through the purchase of offsets/credits would probably be able to treat any net expenditure as a tax allowable deduction in computing the profits of its main trade, although this would depend on the precise circumstances and would be judged by reference to first principles. For some traders, such as power station operators, the purchase of offsets (e.g. EU emissions permits) is a legal obligation and this should assist in securing a tax deduction.

Indirect taxation

UK indirect taxes are generally borne by the end user and are generally collected and accounted for by the business concern effecting the transaction. The principal indirect tax is value added tax. There are also landfill tax, aggregates levy, climate change levy, air passenger duty, air passenger duty and excise duty on fossil fuels and bio fuels.

The levying of excise duty on energy products is mandatory in all EU Member States and the structure of how the excise duty system is to be implemented is set out in EU Directive 2003/96 (Energy Tax Directive). Harmonized excise duties may only be levied on energy products when those energy products are used as motor or heating fuel. This section will also cover the UK excise duty system applied to bio fuels. Bio fuel is the generic term applied to fuels that are produced from biomass. It includes a wide range of materials, including wheat, oil crops, sugar crops, animal waste and domestic waste. Taxable bio fuels are biodiesel, bio-ethanol and biogas.

With effect from 1 April 2001, the United Kingdom introduced the climate change levy (CCL). This is a levy on the business consumption of specified energy commodities. Taxable commodities are electricity, any gas in a gaseous state, any petroleum gas or other gaseous hydrocarbon in a liquid state, coal and lignite, coke and semi-coke, of coal or lignite and petroleum coke.

There is an 80% reduction in the rate of CCL for energy-intensive industries that have entered into a negotiated energy efficiency climate change agreement.

USA

Direct taxation

The federal income tax system includes many provisions intended to achieve some public result such as environmental protection. These provisions may take the form of a deduction against income, deferral of income, a lower tax rate or a credit against tax owed by the taxpayer. The exclusion of an item of income from a taxpayer's gross income is also sometimes used as a policy tool.

There are a number of fiscal incentives with respect to investments in energy-efficient and environmentally friendly assets. For instance there are credits against income tax for purchases of alternative-fuel vehicles, electric-driven vehicles and energy-efficient homes.

Moreover, there are credits for producers who mix alcohol in fuels, produces biodiesel or low-sulphur diesel. There are also credits for renewable electricity production, such as from wind, biomass or solar

power. Advanced nuclear power facilities entitle another credit.

A carbon sequestration credit is available to qualified facilities for the capture and disposal of carbon dioxide that would otherwise have been released into the atmosphere.

Emission rights

The United States does not have a comprehensive programme to address emission reduction. A federal cap and trade system is being discussed in Congress, and some US companies are involved in voluntary domestic carbon offset programmes. State and regional programmes have been enacted or are being considered in some parts of the country. Federal cap and trade programmes exist to address sulphur and nitrogen emissions.

Indirect taxation

Federal revenues in the United States are raised primarily through income and payroll taxes. Excise taxes and other indirect business taxes make up a small portion of overall federal revenues. Some indirect taxes also exist at the state and local level.

A tax is imposed on crude oil received at a US refinery and petroleum products imported into the United States. The tax rate is equal to the Oil Spill Liability Trust Fund financing rate. Another tax is imposed on the removal of a taxable fuel from a refinery or terminal or the entry into the United States of any taxable fuel. An additional tax is imposed to fund the Leaking Underground Storage Tank Trust Fund. Special excise taxes are imposed on the seller or user of certain liquids or compressed natural gas used or sold as motor fuels. Exemptions are provided for certain uses, such as off-highway business uses or farm use.

A credit against the above mentioned taxes is provided for the use of alcohol fuel mixtures, biodiesel, alternative fuel mixtures and alternative fuels.

Other countries

When reviewing a number of countries, in addition to the above mentioned, developed excise duties on fossil fuels are relatively rare outside the European Union. Generally, income tax credits or exemptions for energy purposes such as those available in the U.S. seem to be more common than excise duties on fuels.

E.g. India and Japan have no excise duties at all. Some countries, such as Australia, Canada and South Africa have simplified taxes or levies on fuels.

In **Australia** a fuel excise is levied on petroleum produced, manufactured or distributed where entities propose to use the fuel in carrying on an enterprise. Canada has fuel taxes which may vary between different provinces and municipalities. In South Africa fuels are classified as fuel levy goods and therefore subject to general fuel levy and a road accident fund levy. On the other hand petrol and diesel are zero rated for VAT purposes.

In **France** a carbon tax similar to the one in Sweden has been discussed. A tax of €17 per tonne of carbon dioxide on all forms of energy, except electricity, would be imposed. Tax-payers and businesses would be fully compensated for the new levies through cuts in their income and pay-roll taxes. If the tax is imposed, France would be the first large industrial economy to introduce a systematic, environmental levy of this kind.

7. The Corporate Sector's View on Environmental Taxes

Price WaterhouseCoopers Sweden conducted a survey in June 2008 based on interviews with 200 Swedish companies on how they look at environmental taxes and their impact on business.

The picture that the companies give is that complex rules and sharp throws in parts of the energy tax system contribute to low confidence in the environmental policy. There is a consensus among the companies that environmental taxes have a central role. For example, the study shows that there is great acceptance of the carbon tax as an instrument to reduce carbon dioxide in the atmosphere.

With regard to the design of the tax provisions the picture, however, is the opposite. Many companies feel that the environmental taxes are too complicated and that they change too often. To this is added that companies continue to expect increases in existing taxes and new taxes, while energy costs are expected to increase. In other words it is a heavy burden that is expected by the companies.

Our survey also shows that the environmental debate is of great importance for the companies. A majority of the companies say that environmental taxes affect their investment decisions. The majority of companies also believe that their business strategies have been affected by environmental taxes and the climate situation.

What changes must then be added to the situation to be improved? Companies signal that it is important that the government ensures that the environmental taxes must be more competitively neutral.

The conclusion of the investigation of Swedish companies is that the government must prioritize the climate issue and the business climate, while the rules for environmental taxes must be long term, transparent and competitively neutral.

Other interesting figures from the survey are:

• 30% of the companies make use of voluntary climate related instruments such as climate compensation for corporate travel.

• 20% of the companies reported the cost of energy tax, carbon dioxide tax and sulphur tax in the financial statements

• 49% of the companies say that energy and carbon taxes affect their investment decisions

• 63% of the companies are experiencing increased demand from customers that their products/services shall be the environment/climate suited

• 58% of the companies say their business strategies are affected by energy and carbon taxes and the climate situation as a whole

• 53% of the companies are planning to increase their use of bio-fuels.

8. A Global Coordination of Carbon Taxation

The purpose of this section is to discuss topical issues regarding a globally coordinated taxation of carbon, i.e. a carbon tax levied on the same tax base and with the same minimum tax rates) in countries that are responsible for most of the global consumption of fossil fuels. The discussion is entirely hypothetical and would, if realized, entail a much closer scrutiny of the different tax situations that exist. It should also be stressed, as has been stated previously in this report, that a global coordination of carbon taxes is not a necessary prerequisite for the implementation of a carbon tax at the national level.

The section is an adapted and shortened version of a paper with the same name published by Global Utmaning in April 2009 and written by Knut Rexed, former State Secretary, Ministry of Finance of Sweden.

Interest in the coordinated taxation of carbon is due to the problems involved with isolated national carbon taxes. The main issue discussed in the paper is how to formulate a global agreement - involving a significant number of countries – to introduce a similar carbon tax. Obviously, the content of such an agreement is the product of negotiations and thus difficult to define in detail in advance. Instead, the paper deals with how optimal taxation of carbon could be formulated. Furthermore, issues surrounding the use of the revenue resulting from such a tax, and certain other related issues, are discussed.

General issues

In this paper, the term "tax" is used in the sense of a mandatory fee levied on a recipient as defined by public law that does not entail any right to any service in return. Taxes are levied by national or sub-national governments and are paid by natural persons or by legal entities.

In this paper, the term "carbon tax" is used in the sense of a tax on fossil fuels with the purpose of limiting emissions of carbon resulting from the combustion of fossil fuels. Taxation should thus on one hand promote the more efficient use of energy and on the other enhance the attractiveness of alternative fuels and energy sources. To the extent possible, the tax should be proportionate to emissions of CO_2 into the atmosphere. Emissions deriving from the rotting or combustion of renewable biological fuels do not normally figure in the basis for the taxation of carbon dioxide.

A fee paid by a state is, by the definition given above, not a tax, but an agreed levy. The proposals that have been presented of states paying fees to a global fund in proportion to the emissions of carbon dioxide resulting from each respective country's use of fossil fuels do not refer to a tax. They also have the disadvantage of the fees not necessarily being financed in such a way that the use of fossil fuels is counteracted.

The problems of national carbon taxes

A number of developed industrial countries, among them the Nordic countries, already have national carbon taxes in place. As has been shown in the previous sections of this report, these taxes have had a beneficial impact on carbon emissions and economic growth. There are, however, problems involved with taxation of CO_2 on an isolated national level.

The fundamental problem is that the development of the competitively exposed sector[7] are inhibited if it is burdened with significantly higher energy costs than competitors in countries without equivalent taxation.

7 The term "competitively exposed sector" refers to the sector that is exposed to foreign competition. It refers to both exporting companies and to companies that encounter competition through imports.

For this reason, Sweden has always had relief rules entailing that energy-intensive, competitively exposed industries pay lower carbon tax than households and other companies. These relief rules are, however, difficult to make compatible with the EU's state support rules, and it is far from a matter of course that it will be possible to retain them in the long run.

After a lengthy political debate, relief measures have been introduced for the agricultural sector. The fact that international shipping and air traffic have been exempted from Swedish carbon tax is due to both the competitive situation and the possibilities these companies have of locating refuelling in other countries.

For reasons of income distribution policy, Sweden also has lower taxation on oil fuels used for heating than on equivalent fuels used as vehicle fuel. The low-tax fuels are marked with a special dye to make it possible to ensure that they are not used as vehicle fuel.

Relief rules create a number of problems in themselves. Differences in levels of taxation between different users, different areas of use and different countries create room for unlawful tax evasion. One of the reasons previously held forth against extending relief to industry for fuels that were used for agricultural machinery and for heating in agriculture was, for example, the fact that the same fuel easily can be used for diesel-fuelled private cars. Similar misuse has occurred in the area of shipping, i.e. that oil fuels sold as vessel fuel have subsequently been used as vehicle fuel or for heating houses.

Fuel oil taxed at a lower rate may be used as an alternative to diesel fuels, as mentioned above. These oils may therefore not be sold at Swedish petrol stations. A problem that is difficult to manage is the fact that Finland allows such sales and, in addition, uses a different dye, which has made possible the extensive use of Finnish fuel oil as vehicle fuel in the Swedish border-area close to Finland.

Tax liability

A central issue is where to place tax liability. A carbon tax is by nature an excise tax that is levied at one point in the value chain. Until that point, the taxable goods are traded, transported and stored untaxed. After that point, the goods are traded, transported and stored taxed.

The European excise tax directive is based on the obligation of the trader in taxable goods to register and take responsibility for collection and accounting. This arrangement is not only applied in Sweden and other EU countries, but is probably the most common arrangement outside of the EU also.

All indications point to this being the arrangement that should be chosen for globally coordinated taxation of CO_2 as well. The most important reason is that it is an efficient and appropriate arrangement. To this may be added that all or almost all countries that could come to be parties to an agreement on globally coordinated taxation of carbon dioxide probably already have a similar excise tax arrangement in place.

This arrangement has considerable advantages. Trading companies can store untaxed goods in bonded warehouses and move them in international trade as necessary. At the same time, the number of taxable goods is relatively limited, and their identities are known through registration. Necessary control can be aimed at storage in and withdrawals from bonded warehouses and at transports of untaxed goods. Fossil fuels that are delivered to petrol stations and/or end users are thus already taxed.

Sweden has relatively high rates of taxation on energy and/or carbon . Sweden has therefore, as previously mentioned, introduced relief rules for energy-intensive industry and agricultural industries. These can still only purchase taxed goods, and relief rules result instead in all or part of the energy and carbon taxes that are charged on the taxed fuels purchased are refunded to the consumer.

The alternative of placing taxation on the producer would mean that the greater part of tax collection would take place in a smaller number of countries with considerable production and export of oil, coal and natural gas. This alternative is less attractive from the viewpoint of negotiations, since a considerable part of tax collection would have to take place in those states that are members of the Organization of the

Petroleum Exporting Countries (OPEC)[8] and/or of the Gas Exporting Countries Forum (GECF)[9].

Experiences from previous similar discussions show that these countries would perceive such a tax as the taxation of their revenue from production. A side agreement on the use of part of the revenue from globally coordinated taxation on carbon dioxide for the financing of a fund or a mechanism could thus easily be presented and perceived as a levy on the oil and gas producing states. A number of these countries have furthermore a weak or non-existent democracy and weak national administration and are relatively highly ranked on Transparency International's list concerning the extent of corruption within countries.

Placing taxation closer to the end user would, on the other hand, entail a significant increase in transports of untaxed goods, an increase in the risk of such transports going astray and an increase in the number of parties liable for taxation that would need to be encompassed by control measures. At the same time, it is difficult to see any advantages to this in comparison with taxation in the trading phase that would counterbalance these disadvantages.

On the tax base

The tax base for taxation on CO_2 should consist of the different types of fossil fuels, i.e. of crude oil (petroleum), natural gas, coal and oil shale in addition to refined fuels based on these fuels.

Petroleum is refined in order to obtain various refined products. In refining, six different fractions are obtained: petroleum gas, naphtha, crude kerosene, fuel oils, lubricating oils and distillation residues[10]. Coal[5] is usually used in its natural form, but it may be gasified or liquefied to make gaseous or liquid fuels. Oil shale is usually used unrefined as fuel, but it can be refined to make gaseous or liquid fuels. The cost of these is however at present higher than for corresponding petroleum fuels.

Oil shale is a term for various types of sedimentary rock (but not necessarily shale) that contain fossil oil that can be used in the same way as petroleum. Due to reasons of cost, use usually takes place near the extraction site. Estonia accounted alone in 2005 for 75% of global consumption, and oil shale is also used in Brazil and China and, to some extent, in Germany, Israel and Russia. The United States has, however, begun to study the possibilities of exploiting its considerable reserves.

CO_2 emissions from the combustion of fossil fuels vary depending on the nature and properties of the fuel, so a carbon tax needs to be adapted to each fuel. We will briefly return later to how such a distribution might look.

Fossil fuels are, as previously mentioned, also an important industrial raw material for the plastics industry and other chemical-technical industries, among others. The fuels used as raw material for industry should not be encompassed by a carbon tax. Since Swedish district heating plants have begun to use refuse as fuel, some of the fossil industrial fuels will, however, emit carbon into the atmosphere that way. For this reason, Sweden has introduced a standardised carbon tax on refuse that is used as fuel.

This tax may be questioned, since it hardly has any controlling effect. Furthermore, both district heating and refuse incineration in thermal power plants only exist in a few countries. To attempt to include this element in negotiations on globally coordinated taxation of carbon would therefore probably only obstruct negotiations.

It can be mentioned in this context that a discussion of whether peat should be considered a fossil fuel has taken place. As does timber, peat grows continuously, but its reformation time is considerably longer than that of the raw products of forestry. It is however estimated that Swedish peat grew during 2000 more than that which was extracted by peat mining. Peat, previously considered a fossil fuel, has since 2006 been considered in Sweden a slowly renewable source of energy.

8 Algeria, Angola, United Arab Emirates, Indonesia, Iraq, Iran, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia and Venezuela

9 The Gas Exporting Countries Forum (GECF) was formed in 2001 and encompasses Algeria, Bolivia, Brunei, Egypt, Indonesia, Iran, Libya, Malaysia, Nigeria, Qatar, Russia, Trinidad and Tobago, United Arab Emirates and Venezuela. Equatorial Guinea and Norway participate as observers

10 This includes bitumen, i.e. asphalt.

A convention between states

The implementation of a globally coordinated carbon tax requires a ruling on taxation in each country that intends to take part in global coordination[11]. The normal procedure for achieving an agreement of this kind is that a global conference of states negotiates a global convention which the countries then enter by ratifying the agreement.

The strength of an agreement between states on a globally coordinated carbon tax is dependent on enough states entering the agreement. Without a critical mass of affiliated states, the same bothersome effects of competition arise as with separate national taxation of CO_2 emissions. The convention may thus need to be made contingent on enough countries entering it. This condition should not be expressed as a given number of countries, but as countries who together account for a certain minimum portion of the global tax base.

In this paper, taxation based on use (consumption) of fossil products for transports, heating and the production of electrical power is recommended. In order to attain critical mass, it is in practice necessary to include countries who together account for a very great part of handling transport and of production in such energy-intensive industries as metal works, paper and pulp production and cement production. Without having studied the structure of production in detail, we estimate that this is a question of 50-60 states, including all EU and OECD countries, Brazil, India, China and Russia together with a number of other major countries in Asia, the Middle East/North Africa and South America.

A convention should reasonably deal with an agreed minimum level of national taxation on carbon dioxide and give the affiliated states the option of applying higher levels of taxation if so desired. At the same time, one should be aware that one of the issues that will arise in such negotiations will be what obligations the counties – including Sweden – that have already introduced national taxation on carbon will have to fulfil in order for it to be possible to reach an agreement. There is a risk that other countries also place demands on undertakings on the part of the countries that already have higher levels of taxation on CO_2 than a global convention would prescribe. It cannot be taken for granted that proportional contributions to a global fund or mechanism will be sufficient to facilitate adjustments, but demands may be placed on further commitments.

Should one instead choose to attempt to achieve taxation based on production, a somewhat smaller number of states would presumably come into question, including all major producers of crude oil, oil shale, natural gas and coal and any other states with appreciable charted or presumed untapped reserves.

Sweden would not be part of this group, but it would of course be able to become affiliated. Coordinated global taxation on CO_2 based on production would at the same time have consequences for Sweden's national taxation on carbon, which of course is based on consumption.

Use of revenue

Carbon taxes are primarily a means of control for environmental policy, but at the same time they generate tax revenue for the state. How this revenue is used is an entirely open question.

Sweden is already a high taxation country, and it had as its political goal when the carbon tax was introduced to reduce total taxation. Revenue was therefore used for a so-called green tax changeover in order to reduce taxes on income from labour. Other countries may conceivably choose to use revenue differently, while it seems natural to compensate the households for the increase in costs that taxation entails. One alternative may be to stimulate the production of renewable energy or to facilitate for companies and/or households to adapt their energy consumption to the new relative factor prices. Some countries with a troublesome structural deficit in public finances and relatively lower taxation may at the same time wish to strengthen state finances.

11 Also the countries that previously introduced a nationally formulated carbon tax may need to take a new decision in order to adapt their taxation arrangement to the agreement. Today, the EU does not have the competence for a common European decision, but also here separate national decisions are needed.

There exists a proposal to - in connection with a possible international agreement on coordinated carbon taxation - set aside a part of the increased tax revenue for a global fund or mechanism for the financing of measures for reducing dependence on fossil fuels. There is, however, no necessary connection between an agreement on coordinated taxation of carbon and a parallel agreement on such a fund or mechanism. The formulation, administration and use of the fund or mechanism would thus be entirely open questions in negotiations.

The purpose of a fund or mechanism must however reasonably be to redistribute resources between different countries in order to be motivated. This may be a question of redistribution from countries with few needs of adjustment to countries with greater needs or from countries with high GDP per capita to countries with low GDP per capita or of a combination of both of these dimensions. It is not therefore self-evident that all countries should contribute the same proportion of their revenue from the coordinated carbon tax to the fund or mechanism. The possibility for low-income countries to receive contributions from the fund if and when they become affiliated to the coordinated carbon tax would also be an incentive for low-income countries to affiliate themselves to the agreement.

There are a number of alternatives for how the administration of a fund or mechanism could be organised. One possibility is to tie it to a UN body such as UNEP (UN Environment Programme) or UNDP (UN Development Programme). Other possibilities are to tie the fund or mechanism to the World Bank[12] or to create a separate organisation within or outside of the UN system.

The convention should probably also regulate how follow-up of the implementation of national undertakings should be carried out. The most obvious idea would be that an international organisation would collect information on national legislation and national application and conduct special country studies as needed. There may also be a need for a clause entailing that the convention be suspended if too many of the affiliated countries do not fulfil their undertakings according to the convention.

Size of revenue

A more precise assessment of the possible revenue from a globally coordinated carbon tax would require more time and better data. The estimates of possible revenue presented below are therefore very rough and subject to considerable uncertainty.

The estimates are made difficult by the fact that different fossil fuels are not accounted for in uniform volumes in the easily accessible statistics. Data on comparable prices are only accounted for in US$ per a given quantity of energy (British Thermal Units, BTU), and not in relation to the same units as consumption statistics. Conversions have therefore been made here, using a conversion table in the statistical source.

The table below contains data on consumption in 2007, both globally and for the OECD area and the four large countries outside of the OECD[13]. As the reader can see, these countries dominate consumption in all areas. The statistical source does not contain any data for refined petroleum products or for oil shale, probably because these do not move in international trade to the same extent.

	Oil Mtonnes	Gas Mtonnes equivalent	Coal Mtonnes oil equivalent
World	3 953	2 638	3 177
OECD	2 249	1 317	1 184
China	385	63	1 318
India	128	36	208
Russia	126	395	95
Brazil	96	20	14
Total share	76%	69%	89%

12 Actually to the International Bank for Reconstruction and Development (IBRD)

13 BP Statistical Review of World Energy, June 2008.

The data on refined petroleum products that does appear in the statistical source used is not divided into individual countries. Global consumption of refined petroleum products in 2007 was however distributed among different product groups as presented below[14].

Product group	*Share*
Light distillates (petrol etc.)	**38%**
Medium-heavy distillates (kerosene, diesel etc.)	**44%**
Fuel oils	**14%**
Others (incl. LPG and lubricating oils	**4%**

The same source gave the prices for 2007 in US$ per million BTU as 11.95 for crude oil, 7.73 for liquid natural gas, 6.01-8.93 for natural gas and 1.92-3.31 for coal (the spread for the two latter prices is due to the price being given at different points of delivery). Using these prices and the data on global consumption above as a guide, the total annual production value of crude oil, natural gas and coal can be estimated at about 3,000 billion US$[15]. If the value of crude oil is replaced by the value of refined products, the total production value would be even higher.

A coordinated carbon tax of 1% of the production value that was applied in all OECD countries and in the other four countries mentioned especially above could thus be assumed to provide total tax revenue of over 22 billion US$ per year, using 2007 prices.

The fact that a tax of 1% has been used in the calculations should not be perceived as a proposal of taxation at this level. The intention is merely to provide a starting point for assessments of what various tax rates may result in. In this context, it may be necessary to take into consideration that the tax presumably erodes its own tax base (i.e. that it by intention results in lower consumption of taxable fuels), and that potential tax revenue therefore increases more slowly than the tax rate.

14 BP Statistical Review of World Energy, June 2008.

15 The price of coal is given in the source in US$/tonne, but has been converted using the conversion table in the source.

Differences between different fuels

The relative size of the Swedish carbon taxes may serve as an indication of the differences. In the below table, tax on petrol has been set at 100 units, and the highest existing tax rate has been chosen for each group of fuels.

Product	*Relative tax*	*Unit*
Fuel oil, diesel, kerosene	**123**	**cubic metres**
Coal fuels and petroleum coke	**107**	**tonnes**
Gasol (LPG)	**130**	**tonnes**
Natural gas	**92**	**1000 cubic metres**
Petrol	**100**	**litres**

Gasol is a Swedish trade name for a gaseous fuel consisting of light carbon molecules such as propane and butane. The international denomination is LPG (Liquefied Petroleum Gas).

Administrative preconditions

Excise taxes are very common in all market economies and are used for a number of tax bases. All OECD countries have some form of energy taxation and thus the organisational infrastructure needed for the collection of a carbon tax[16]. Outside of the OECD area, reasonably all countries that form part of the critical mass for a globally coordinated carbon tax have the similar administrative capability to introduce and apply such a tax.

Things look different outside of this core group. There are a number of countries that are experiencing internal conflicts that make efficient administration difficult and a number of so-called "failed states" that in practice lack a functioning public administration. To this can be added special such as North Korea, which is the only remaining country with no elements of market economy mechanisms. It may also be difficult for countries with a high level of corruption to guarantee the uniform application of every type of national taxation and they lose a part of tax revenue

16 It may be mentioned that Great Britain has the highest total taxation on fuel in the EU.

due to corruption. The participation of these countries in a system for globally coordinated taxation of carbon is, however, not a necessary precondition for the system to work.

Structural effects of taxation

The taxation of carbon dioxide is primarily a means of economic control, and the structural effects of this taxation are thus the main motive for introducing it. At the same time, the structural effects set the limits for how quickly the tax can be introduced and how high the tax rates can be.

The relative prices for different production factors have significance for both industries' choice of technology and the development of the structure of society's building stock. Each investment decision will reflect the factor prices in effect at the time of the decision and their expected future development. Even if the relative factor prices change, traces of the previous price relationships will be visible in the technological structure of industry and in the structure of society's building stock.

Carbon tax entails increased costs for heating and transports. It has been argued that this will lead to lower profitability in many existing production facilities and increase interest in investment in new production facilities with more optimal technology and a more optimal location (see also section 4). In a strongly internationalised economy, the new production facilities may well be located outside of country's boundaries.

The relative factor prices for energy are also of significance to the structure of the building stock. In the U.S.A. for example, low prices on fossil vehicle fuels have in many places led to the growth of urban sprawl and to neglected public transport. Those who have bought these houses have often based their calculations of housing costs on unchanged fuel prices, and sharp price increases would probably lead to them having to leave their homes and at the same time find it difficult to find available housing in downtown areas. In Europe, higher taxation of vehicle fuels has counteracted such a development of the building stock. Residential areas are in general more closely built, and public transportation is more extensive.

A new or increased carbon tax would increase housing costs for many households and reduce the margin for other consumption. The change also affects the distribution of wealth. The value of homes in peripheral areas would diminish, while downtown homes would tend to increase in value.

Rapid and unexpected changes in energy and carbon taxes – i.e. of the relative factor prices for energy – may lead to old production facilities being closed down more rapidly than they can be replaced by new ones, to shrinking national production capacity and to the decline of national economic activity.

Changes that can be predicted or should have been possible to predict can also have similar effects. One example is Swedish electricity prices. In the final phase of the massive expansion of hydroelectric power and nuclear power, Sweden had a considerable surplus of capacity and consequently very low prices. These were a necessary precondition for profitability for at least one industrial facility that was constructed during this period, the aluminium smelting plant at Kubikenborg, south of Sundsvall. Growing domestic demand for electricity and new opportunities for the export of power have entailed that the price of Swedish power has risen sharply and approached European price levels. The shutdown of certain energy-intensive facilities such as this can bring about is a wholesome adaptation to new long-term relative factor prices[17].

The conclusion one may draw from the reasoning in this paragraph is that one must be very careful in the application of great and unexpected increases in carbon taxes. An immediate tax hike will directly weaken the competitiveness of existing production facilities. Statements regarding the long-term development of the level of taxation do not have the same direct negative effect, but, provided that they are credible, planned future increases of the tax will be considered and discounted in the various investment calculations and thus affect the future structure. It is

17 One element in the equation is that no new commercial facilities for the production of power can be built until the price electricity is as high as the total cost of production at a new production facility.

therefore more important to present a long-term course or corridor for how the tax will develop over time than to immediately introduce a high level of taxation or suddenly raise the tax.

Emissions trading

A number of countries, including the member states of the EU, have introduced systems for trade in emission permits for carbon. The idea behind the emissions trade is that a ceiling is set for total emissions and that these are divided among a limited number of emission permits (cap-and-trade systems). The companies that are covered by the system must possess emission permits corresponding to their actual carbon emissions. There needs to be some form of sanction for those companies that do not present a sufficient number of emission permits.

These systems have considerable advantages. If emission permits corresponding to actual emissions initially are handed out free of charge, profitability will not be affected for existing facilities, while the costs for carbon emissions increase for expanded activities and investments in new facilities. Trade in emission permits will result in carbon emissions taking place in sites where they generate the greatest added value and in investments in the reduction of emissions being aimed at the most cost-efficient measures, regardless of in which activity or company these are taken. The politically determined ceiling for total emissions also gives the states possibilities of forcing reductions in emissions by reducing the number of available emission permits.

There is no natural contradiction between a carbon tax and a system of emission permits, and a country – as does Sweden today – may easily use both systems. The sanction in a system of emission permits could also be constructed as an increased carbon tax. In assessing the effects of the system and of future changes (tax rates, number of emission permits) on structure, growth and distribution, it becomes necessary to look to the total effect of both systems.

The fact that Swedish industrial companies that are encompassed by our system of emission permits have been exempted from the normal carbon tax is due to high Swedish carbon taxes, the competitive situation of energy-intensive industry and uncertainty regarding how long it will be possible to maintain the relief rules currently enjoyed by energy-intensive industry. Trade in emission permits generates no increase in the companies' tax burden, and for industry as a whole this trade is a zero sum game, where all transfers of resources take place between the participating companies.

A system of emission permits can, however, be made the basis for differentiated taxation of CO_2 emissions. The companies that are covered by the trading system are then exempted from the normal taxation of carbon and instead pay a special carbon tax calculated on the extent of the emission permits possessed.

An agreement on a globally coordinated taxation of carbon could give the countries the possibility of having a system using taxed emission permits in parallel with the normal carbon tax. In the short term, one might conceive of a more rapid course of development for the carbon tax that affects transports and household heating than for the tax that is collected from energy-intensive industry. In that case, the motive would be to be able to take the different structural effects within these two sectors into account. In the long term, however, it is difficult to see any tenable motive for lower taxation of energy-intensive industry.

Summary

- The purpose of a globally coordinated carbon taxation is to promote the rationalisation of energy and enhance the attractiveness of alternative energy sources. The primary purpose is thus to function as a means of political control, not to generate revenue. It is, however, entirely possible to link a carbon tax, for example, to an international fund for climate adaptation.

- National carbon taxes are limited, since they can affect competitive relationships. With a sufficiently broad global agreement, it would be possible to formulate a more effective carbon tax.

- The tax should be levied as an excise tax, since this is efficient and one of the most common forms of taxation. Most of the world's carbon emitting countries have similar excise taxes. It should, like European energy taxes, be levied in the trade phase.

- The tax base should be comprised of the various types of fossil fuels, i.e. crude oil, natural gas, coal and oil shale and refined fuels based on these fuels. Fossil fuels that constitute raw material for industry, for example in the plastics industry, should be exempted.

- Coordinated taxation of carbon should be regulated by a convention between states conditional on its ratification by the countries that account for a given minimum share of total carbon emissions.

- The convention should regulate the minimum level of national taxation of carbon. Coordinated taxation of carbon at 1% of the value of production would result in total global revenues of about 22 billion US$ per year.

- One should be careful with large and unexpected increases in the carbon tax, since this directly affects the competitiveness of carbon -intensive industry. It is therefore important to present a long-term course or corridor for how the tax should develop.

- The effects of coordinated taxation of carbon would be limited from the viewpoint of distribution policy, one of the reasons being that the poorest people in developing countries make little use of carbon .

- It is entirely possible to combine globally coordinated taxation of carbon with a system for trade in emission permits. This is already being done in Sweden.

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Annex: Energy and Carbon Regulations in Sweden

Sweden introduced taxation on petrol in 1924. The main reason was fiscal, i e to raise public revenues. In 1991 a uniform CO2 tax was introduced, and it has gradually been raised. This annex describes the Swedish energy and carbon regulations, as an example of how energy and carbon taxes may be implemented.

Electricity certificate system

The electricity certificate system has proved efficient in introducing renewable electricity. It is a market-support system for the development of electricity generation from renewable energy sources and peat aiming to increase electricity generation from such sources.

The system will help to produce more ecologically sustainable electricity. The system is structured so that producers of renewable electricity receive an electricity certificate for each MWh of electricity produced. To create demand for electricity certificates, it is mandatory for suppliers of electricity and some defined energy users to buy a certain amount of electricity certificates in relation to its electricity delivery/electricity consumption, the so-called quota. When selling electricity certificates producers get additional revenue in addition to revenues from electricity sales, which create better economic conditions for environmentally sound electricity generation. Electricity suppliers are obliged to buy electricity certificates equivalent to a certain percentage of the electricity they sell, the so-called quota. The quota is currently set to the year 2030. For 2010 the quota is set to 17,9 percent.

An electricity certificate is awarded an approved facility for each produced and measured MWh of electricity from renewable energy sources or peat. The sources authorised to be allocated to electricity certificates is wind, some hydropower, some bio fuels, solar, geothermal, wave energy and peat power generation.

The electrical certificate system will support the rollout of new plants for the production of electricity from renewable energy sources and peat. In order to limit the consumers' cost there is a time limitation on the right to the electricity certificates. Establishments in operation after the system's introduction are entitled to electricity certificates for 15 years, until the end of 2030. The establishments that were in operation before the system's introduction are entitled to electricity certificates under certain conditions.

Emissions of nitrogen oxide – the NOx-fee

Since January 1, 1992 a fee targeting emissions of nitrogen oxides (NOx) from combustion related to energy production is in force. Plants that produce at least 25 GWh utilised energy per year, are liable to pay the fee. Energy producers have to pay a fee of SEK 50 per kilogram of NOx emitted. The purpose of the levy is to reduce the amount of harmful acid and NOx from combustion. For the benefit of reduced emissions the system also contains a refund based on how much utilised energy that is produced. The total amounts of levies are then redistributed among the fee payers. Companies with small emissions of NOx per utilised energy unit gets a larger amount back than they pay in, while companies with high emissions per unit of utilised energy are net contributors.

The motive for introducing the fee was to lower acidification. The total amount of NOx emissions from all sectors in Sweden has decreased from 306 000 tonnes in 1990 to 197,000 tonnes in 2004. At the same time the amount of produced energy has increased.

The EU Emission Trading Scheme – EU ETS

Trade in carbon emission rights includes more than 730 Swedish plants in the industrial and energy production sectors. In total, the system affects approximately 13 000 plants across the EU, that emit about 40 percent of the total emissions of carbon dioxide in the Union.

The trading system covers emissions of carbon dioxide from large combustion plants in the industrial sector, power and thermal plants and oil refineries and plants where production and processing of iron, steel, glass, fibreglass, cement, ceramics, pulp and paper takes place.

Taxes on energy

As a general rule value added tax (VAT) is levied on all kinds of energy consumption with the exception of fuels used for air navigation. The tax rate is 25 per cent.

Excise Duties on fuels

Fossil fuels

Taxation of energy is regulated in the Act on Excise Duties on Energy (LSE), which is based on EC-directives. There are three excise duties that are levied on fuels – energy tax, carbon dioxide tax and sulphur tax.

Energy and carbon taxes in Sweden

Kind of fuel	**Energy tax**	**Carbon dioxide tax**	**Sum tax**
Gasoline which meets requirements for			
a) the environmental class 1 -- Petrol	SEK 3.08 per litre	SEK 2.44 per litre	SEK 5.52 per litre
-- Alkylate petrol	SEK 1.38 per litre	SEK 2.44 per litre	SEK 3.82 per litre
b) the environmental class 2	SEK 3.11 per litre	SEK 2.44 per litre	SEK 5.55 per litre
Other than gasoline referred to above	SEK 3.84 per litre	SEK 2.44 per litre	SEK 6.28 per litre
Fuel oil, diesel oil, kerosene, etc. as			
a) bears the label-and dyes, or gives less than 85 volume distillate at 350 ° C;	SEK 797 per m^3	SEK 3 007 per m^3	SEK 3 804 per m^3
b) have not been provided with marking and colours and give at least 85 volume distillate at 350 ° C, belong to			
Environmental class 1	SEK 1 322 per m^3	SEK 3 007 per m^3	SEK 4 339 per m^3
Environmental class 2	SEK 1 596 per m^3	SEK 3 007 per m^3	SEK 4 603 per m^3
Environmental class 3 or not belong to any environmental class	SEK 1 735 per m^3	SEK 3 007 per m^3	SEK 4 742 per m^3

Petrol, diesel, light and heavy fuel oil, kerosene, LPG, natural gas and coal are directly subject to energy tax, carbon dioxide tax and sulphur tax. Sulphur tax is also levied on peat. From 1999 crude tall oil is subject to energy tax only. The general principle, stated in the EC-directive as well as in the Act, is that excise duties are only to be paid if the fuel is used as motor fuel or for heating purposes. Further there are possibilities to use fuels excise duty free for certain purposes listed in the Act.

Apart from these directly excisable fuels, excise duties are also levied on certain other fuels when sold or used as motor fuels or for heating purposes, so called indirect taxable fuels. This applies to all mineral oils, fats from both vegetable and animal sources and fatty acid methyl esters. Any product used as motor fuel and any hydrocarbon sold or used for heating purposes is also taxable.

Energy tax and carbon dioxide tax

The excise duty rates 2009 on some of the most common fuels. Exchange rates per 2009-12-09; 1 SEK = 0.094 EUR, 1 EUR = 10.59 SEK.

There is an annual index adjustment of the excise duty rates for energy products linked to changes in general prices.

Sulphur tax

The sulphur tax is a national tax. The tax rate for sulphur tax on peat, coal, petroleum coke and other solid or gaseous products is set at 30 SEK per kg of sulphur in the fuel. The sulphur tax on liquid fuels (for example diesel oils and heating oils) is 27 SEK per cubic meter of oil for every tenth of a weight per cent of the sulphur content. However, fluid or gaseous products with sulphur content of a maximum of 0.05 weight per cent are exempted from tax. Oils with sulphur content greater than 0.05 per cent but less than 0.2 per cent are taxed as oils with a sulphur content of 0.2 per cent.

Environmental classifications for certain fuels - unleaded petrol

There are two different rates of excise duty on unleaded petrol. The aim of the reform was to promote a change to more environmentally friendly petrol. The best quality (environmental class 1) has the lowest tax rate. The classification was based on technical characteristics such as sulphur, benzene, aromatic hydrocarbons, olefins, phosphorus content and vapour pressure. From November 2002 alkylate petrol was introduced in class 1 and given a lower tax rate than other class 1 petrol. Unleaded petrol, not complying with the class 1 characteristics, is classified as environmental class 2 and is charged at a higher tax rate.

Environmental classifications for certain fuels - diesel oils and alternative fuels

Unmarked diesel of environmental class 1 is taxed at a slightly higher tax rate than green-marked heating oil. Differentiation of the tax rate in terms of three environmental categories is applied to the energy taxation of diesel. The different energy tax rates are related to precise technical characteristics such as the content of sulphur, polycyclic aromatic hydrocarbons and other aromatics in the fuel.

In 2006 new environmental classes were introduced for alternative fuels, also adjustments were made to the already existing classes. One class was made for an ethanol based fuel, E85, and another for a group of three different specifications where one is aimed at fatty acid methyl esters, FAME, another at a special ethanol based fuel, E92, and a third at synthetic diesel fuels. If the requirements in these new classes are met, the motor fuels are categorised as a class 1 fuel and taxed as the corresponding class 1 fuels. The biomass based proportion of the fuel is tax exempt if certain conditions are fulfilled.

Aviation fuel

From 1 July 2008, tax is levied on aviation fuel consumed for private purposes. Petrol used for flights consumed for commercial purposes will continue to be exempt. This is done by a refund for consumption for such a purpose. The same applies to other fuels used in aircrafts, with the exception of kerosene. For aviation kerosene the present opportunities for duty-free purchases are retained.

Tax on renewable fuels

From 1 January 2007 vegetable and animal oils and fats as well as non-synthetic methanol and fatty acid methyl ester, are subject to tax. Tax liability for these products occurs when there is an intention to consume the product as fuel for heating or as a motor fuel.

Relief from energy- and carbon dioxide tax is granted for methane produced from biomass. Relief is also granted for wood fuel, with the exception of wood waste derived from household waste.

Relief from excise duties

The possibilities for tax relief are described below; please note that there are further possibilities possible for primary sectors.

Relief from excise duty for fuels used for certain purposes

Total relief from energy tax and carbon dioxide tax is granted for certain purposes. These purposes are;

- fuels used for purposes other than as motor fuels or as heating fuels,
- fuels used in metallurgical processes if the incoming material through heating in ovens has been changed chemically or its internal physical structure has been changed or is kept in shanks or similar vessels,
- fuels used in processes for manufacturing of other mineral compounds than metals if the incoming material through heating in ovens has been changed chemically or its internal physical structure has been changed,
- fuels used for industrial processes not mentioned earlier where the fuel has a "dual use",
- other fuels than petrol used for transportation by rail,
- fuels used for the purposes of navigation, other than in private pleasure craft,
- jet fuel and aviation spirit used for the purpose of air navigation (commercial use),
- fuels used for the production of energy products and other fuels for which excise duty is paid, and
- fuels used for the production of electricity (Energy tax is however levied on electricity).

Relief from sulphur tax is granted for the purposes set out in paragraphs 1–8 above. Relief from sulphur tax is also granted for sulphur based production of paper pulp. Sulphur tax is exempted if the sulphur is not emitted to the atmosphere through binding in the process in products or in ashes.

Relief for the remaining industrial sector

For the manufacturing process in industrial activities or parts of the manufacturing process in industrial activities not qualifying for the total relief described above, tax exemptions are granted for the entire energy tax and 79 per cent of the carbon dioxide tax on certain fuels used for any purpose other than the operation of motor vehicles in the manufacturing process in industrial activities.

For industry participating in the European Union Greenhouse Gas Emission Trading Scheme (EU ETS), there are possibilities to obtain further exemption up to 85 per cent of the carbon dioxide tax from 1 July 2008, see below.

Combined heat and power plants

By a combined heat and power plant (CHP) is understood the simultaneous production of heat and electricity in one process where the heat generated is utilized, and the electricity efficiency is at least 5 per cent.

For a CHP, not participating in the EU ETS, full reduction for the energy tax and 79 per cent of the carbon dioxide tax is granted for fuels used for the production of heat. If the electricity efficiency in the process is below 15 per cent the tax reduction is limited. If the efficiency is at least 5 per cent then the 100 per cent exemption from energy tax is granted. The carbon dioxide tax is reduced by 19 per cent if the electricity efficiency is 5 per cent. Above that limit the reduction increases gradually with increasing efficiency. When the efficiency reaches 15 per cent and above, the reduction is 79 per cent. The proportion of the fuel related to the electricity produced is fully exempt from tax.

For CHP, participating in the EU ETS, tax exemption is granted for consumption for the production of heat in a CHP with 100 per cent of the energy tax and 85 per cent of the carbon dioxide tax. The proportion of the fuel related to the electricity produced is fully exempt from tax, see below.

Relief from carbon dioxide tax for plants participating in the EU ETS

Swedish plants that participate in the EU ETS pay carbon dioxide tax for the portion of fuel consumed for heating or motor operations, with the exception of power plants and oil refineries.

Energy and carbon dioxide taxes are paid, in case production of heat that does not occur in an industrial plant or a combined heat- and power plant. Fuels used in some industrial processes (so-called input and dual use of fuels) are exempt from taxation. The same applies for fuels used to produce electricity.

From 1 July 2008 there is a reduced carbon dioxide tax on fuel consumed in plants covered by the EU ETS. The percentage of tax reduction for fuels consumed in the industrial plants and combined heat and power plants participating in the trading system increases by 6 percentage points.

Tax relief for renewable fuels

Renewable energy products used as motor fuels

The government can apply exemptions or reductions in the rates of duty to fuels used for pilot projects for technological development of more environmentally-friendly products and in particular in relation to fuels from renewable resources. With reference to this regulation a complete tax relief from excise duties for ethyl alcohol and rape seed methyl ester (RME) used as motor fuels has been granted.

Renewable energy products used for heating purposes

As a result of vegetable and animal oils and fats becoming taxable, there is an explicit provision for granting tax-free use of these products for heating purposes. This maintains the previous duty-free status of these fuels. The same applies to the fatty acid methyl ester and non-synthetic methanol.

Energy tax on electricity

Chapter 11 § 1 LSE states that electric power consumed in Sweden is taxable unless exempted. Hence it follows that electric power consumed and exported abroad is not taxable in Sweden. Electricity is subject to energy tax.

The energy tax is for 2009 SEK 0.005 per kWh for electric power consumed in industrial activity in the manufacturing process or at a professional greenhouse. The energy tax is SEK 0.186per kWh for electric power other than that referred to above and consumed in certain listed municipalities in the northern part of Sweden. The energy tax is SEK 0.282 per kWh for electric power consumed in other cases. There is an annual index adjustment of the tax rates for electricity.

Electric power is tax exempt if it is: 1. produced in Sweden in a wind power plant by a producer who does not by occupation supply electrical power, 2. otherwise the electricity was produced in Sweden by a producer who has an installed generator effect of less than 100 kilowatts and does not by occupation supply electrical power, 3. at lower effect than 50 kilowatts without compensation delivered by a producer or a supplier to a consumer that is not associated with the producer or supplier; 4. produced and consumed on a ship or other means of transport, 5. used for the production of electric power, 6. obtained in an reserve power station.

A person who is subject to taxation, on energy tax on electricity, may deduct the tax on electricity if 1. consumed or sold for consumption on a train, 2. mainly consumed or sold for consumption in chemical reduction, or electrolytic processes, 3. consumed or sold for consumption in the production of taxable energy products; 4. consumed or sold for consumption in transfer of electricity to the electric grid, in order to maintain the network function, 5. consumed or sold for use in metallurgical processes, or in the production of mineral products subject to that the material by heating has changed its internal chemical or physical structure, 6. consumed in industrial production, if participating in the programme for energy efficiency, and 7. received by a approved tax-exempt consumer.

Property tax for hydro-power stations

There is a special property tax on hydro power stations. The tax rate has increased by 0.5 percentage points from 1.2 to 1.7 per cent from 1 January 2008. This together with the temporary increase in the property tax by 0.5 percentage points over the period 2006-2010, brings the tax rate for hydro power stations to totally 2.2 per cent.

Tax on nuclear energy

Apart from energy tax levied on the consumption of energy, there is a supplementary tax on electricity applied on production of electricity in a nuclear plant. The tax is based on the thermal production capacity in the nuclear reactor. The applicable tax rate is SEK 12 648 per month and megawatt of the permitted thermal capacity. The tax on a nuclear reactors thermal effect has been raised significantly during the last few years.

Energy-intensive industry

Further tax reductions can be applicable to enterprises with a very high consumption of energy. If the paid reduced carbon dioxide tax exceeds 0.8 per cent of the sales value of the products being sold by the enterprise, it is possible for the enterprise to apply for further reduction of the excess tax amount so that only 24 per cent of this amount is paid.

Other taxes on the environment

Apart from the below mentioned taxes Sweden also has excise duties on fertilizers and pesticides.

Congestion tax in Stockholm

A congestion tax is imposed on Swedish registered vehicles driving into and out of the Stockholm inner city zone on weekdays (Monday to Friday) between 6.30 a.m. and 6.29 p.m.

No tax is charged on Saturdays, Sundays, public holidays, the day before a public holiday and during July. Vehicles are registered automatically at "control points" during the period when the tax is charged. Each passage made in or out of the zone costs 10, 15 or 20 SEK, depending on the time of day. The accumulated passages made by any vehicle during a particular day are aggregated into a "tax decision". The maximum amount charged per day and vehicle is 60 SEK.

The following vehicles are exempt from the congestion tax: emergency service vehicles, buses with a total weight of at least 14 tons, diplomatic cars, motorcycles, foreign registered vehicles, military vehicles, and environmental vehicles that according to the SRA's vehicle registry are equipped with technology for running (these two exemptions below will only be in force for five years) a) completely or partially on electricity or a gas other than LPG or b) on a fuel blend that predominantly comprises alcohol.

Vehicles could be granted exemption by the National Tax Board of Sweden subsequent to an application by a person who has been granted a disabled persons parking permit.

Tax on disposal of waste

In January 2000 a tax on disposal of waste was introduced. Hence the rules for exemption of tax deductions and deductions have been changed. The tax rate was then SEK 250 per ton of waste going to landfill, the tax amounts since 1 January 2006 to SEK 435 per ton waste. The tax includes both conventional waste and sector-specific waste from the industry. The purpose of the tax is to reduce the amount of waste going to landfill. It will also help in motivating recycling since it is more profitable to reuse, recycle and through other methods process or make use of waste. Waste is defined as any object or substance in a category of waste which the holder disposes of, intends to do away with or is required to dispose of. Tax liable waste facilities are facilities where hazardous wastes or other waste of an amount of more than 50 tons per year are finally held (deposited) or stored for longer than three years.

Waste tax is taken out after a net deposit method, meaning that everything brought into a facility, regardless of whether it is something that by definition be considered as waste or not, is subject to taxation when it is brought into the plant. The purpose of the tax, however, is that only waste going to landfill will be burdened with taxes. This is accomplished by the taxpayer in his declaration being able to deduct the tax on waste carried out from the plant. In addition, there are exceptions for certain treatments.

Exemptions for certain establishments

Exemptions apply to establishments where the disposal or storage is done exclusively by one or more of the following types: 1. soil, gravel, clay, slate, limestone dust, limestone or other stone, 2. mineral waste from industrial mining activities or 3.waste sand from industrial mining activities and waste water treatment from such activities and ferrous waste from smoke gas cleaning in the manufacture of iron ore pellets. These exemptions are linked to the type of facility and not to waste fraction in itself. Exemptions also apply to establishments where the disposal or storage is done exclusively by 1. radio active waste, 2. sludge from a water plant, or 3. liquid waste embedded in rushes. Exemptions are also allowed even when the waste is used for alternative uses such as filling out water to create a port or land for industrial purposes.

Other exemptions

The waste or treatments that are exempt from tax are not accounted for in the declaration. Waste tax is therefore not paid for: 1. material intended to be used for the operation of a facility or brought into such a facility without any direct connection with waste management, 2. waste that is intended to be in a holding a) treated by composting or reactor based anaerobic di-

gestion, b) incinerated, c) used in the production of solid storable fuel, wood chips or pellets, d) dewatered, e) purified, provided that the waste is liquid, 3. liquid waste in a plant which is intended to be embedded in rushes.

Deduction

Deductions can only relate to tax on waste that has been raised before. This means that the tax burden only occurs on waste eventually dumped at the site. A person who is subject to taxation may also deduct some of the in the Act specifically pointed out waste fractions. For these the right to deduct tax occurs simultaneously with the tax liability.

Vehicle tax

Vehicle tax for private cars

Private cars class I, which according to data in the Swedish vehicle registry have vehicle year 2006 or a vehicle year earlier than 2006 but fulfil the requirements of environmental class 2005, electricity or hybrid, are taxed with the carbon dioxide emissions based vehicle tax. To be classified as an environmental class "2005" vehicle the car has to fulfil limits set up for exhausts of carbon monoxide, hydrocarbon and nitrogen oxide. Environmental class "EL" covers vehicles that are driven only by electricity from batteries. Environmental class "hybrid" covers vehicles that are driven by electricity from batteries as well as an internal combustion engine. Cars not fulfilling these requirements have a weight based vehicle tax.

Since 1 May 2006 private cars class I are targeted by a carbon dioxide emission based vehicle tax. A private car class I is defined as a private car which is not a private car class II (camper).

The carbon dioxide emission based vehicle tax consists of a fixed primary amount and an amount based on the vehicles carbon dioxide emissions (carbon dioxide component). Currently the fiscal primary amount is 360 SEK. The carbon dioxide component varies depending on which fuel the car is driven on. Below the tax is described for each fuel.

For petrol driven private cars tax the carbon dioxide component is 15 SEK per gram carbon dioxide emission that exceeds 100 gram per km.

For private cars that are equipped with engines that could be driven with a fuel mixture containing to a greater part alcohol or totally or partly with another gas than LPG, the carbon dioxide component is 10 SEK per gram carbon dioxide that exceeds 100 gram per km.

For private cars that run on diesel fuel the carbon dioxide component is 15 SEK per gram carbon dioxide that exceeds 100 gram per km. The sum of the fiscal primary amount and the carbon dioxide component is multiplied with an environmental and fuel factor of 3.5.

Tax relief for certain diesel driven private cars

The vehicle tax for diesel driven cars shall be reduced by SEK 6 000 for a diesel driven private car that has been liable to tax for the first time before the end of 2007 and fulfil the requirement of environmental class "2005 PM". Environmental class "2005 PM" requires that the vehicle fulfils the requirements of environmental class "2005" and that it does not emit more particles than 0.005 gram per km. Environmental class "2005 PM" covers private cars, light trucks and light buses. Vehicles that fulfil these requirements are normally equipped with a particle filter.

Vehicle tax for heavy trucks and buses

For heavy trucks the vehicle tax depends on if the heavy truck is obliged to pay road fees or not. For heavy trucks the amount of vehicle tax depends on the following factors: tax weight, type of fuel, axletrees, environmental class and type of coupling device.

For heavy buses the vehicle tax depends on the following factors: tax weight, type of fuel, environmental class and number of axletrees.

For heavy diesel driven trucks and heavy diesel driven buses that fulfil the requirements of environmental class "2005" or better have a lower vehicle tax which is based on the factors mentioned above for each type of vehicle.

Future legislation proposals in Sweden

The tax on incineration of household is proposed to be removed on September 1, 2010

Bio gas will be liable to energy- and carbon tax from 1 January, 2011, however tax exemption will possible by deduction.

From January 1, 2011 it requires an electrical efficiency of at least 15% for the rules on taxation of CHP:s to

be applicable. The current legislation regarding CHP:s requires an electrical efficiency of at least 5%.

Index adjustments of tax rates will apply annually.

Carbon tax on heating fuels in the CHP and industry outside the ETS is increased from 21% to 30% on 1 January 2011 and to 60% on 1 January 2015.

Carbon dioxide tax for CHP:s in the ETS is lowered from the current 15% to 7% on 1 January 2011.

For CHP, industry etc. it is proposed that the energy tax will levied by 30% from 1 January 2011, current rate is 0.

There are also changes proposed in the taxation of vehicles.

Proposals for taxation of hydro-fluorocarbons

A government commission has proposed an excise duty on the use of hydro fluorocarbons (HFC), which are primarily used as refrigerants in refrigerators, freezers, air conditioners and heat pumps. The purpose of the tax is to reduce greenhouse gas emissions. . The global warming potential is significantly greater for those gases than carbon dioxide. In order to achieve Sweden's target of reducing greenhouse gas emissions under the Kyoto Protocol a tax is proposed for these gases. According to the proposal, a premium equivalent to the tax paid will be paid when the HFC are submitted for destruction. The tax is proposed to be introduced with effect from 1 July 2010.

Carbon taxes seem to be a forgotten policy tool in the climate policy debate, and there are several misconceptions regarding their use and effectiveness. In this report, the Swedish think-tank Global Utmaning (Global Challenge) analyses the theories and evidence regarding carbon taxation, and presents 10 principles on carbon taxation.

The report highlights interesting developments and research such as the current review of the European Union's Energy Tax Directive, and the effects of carbon taxes on income distribution in developing countries.

The report finds that:

- Carbon and energy taxes can be environmentally efficient in terms of reducing carbon emissions.
- A green tax shift, i e shifting the tax burden from taxation of labour to taxation of carbon and energy, can have a small positive impact on GDP.
- The effect of carbon taxes on income distribution tends to be regressive in developed countries.
- ...and seems to be progressive in developing countries.
- Carbon taxes and emission trading systems are compatible and complement each other, since they are suited for different sectors of the economy.
- Several European countries have implemented both carbon taxes and emission trading systems with good results during several years.
- A careful selection has to be made when combining taxes, emissions trading systems and other climate policy instruments.
- A carbon tax should be introduced at a low level and gradually increased, and tax increases should be announced well in advance, in order to allow for adaptation by households and companies.
- It is necessary to adapt tax policies to country-specific situations.

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Sveavägen 66 • 111 34 Stockholm • Sweden • www.globalutmaning.se