EVALUATION OF ENVIRONMENTAL TAX REFORMS: INTERNATIONAL EXPERIENCES

Final Report

Prepared by:
Institute for European Environmental Policy (IEEP)
55 Quai au Foin
1000 Brussels
Belgium

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Institute for European Environmental Policy
London Office
15 Queen Anne's Gate
London, SW1H 9BU
Tel: +44 (0) 20 7799 2244
Fax: +44 (0) 20 7799 2600

Brussels Office
Quai au Foin, 55
Hooikaai 55
B- 1000 Brussels
Tel: +32 (0) 2738 7482
Fax: +32 (0) 2732 4004

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EXECUTIVE SUMMARY

Environmental tax reforms (ETR) were first launched in the early 1990s among a small number of European countries as a means to address environmental, economic and social objectives. In recent years, a number of other countries and regions have joined the early vanguard in introducing some form of ETR, with even more countries planning or considering introducing ETR in the near future. In addition, those countries which have already engaged in such reforms and have carbon and energy taxes in place are also considering their further evolution. Switzerland is considering the introduction of an ETR as a possible instrument to contribute to the objectives of the 2050 Energy Strategy which include a commitment to phase-out nuclear energy as well as objectives relating to climate change, energy security, energy efficiency, investments in power plants and the electricity grid.

This study seeks to inform these preparations in Switzerland by providing an overview of experiences with carbon and energy taxes in **Australia, British Columbia** in Canada, **Denmark**, **Finland, Germany, Ireland, Netherlands, Norway, Sweden** and **United Kingdom** (see Table E1). The study also briefly discusses plans to introduce carbon taxes in the **Czech Republic, France, Italy, Japan, United Kingdom and United States.** Through this examination of international experiences, this study aims to provide insights on key issues relating to the introduction and implementation of carbon and energy taxes, including the design of taxes (objectives and rationale, tax rates and adjustments over time, tax base, revenue raised, revenue use, exemptions), as well as the environmental effectiveness of the taxes and their economic and social impacts. This study was carried out by the Institute for European Environmental Policy (IEEP) from January to May 2013 and is based on an analysis of literature and consultation with experts.

Some insights on the design of ETR based on international experiences

The underlying reasons for introducing carbon or energy taxes in a country often reflects a combination of environmental, economic and social considerations. Interest in reducing GHG emissions, saving energy and associated fuel costs, raising revenue and supporting employment are common themes behind many of the carbon and energy tax reforms examined in this study.

Some of the cases of carbon and energy taxes examined have been climate or sustainable energy focused (e.g Australia and British Columbia), some have been a response to fiscal necessities (e.g. Ireland); while some have been introduced as sub-elements of wider tax shifting programmes aimed at catalysing growth and jobs (e.g. Finland and Denmark). Objectives behind an ETR may also change over time. For example in Sweden, early ETR efforts were part of a broader tax shifting operation that strengthened environmental taxes and reduced taxes on labour, the introduction of the CO_2 tax moved the focus more towards environmental protection although the principle of tax-shifting still applied, the latest reform in 2009 moved the focus even further towards environmental protection.

This diversity indicates that ETR is motivated by multiple objectives, with one primary objective often catalysing and driving the ETR process, but multiple policy objectives influencing its final design and implementation. For example, concerns about the potential impacts of the new or reformed carbon or energy tax on the competitiveness of domestic industries (particularly energy-intensive, trade-exposed sectors) are often a key factor affecting the ambition and scope of the reform.

Table E1: Overview of carbon and energy taxes, carbon tax rates and coverage in selected OECD countries

Country / region	Brief description	Explicit CO_2 tax rate where applied (in EUR per tonne CO_2)	CO_2 emissions covered by CO_2 tax
AU	'Carbon Pricing Mechanism' (CPM) applied from July 2012. For the first three years, the carbon price will be fixed (i.e. operate as a carbon tax), before moving to an emission trading scheme in 2015.	AUD 23 (EUR 18.6)/t CO_2 on 1/7/2012	60 per cent (of GHG emissions)
BC	CO_2 tax introduced in July 2008 which applies the same price for every unit of GHG emissions from fossil fuel combustion across the economy.	CAD 30 (EUR 23.3)/t CO_2 on 1/7/2012	70 per cent
DK	CO_2 tax introduced in 1992 on energy products consumed by households and extended to businesses in 1993. In addition, an energy tax is applied to bottled gas, fuel oil, gas oil, coal, electricity and natural gas and a SO_2 tax applied on all fuels containing sulphur used by households and industry.	EUR 21.3/t CO_2 in 2012	59.1 per cent
FI	CO_2 tax introduced in 1990, the system has subsequently developed through a number of stages influenced by other instruments, EU policy, concerns regarding violation of trade agreements and party political aims.	EUR 60/t CO_2 (transport fuels), EUR 30/t CO_2 (fuels for heating) on 1/1/2012	32.6 per cent
DE	ETR introduced in 1999 by gradually increasing existing taxes on transport fuels, natural gas, light heating, heavy oil fuels and introducing a new electricity tax. Reform inspired by environmental and economic objectives and included several derogations for manufacturing and energy-intensive industries.	*N/A - energy tax*	*N/A - energy tax*
IE	CO_2 tax introduced in December 2009 phased in over three stages from 2009-2013. Tax applies to CO_2 emissions from non-ETS sectors and is based on the carbon content of the fuel.	EUR 20/t CO_2 (petrol, auto-diesel, kerosene, marked gas oil, LPG, fuel oil, natural gas) in 2012; EUR10/t CO_2 (solid fuels) from 05/2013	60.4 per cent
NL	(Regulatory) energy tax introduced in 1996 applies to energy products used for heating and electricity generation by households, small businesses and intermediate firms.	*N/A - energy tax with a carbon component*	58.5 per cent
NO	CO_2 tax introduced in 1991 on consumption of petrol, auto diesel oil, mineral oil and offshore petroleum sector. The CO_2 tax forms part of the Norwegian excise duty scheme on fossil fuels which also includes an energy tax and a SO_2 tax.	Depend on energy product: NOK 101 (EUR13.7)/t CO_2 (heavy fuel oil), NOK 225 (EUR30.5)/t CO_2 (natural gas, light heating oil), NOK 384 (EUR52.1)/t CO_2 (petrol) in 2012	75.2 per cent
SE	CO_2 tax introduced in 1991 followed by a 10-year 'green tax-shifting programme' from 2001–2010. Reform of energy and CO_2 taxes in 2009 removed a number of exemptions that were in place to protect the competitiveness of energy-intensive industries.	SEK 1080 (EUR 118)/t CO_2 in 2012	41.2 per cent
UK	Climate change levy (CCL) introduced in 2001 and applies to electricity, natural gas, liquid petroleum gas (LPG), other gaseous hydrocarbons, coal, lignite, coke, semi-coke of coal or lignite, and petroleum coke used by industries, business and the public sector.	Equivalent to EUR 12.0/t CO_2 (natural gas), EUR 8.8/t CO_2 (petroleum), EUR 6.4/t CO_2 (coal)	35.4 per cent
For comparison: CO_2 tax in CH: SFR 36 (EUR 30)/ t CO_2 in 2013 & **EU ETS rate:** Between EUR 6 and 10/t CO_2 eq. in 2012			**CH:** 35.3 per cent

For sources and explanations: see tables in the main report, country case studies and associated references in Annex 1.

The design of the taxes (i.e. its point of application, breadth of coverage, tax rate applied) and their implementation vary substantially across countries. With regards to the **tax base,** some countries focus on a narrow set of energy carriers and users, for example in Australia the carbon tax only applies to around 500 of the countries 'large emitters'; while others adopt a much wider approach as in British Columbia where the carbon tax covers GHG emissions from the combustion of all fossil fuels (emissions from non-combustion sources are not covered). There are currently no schemes that cover all GHG emissions in a given country. This is partly due to the existence of other taxes (e.g. fuel taxes), other policy instruments, and political concerns regarding social impacts or competitiveness concerns. The estimated CO_2 emissions covered by carbon taxes vary substantially ranging from between 32 to 75 per cent in the 10 countries examined (see Table E1).

The **tax rate** applied varies substantially among the countries examined, both with regard to the level at which it is set and the rate applied to different energy products and users (see Table E1). The analysis of experiences in 10 countries indicates that practice often deviates from the economic ideal[1]. Such deviations reflect underlying political considerations relating to *inter alia* economic and social impacts as well as wider concerns regarding instrument mixes, double regulation, composite tax burdens, and may be necessary for political and public acceptability of the tax. The experience in British Columbia is an exception in this regard as a homogenous CO_2 tax applies to GHG emissions from the combustion of all fossil fuels indicating that 'carbon taxation schemes which are designed as close to the theoretical ideal are feasible' (Speck 2013). Thus, there is room for improvement in levelling tax rates applied across different fuel types and end users for the same pollution content as well as better aligning tax rates with estimates of environmental impacts (Heine et al 2012).

However the level of the tax rate alone does not determine the impacts of the tax. The **evolution of the tax over time**, exemptions granted and associated conditionalities, as well as the use of revenues raised are equally important factors influencing its effectiveness. Scheduled increases in the tax rate (e.g. as in Ireland) can help to minimize potential adjustment costs and overcome resistance to the introduction of the tax and subsequent revisions. Moreover linking increases in the CO_2 tax to the achievement of emission reduction targets (e.g. as in Switzerland) can help to improve certainty and clarity on how taxes are linked to emission reduction targets (Speck 2013). Similarly, gradually broadening the tax base over time (e.g. as in Ireland, Denmark and the Netherlands) allows affected actors sufficient time to adapt and also provides the opportunity to learn from experience. There are a number of cases where taxes are reformed to take better account of the carbon content of the fuel so as to strengthen incentives to reduce CO_2 emissions. Examples with regard to fuel use in transport include Denmark, Ireland and Sweden (OECD 2013).

Some form of **exemptions** and/or tax reductions are often a necessary component of ETR and are relied on as a politically expedient measure. However, such practices tend to impair the effectiveness of the ETR as the cheapest emission reduction potential is not exploited, thus making it a less efficient instrument than it would otherwise have been. For example in Germany, derogations granted to manufacturing and energy-intensive industries have limited the positive environmental impacts of the ETR as the rather high energy efficiency potential in the sector remains largely untapped due to insufficient price signals (Speck and Jilkova 2009). Given the current difference between the ETS and non-ETS carbon price, exemptions granted to sectors covered by the EU ETS have also led to inefficiencies. Moreover such practices may imply advantages for certain companies and sectors, but disadvantages to others.

[1] The economic ideal for a carbon tax is to have an economy-wide tax covering all sources of CO_2, with the rate proportional to CO_2 emissions, ensuring equal CO_2 incentives across sectors, fuels and groups, and hence encouraging cost-effective reductions, fuel switching and innovation. Furthermore, the tax rate applied should start at a moderate level, increase over time with a set and transparent schedule to allow time for adjustment, hence reducing costs and increasing support for the reform (building on Jaccard 2012 and Speck 2013).

In certain cases, exemptions granted have been overly generous. For example, this has arguably been the case in the UK where an assessment of the CCL found that if the Levy had been implemented at the full rate for all businesses, substantial further cuts in energy use could have been achieved without jeopardizing economic performance (Martin et al, 2009). Thus, granting such provisions should be carefully examined and linked to conditions such as voluntary agreements, e.g. Germany, the Netherlands, Denmark and UK. Such agreements are seen as a constructive means to encourage change (ten Brink et al 2002; 2003), but at the same time some have been criticised for being weak (as in the UK case noted above). Concerns of state aid objections for potential non-proportionate support via tax reductions have been an important driver for the use of such conditionalities and for sharing information between targeted sectors and authorities. This can help improve information asymmetry between companies and authorities and aide deliberations on future revisions to the tax.

ETR has the potential to **raise additional revenues** which amount to billions of Euros in some countries (e.g. during the first phase of ETR in Denmark, in Sweden, the Netherlands and Germany). As countries often ramp up tax rates over time and stagger implementation (e.g. application to certain groups or energy products), revenues tend to increase over time. However, the overall contribution of such taxes to national tax revenue is relatively small (amounting to a few percentage points of GDP and of tax income) and existing ETRs cannot be seen as representing a major shift in countries tax regimes.

The effectiveness of an ETR is due not just to the design and level of the taxes and charges, but also importantly to **how revenues are used**. Revenues can be used as part of a wider tax shifting programme to off-set some revenue losses from a reduction in other taxes, often on labour (e.g. as in Finland, Sweden, Denmark), to raise revenues to help with fiscal consolidation (e.g. Ireland) or for specific environmental expenditures, or recycled back into the economy such that the overall tax burden remains the same (Speck 2013), or indeed as a mix of these approaches.

Revenue or budget neutrality has been a broad principle underlying carbon-energy tax reforms in Australia, British Columbia, Germany, the Netherlands, and the UK. Some countries have deviated from the revenue neutrality principle, in some cases temporarily for example in Germany and Ireland. While in others, despite revenue neutrality ambitions, taxes have been revenue negative, as for example has been the case in British Columbia and the UK as tax cuts, credits and reductions in social security contributions have exceeded revenues generated from the taxes.

These countries have used various **mechanisms to recycle revenues** back into the economy, including in particular reductions in income tax rates and/or reductions in social security contributions, as well as lump-sum transfers to certain groups such as pensioners (e.g. Australia); and incentives for energy efficiency improvements (e.g. British Columbia, Denmark, Germany, Ireland, Netherlands, and UK). These reductions in social security payments and income taxes have been a driver behind some positive GDP impacts of ETR while the use of revenues for energy efficiency measures have proven valuable in encouraging fuel savings and reducing GHG emissions.

Some insights on impacts and effectiveness of ETR based on international experiences

The effectiveness of carbon-energy tax reforms varies across countries reflecting different tax designs, exemptions in place, and how revenues raised are used. Furthermore, their impact needs to be seen in the wider context of related taxes and other policy instruments in place as these also lead to GHG reductions and energy savings. In general, carbon-energy tax reforms are a relatively small subset of the overall tax burden and incentives in a country. The major source of revenue within the category of environmental taxes are from transport fuel taxes which are generally the most highly taxed and are often (with due exceptions) not part of specific ETRs. Thus, the effect of carbon-energy taxes can be difficult to identify precisely given the range of instruments and factors that drive change.

In terms of **environmental impacts**, insights from past experiences indicate that, while there have been substantial variations across countries, carbon and energy taxes have led to CO_2 savings of up to 1 per cent per year for some of the countries examined, with not dissimilar though generally slightly lower levels of energy savings. In Denmark for example, total CO_2 emissions decreased by 24 per cent between 1990 and 2001, with Danish industry reducing its CO_2 emissions by 25 per cent per produced unit from 1993 to 2000. In Sweden, average 2008-11 emissions were 12.6 per cent lower than 1990 levels, while in Finland energy and carbon taxes were found to have reduced carbon emissions by over seven per cent in 1990-1998. Carbon and energy taxes have also been found to contribute to reductions in fossil fuel use in some counties, for example in British Columbia consumption of petroleum fuels fell relative to levels in the rest of Canada (as did the province's GHG emissions).

Despite these positive trends, the overall rate of emission reductions is however insufficient to meet medium and long-term GHG emission reductions targets and to achieve full decoupling of economic growth from GHG emissions. The limited effectiveness of the taxes is often linked to the numerous exemptions and tax reductions provided to sectors with the greatest potential to achieve emission reductions. For example, in Germany, derogations for the manufacturing and energy-intensive industry lowered the overall potential positive environmental impact of the ETR, although modifications to these derogations in 2003 have been found to increase CO_2 emission reductions compared to previous calculations.

There is increasing evidence and analysis that suggests that ETR has had and can on the whole have positive effects on **GDP** growth, although there are also cases of negative effects and changes over time (Andersen 2007, Kohlhaas 2005, and Bach et al. 2002). In Finland for example, ETR is found to lead to an average increase in GDP of around 0.5 per cent in 2012, with the main reason being that the taxes fall almost exclusively on imports of energy products, thus when energy demand falls there is an improvement in the international trade balance (Andersen et al 2007). The economic impacts of a particular carbon or energy tax reform depend on design (e.g. where taxes are levied), where the burden falls (e.g. on important domestic activities), timescale (e.g. phased approach, long-term impacts on competitiveness by encouraging resource efficiency and innovation) and on the use of revenues (e.g. investing in energy efficiency improvements in affected industries).

It is also useful to underline that impacts on GDP do not provide the whole story of economic impacts of an ETR which can lead to a number of wider economic and welfare benefits. For example, British Columbia is found to have attracted green investment and green technologies at twice the Canadian average adoption of hybrid vehicles, 20 per cent of all Canadian LEED gold building registrations since 2007, and a 48 per cent increase in clean technology industry sales from 2008-10 (British Columbia Ministry of the Environment 2012). Moreover, the carbon tax has had a significant impact on the capital project decisions of local government officials (Harrison 2012). The carbon tax has been one of many factors affecting the overall economic picture of the province.

Experiences also generally show a positive impact on **employment** overall although this depends on whether and how revenues are recycled as well as the nature of the wider ETR including what other taxes or charges are reduced (e.g. labour taxes). For example an ex-post assessment of ETR in Germany with recycling was found to have positive employment effects of between 0.15 to 0.75 per cent (Truger 2008), while ETR has been shown to contribute to a growth in employment by up to 0.5 per cent in Denmark and Sweden (Andersen et al 2007). Similarly the point of application of the tax will determine where job losses may take place, as there may be losses for specific companies in a given sector but positive impacts for the economy as a whole.

Competitiveness impacts have been a key concern across all countries examined. Carbon-energy taxes have the potential to (positively or negatively) affect a nation's overall competitiveness, the competitiveness of a particular sector, and the competitiveness of individual enterprises within the economy. The analysis of experiences in 10 OECD countries indicates that to date, competitiveness concerns have not materialised and there is currently no robust evidence of actual significant negative competitiveness impacts of existing carbon-energy taxes. This reflects the relatively low price effects[2] to date and the extensive use of exemptions, reductions, and compensation mechanisms. To address competitiveness concerns, some countries have adopted a cautious approach, starting with a range of partial exemptions which are gradually reduced over time (e.g. Sweden). It is important to note that a reduction in labour taxes can increase the competitiveness of sectors less affected by taxes within the ETR and the overall competitiveness of the country, thus sectoral concerns should be seen in the context of wider national transformation and benefits.

The **social impacts** of ETR (including distributional impacts[3], impacts on consumer prices, and household income levels) strongly depend on the use of revenues within the wider revenue recycling mechanisms of the ETR and vary across applications and over time. ETR can lead to higher fuel prices which can also manifest itself in a higher consumer price index (an effect seen in Sweden and to a lesser extent Netherlands). In some cases the tax shift (e.g. reduced labour costs) in the ETR compensates for higher prices in one area (e.g. fuel) but increases income or lowers prices in another. There may therefore be a positive net impact on **income** across the economy as a whole.

In terms of **distributional impacts**, schemes in Denmark, Finland, Germany, Ireland and increasingly BC have demonstrated some elements of regressivity. Distributional impacts can be addressed through proper use of revenues on well-targeted initiatives. For example, in the Netherlands, the regressive design of the tax rates is nearly neutralised through the use of tax free allowances, tax reductions and ceilings. Similarly, means-tested heating benefits are offered in Germany, mitigating the impact of energy price increases on the poorest households (EEA 2011).

Future potential for ETR and the way forward for Switzerland

An increasing number of countries and regions are implementing various forms of ETR, including carbon-energy tax reforms. The tipping point of having enough countries adopting ETR such that it is 'the new normal' is still someway off, although there is clear progress in this direction. As experiences with ETR increase and associated benefits are better understood, one can expect more countries and regions to opt for ETR and for those that have already implemented ETR to broaden, deepen and fine-tune their systems. Despite progress, efforts today fall short of what is needed to meet long-term climate change objectives. For these and other ambitions such as energy security to be met, key issues need to be reflected in the design and implementation of ETRs as set out below.

ETRs should start with as wide a **tax base** as is politically and technically possible with gradual scheduled expansions to the coverage of the tax over time to increase the proportion of GHG emissions subject to the tax. As discussed further below, it is also advisable for **tax rates** to gradually

[2] For example, an EU-wide study examined ETR effects on six sectors (food, drink and tobacco; wood and paper; pharmaceuticals; other chemicals; non-metallic minerals' basic metals) and found that energy inputs as a share of turnover was generally around 5 per cent (over 10 per cent for 'other chemicals' in Netherlands), with expected price effects generally between 0.2 per cent and 0.4 per cent and above 1 per cent for only two sectors in Sweden (non-metallic minerals; food, drink and tobacco) (Andersen et al 2007).

[3] I.e. whether the ETR is progressive favouring poorer deciles of society, or regressive leading to a higher relative burden on poorer households.

increase over time (both through indexation to inflation and a rate escalator) with greater reflection of CO_2 emissions in the pricing itself.

Exemptions should be used sparingly (and arguably not at all) and targeted at those most affected, i.e. the subset of industry that is energy-intense[4], operate in a highly competitive market and in a sector with significant international trade. It is preferable to use partial tax reductions (rather than full exemptions) as this provides an opportunity to review and reform exemptions and keeps marginal incentives positive (Personal communication). Furthermore it would be useful not to offer exemptions for installations covered by the EU ETS while prices are at current levels, a review clause could be included to allow eventually reassessment when the EU ETS price increases.

It is recommended that where partial or full exemptions are granted, they are linked to **conditionalities,** such as voluntary agreements. Experience has shown that requiring an environmental management system can help give the issue due executive attention to encourage progress. Similarly, a requirement for regular energy audits and a commitment to investments or initiatives that have a short payback time to be eligible for the compensation could be a pragmatic solution to encourage progress. Furthermore where conditionalities are set, the opportunity should be seized to ensure communication of information by industry (e.g. to demonstrate merits of the tax reduction) to help address information asymmetry between business and public authorities and improve authorities' understanding of the potential for future ETR.

Experiences with ETR to date indicate that there have not been significant impacts on **competitiveness** – indeed if well-designed such reforms can lead to a positive impact on GDP, employment, and long-term competitiveness gains. However, observations on the lack of current competitiveness impacts do not mean that competitiveness concerns are not an issue for future ETRs. Indeed, were countries to launch increasingly ambitious ETRs (e.g. with broad tax bases and high tax rates), careful analysis would be needed and provisions put in place such as partial tax reductions for specific sectors and related conditionalities to help encourage proportional progress.

A mix of different approaches to the **use of revenues** can be considered depending on the needs of the country. For example the majority of revenues can be used to reduce other taxes which are more distortionary such as social security and employment taxes. Some revenues could be recycled to the affected sector to help keep down pressure on the sector and encourage its transformation (e.g. targeted support for 'emission-intensive trade-exposed' industrial activities in Australia). Recycling mechanisms need careful development to ensure effective incentives and encourage due dynamics in the sector (in the Australian example noted above, support varies according to degree of exposure of particular industries and is reduced by 1.3 per cent/year). In addition, the use of specific earmarking can be considered, although this needs to be designed carefully and include a target, level and timescale which take into account the needs and absorption potential in the target area. In general, earmarking should be time limited and open to review.

Possibly shrinking **revenues from carbon and energy taxes** over time can be addressed by indexing rates to inflation (e.g. as in the Netherlands) to allow a more dynamic development of tax rates, have a scheduled increase each year and/or a broadening of the tax base (e.g. as in Ireland). This should be complemented with a monitoring system which takes into account external factors such as changes in world oil prices or alternatively uses a performance indicator (e.g. similar to the

[4] There are different approaches to defining energy intense sectors - for example the German system of exemptions applies to all companies that belong to specific statistical classifications while in Denmark special tax provisions are only granted to specifically designed production processes. The COMETR study used the indicator of energy input as a percentage of turn-over and used 10 per cent as a pragmatic threshold. They also discuss the 5 per cent rate but note that with price elasticities, even a 50 per cent increase in tax rates would generally not have an overall price impact of more than 2.5 per cent which is within many sector's capacity to either absorb and pass on (Andersen et al 2007).

existing scheme in Switzerland). Another approach is to reduce exemptions and tax reductions over time which can be considered environmental harmful subsidies (EHS) needing reform (see Withana et al 2012 and Oosterhuis and ten Brink 2013 forthcoming). In the long-term, a broadening of the energy elements of the tax will need to make up an ever greater share of the ETR if revenues are to be maintained. However revenues here may also be eroded if energy demand falls and the rationale for an energy tax would not be the same as and when environmental issues are addressed.

All instruments have the potential to evolve, and indeed need to evolve with changes in the economy, society, and environmental contexts, as well as changes to the wider policy instrument mix in which the ETR is embedded. Thus, it is important to have **monitoring systems** to review progress every three-five years to assess how things are developing against set criteria and adjust the system where needed. Within the EU, regular reporting on environmental satellite accounts that note environmental taxes, and developing inventories of EHS should provide regular windows of opportunity to revise and fine-tune ETR systems in light of results and to reflect priorities of the day.

In terms of **insights for Switzerland**, ETR can support Swiss objectives set out in the Energy Strategy 2050 by providing necessary price signals to incentivise a reduction in energy consumption. It can also contribute to objectives to reduce CO_2 emissions by facilitating fuel switching and innovation. Options to revise existing energy and CO_2 taxes include gradual expansion of the tax base to increase the coverage of GHG emissions, e.g. expanding the CO_2 tax to cover transport fuels; further increasing CO_2 tax rates applied to heating and process fuels; and reducing exemptions over time.

Meeting Switzerland's objective for revenue neutrality requires careful design and can be supported by complementary EHS reform. Potential revenue recycling measures could include tax reductions and/or redistributions to affected households and companies (using flat rates or other schemes). Avoiding regressivity impacts requires an analysis of likely impacts and careful consideration of potential mechanisms such as non-regressive tariff setting where possible (e.g through rising block tariffs) or other tools (e.g. refunds linked to electricity bills as in the case of the Netherlands). "Means testing" can be a useful way of avoiding inefficient use of refunds and reductions.

To avoid negative impacts on competitiveness, selected partial reductions from the tax can be introduced targeted at the most exposed sectors, e.g. energy-intensive, trade-exposed sectors. These exemptions should be carefully designed and entail partial tax reductions rather than full exemptions to maintain a positive incentive. Furthermore, exemptions should be linked to conditionalities and also entail information provision requirements. Conditionalities can be designed such that they are more demanding if exemptions granted are significant (i.e. full exemptions), and less demanding if only a small advantage is given. Finally a monitoring system should be put in place to review progress every three to five years.

A combination of the above mentioned options of broadening the tax base, increasing the tax rate applied, removing exemptions over time and replacing this with (ever decreasing) tax reductions, as well as a wise use of revenues raised, could help to meet Swiss objectives to phase out nuclear electricity production as well as contribute to wider objectives relating to climate change and energy efficiency, competitiveness and social considerations.

All regions and countries will watch their neighbours, trading partners and what vanguard countries or regions are doing or planning. As others implement revise ETR, new opportunities arise for mutual learning and considering new initiatives domestically. Progress will likely be a series of pragmatic steps forward, often small (relative to the overall goal), but each essential. Together they will have the potential to reach the range of objectives set by policy makers and needed on environmental, economic and social grounds.

CONTENTS

1. INTRODUCTION

1.1 Brief background to environmental tax reform

Environmental tax reform (ETR) refers to ‘changes in the national tax system where the burden of taxes shifts from economic functions, sometimes called 'goods', such as labour (personal income tax), capital (corporate income tax) and consumption (VAT and other indirect taxes), to activities that lead to environmental pressures and natural resource use, sometimes called 'bads'’ (EEA 2005). Several recent reports underline the benefits of carefully designed ETR in spurring innovation, improving competitiveness, encouraging energy savings, improving income distribution, contributing to environmental (including climate) objectives, and as a potential new source of government revenue (see for example OECD 2010, EEA 2011, IMF 2012). At the same time, ETR can lead to negative impacts including on income distribution and competitiveness, particularly when introduced unilaterally (Speck 2009). Thus, careful design of the process is warranted to avoid possible negative implications and achieve the positive potential inherent in shifting tax burdens and making use of the revenues raised (Heine and Parry 2012).

ETRs were initially introduced in the early 1990s among Nordic countries, in most cases as part of wider tax shifting programmes to reduce relatively high labour taxes and stimulate employment. This practice gradually extended to a number of other European countries including the Netherlands, Germany, and the UK in the late 1990s and early 2000s. The momentum behind ETR has continued to grow over the years. A number of countries within the EU (e.g. Ireland) and other OECD countries have recently initiated ETR efforts at the national (e.g. Australia, Japan) and sub-national level (e.g. British Columbia in Canada, California in the US). Plans to introduce some form of ETR are also under consideration in emerging and developing economies including China, India and South Africa. In a number of cases, ETR has included the introduction or revision of carbon and energy taxes. Other measures include water pricing, landfill taxes, taxes on commodities and natural resources, as well as renewed interest in the reform of environmentally harmful subsidies as part of wider fiscal reform efforts (Withana et al 2012).

Despite these developments, such taxes are not widely used across the global economy reflecting the fact that ‘citizens and consumers are not familiar with the efficiency features of the price mechanism in a market, and that distributive or power issues take precedence over efficiency issues in the political process, shaping the choice of environmental policy instruments’ (Barde and Godard 2012). Thus, there remains scope for the increased application and more effective use of such instruments in the wider policy mix.

It is against this backdrop and within the context of the decision to phase-out nuclear energy that Switzerland is considering a reform of its carbon-energy tax system. The decision to phase-out nuclear is significant as nuclear energy currently provides 40 per cent of Switzerland’s electricity generation and will require major changes over the next two decades in relation to demand (improving energy efficiency, reducing oil consumption in the heating sector) and supply (promoting renewables, developing new base load capacity including gas-fired capacity, and increasing imports) as well as efforts to encourage energy technology research, development and demonstration (IEA 2012). Switzerland is currently considering the introduction of an ETR as a possible instrument to contribute to the objectives of the 2050 Energy Strategy which include a commitment to phase-out nuclear energy as well as objectives relating to climate change, energy security, energy efficiency, and investments in power plants and the electricity grid.

1.2 Objectives and scope of the study

This study seeks to inform preparations to revise carbon-energy taxes in Switzerland by providing an overview of experiences with carbon and energy taxes in selected OECD countries. It aims to provide insights from relevant literature and international experiences on key issues relating to the introduction and implementation of carbon and energy taxes, including the design of taxes (objectives and rationale, tax rates and adjustments over time, tax base, revenue raised, revenue use, exemptions granted), as well as the environmental effectiveness of the taxes and their economic and social impacts.

This study was carried out by the Institute for European Environmental Policy (IEEP) between January and May 2013. The tasks of the study were to develop an overview of carbon and energy taxes in selected OECD countries and examine the environmental effectiveness and economic impacts of these systems (Tasks 1 and 2); identify future plans for the introduction of carbon and energy taxes in OECD countries (Task 3); explore the transferability of experiences to the Swiss model and draw some recommendations for Switzerland (Tasks 4 and 5). The primary aim has been to provide insights on international experiences in implementing carbon and energy taxes, thus the particular focus of the study has been on Tasks 1-3.

This study is based on a review of existing literature (including ex-post evaluations and ex-ante simulations, in particular for taxes that have been introduced recently) and consultation with experts. The work focused on 10 case studies of existing carbon and energy taxes and six cases of plans to introduce carbon taxes in OECD countries (see Table 1.1), and was complemented by a wider review of the ETR literature. The case studies were selected from a long list of cases in light of whether they have interesting design features, impacts and issues of relevance for Switzerland. The study will feed into the report of the Federal Finance Administration (FFA) on carbon-energy tax reform which is to be submitted for consultation in summer 2013.

Table 1.1: Overview of cases examined in this study

Existing carbon or energy taxes	- **Australia** - 'Carbon Pricing Mechanism' (CPM) introduced in 2012 - **British Columbia in Canada** – CO_2 tax introduced in 2008 - **Denmark** – CO_2 tax introduced in 1992 - **Finland** – CO_2 tax introduced in 1990 - **Germany** – ETR in 1999 by increasing existing energy taxes and new electricity tax - **Ireland** – CO_2 tax introduced in 2009 - **Netherlands** – ETR introduced with regulatory energy tax in 1996 - **Norway -** CO_2 tax introduced in 1991 - **Sweden –** CO_2 tax introduced in 1991 - **United Kingdom** – Climate Change Levy introduced in 2001
Plans to introduce carbon taxes	- **Czech Republic** – Proposal for a carbon tax put forward in April 2012 - **France** – Failed proposal for carbon tax in 2009 - **Italy** – Proposal for a carbon tax as part of General Tax Reform approved in April 2012 - **Japan -** "Tax for Climate Change Mitigation" introduced in October 2012 - **United Kingdom** - Carbon Price Floor applied from April 2013 - **United States** – Draft Bill to tax CO_2 emissions proposed in February 2013

Report structure

This is the final summary report of the study, synthesising insights on the design of carbon and energy taxes (Chapter 2), impacts of the taxes (Chapter 3), and an overview of plans to introduce carbon taxes in selected countries (Chapter 4). Chapter 5 presents a synthesis of the main conclusions of the study and some insights on the way forward for Switzerland. The full case studies are presented in Annex 1 and 2 and an overview of carbon and energy tax rates provided in Annex 3.

2. INTERNATIONAL EXPERIENCES IN DESIGNING CARBON AND ENERGY TAXES

2.1 Introduction

A key aim of this study has been to identify, analyse and compare experiences in implementing carbon and energy taxes in selected OECD countries. Based on a review of recent studies, documentation and databases on ETR as well as consultation with experts, 10 countries were selected for further analysis: Australia (AU), British Columbia in Canada (BC), Denmark (DK), Finland (FI), Germany (DE), Ireland (IE), Netherlands (NL), Norway (NO), Sweden (SE), and the United Kingdom (UK) (see Table 2.1 for brief description). Detailed case studies were developed on each country and are provided in Annex 1. The case studies assess the design and implementation of the carbon or energy taxes in place, their environmental effectiveness, economic and social impacts.

There are a number of other countries and regions where carbon and/or energy taxes have been introduced. For example in Europe, this includes Slovenia which was the first country in central and eastern Europe to introduce a CO_2 tax in 1997 (EEA 2005), Austria which introduced an energy tax on coal, electricity and gas in 1998 and a coal levy of EUR 19/t CO2 in 2004 (EEA 2005), and the Czech Republic which launched a three-stage ETR process in 2007 which involved *inter alia* the introduction of new taxes on natural gas, solid fuels , electricity, and supplements to existing charges on mineral oils (Šauer et al, 2011). While these experiences no doubt also offer interesting insights, it was not possible to examine them within the scope and time available for this study.

Table 2.1: Overview of selected international experiences with carbon and energy taxes

Country / region	Brief description
AU	The 'Carbon Pricing Mechanism' (CPM) applied from July 2012. For the first three years, the carbon price will be fixed (i.e. carbon tax), before moving to an emission trading scheme in 2015.
BC	A CO_2 tax was introduced in July 2008 and applies the same price for every unit of GHG emissions from fossil fuel combustion across the economy. The tax started at a moderate level, it gradually increased at a set schedule, and is designed to be revenue neutral.
DK	A CO_2 tax was introduced in 1992 on energy products consumed by households and extended to businesses in 1993. In addition, an energy tax is applied to bottled gas, fuel oil, gas oil, coal, electricity and natural gas as well as a SO_2 tax.
FI	Finland was the first country to introduce a CO_2 tax in 1990. The energy and CO_2 tax system has subsequently developed through a number of stages influenced by other instruments, EU policy, concerns regarding the violation of trade agreements and party political aims.
DE	ETR was introduced in 1999 by gradually increasing existing taxes on transport fuels, natural gas, light heating and heavy oil fuels and introducing a new electricity tax. The reform included a number of derogations for manufacturing and energy-intensive industries.
IE	A CO_2 tax was introduced in December 2009 and has been phased in over three stages from 2009-2013. The tax applies to CO_2 emissions from non-ETS sectors.
NL	The (regulatory) energy tax was introduced in 1996 and applies to energy products used for heating and electricity generation by households, small businesses and intermediate firms.
NO	A CO_2 tax was introduced in 1991 on the consumption of petrol, auto diesel oil, mineral oil and the offshore petroleum sector. The tax forms part of the Norwegian excise duty scheme on fossil fuels, which also includes an energy tax and a SO_2 tax.
SE	A CO_2 tax was introduced in 1991 followed by a 10-year 'green tax-shifting programme' from 2001–2010. In 2009 a number of exemptions in place to protect the competitiveness of energy intensive industries were removed.
UK	The climate change levy (CCL) was introduced in 2001 and applies to electricity, natural gas, liquid petroleum gas (LPG) and other gaseous hydrocarbons, coal and lignite, coke, and semi-coke of coal or lignite, and petroleum coke used by industries, business and the public sector.

Sources: For further detail, please see country case studies in Annex 1

A variety of considerations affect the design of a carbon or energy tax including political, economic, legal and technical issues. This is reflected in the different approaches taken to the design of carbon and energy tax systems in countries. This chapter provides an overview of insights from relevant literature and practices in 10 OECD countries on various aspects of tax design including objectives and rationale, the tax rates applied (and adjustments over time), the scope of the tax base, the system of exemptions in place, revenues raised and how these revenues are used. For more detail on individual country experiences, please see case studies in Annex 1.

2.2 Objectives and rationale of carbon and energy taxes

2.2.1 Introduction to the issue

Carbon and energy taxes may be introduced for a variety of reasons including economic, financial, social and environmental concerns. The underlying objectives vary depending on national or local circumstances and may evolve over time. For example taxes may be introduced to help address environmental problems such as climate change, local pollution and congestion. They may be a means of encouraging fuel security by decreasing demand, reducing fuel import bills and national balance of payments. Alternatively taxes may be seen as a means of raising revenues either for the general government budget or for specific purposes such as the maintenance of transport infrastructure or to encourage the development of renewable energy (OECD 2013). Most energy taxes were historically put in place to raise revenue with rates increased to help reduce oil dependency, decrease fuel import bills, and improve economic resilience to oil price volatility in light of the 1973 and 1979 oil price shocks. Climate change concerns have only become a driving force over the last two decades.

Introducing or reforming carbon and energy taxes should also in principle be coherent with wider policy objectives such as economic development as well as social concerns including equity considerations (see discussions in Chapter 3). These wider objectives are reflected in the design and implementation of carbon and energy taxes (and associated measures), for example taking into account potential negative impacts of the taxes on the competitiveness of domestic industry and income distribution among households (OECD 2013).

2.2.2 Examples from practice

The introduction of carbon and energy taxes is often motivated by a combination of environmental, economic and social factors - see Table 2.2 for an overview.

In the early 1990s when carbon and energy tax reforms were first being introduced among certain Nordic countries, ETR was part of wider tax-shifting programmes to help offset some of the revenue losses caused by reductions in relatively high labour taxes which were being made to stimulate employment. For example in Finland, early ETRs were used as a means to partly compensate the fall in revenues from the reduction in income taxes and employers' social security contributions as well as achieve environmental objectives. This was also the case in Denmark, Sweden and Germany.

In certain cases, environmental objectives have been a key driver for the introduction of carbon or energy taxes. For example in Australia the Carbon Pricing Mechanism (CPM) was introduced in 2012 as a central part of the Federal Government's plan to move to a clean energy future. In Norway, a CO_2 tax was introduced primarily as a means of reducing CO_2 emissions from the petroleum industry and stimulating low carbon technologies specifically in the sector.

In recent years, ETR has been advocated as a revenue raising tool which can contribute to fiscal consolidation needs of certain governments and provide a more efficient tax system (IMF 2012). For example, the need to raise government revenues was a key factor driving the introduction of a carbon tax in Ireland in 2009 which was seen as a important revenue raising mechanism as well as a means to help reduce GHG emissions. This followed a failed attempt to introduce a carbon tax in Ireland in the early 2000s.

Objectives behind an ETR may also change over time. For example in Sweden, early ETR efforts were part of a broader tax shifting operation that strengthened environmental taxes and reduced taxes on labour. With the introduction of the CO_2 tax in 1991, the focus moved more towards environmental protection, even though the principle of tax-shifting still applied. The reform in 2009 moved the focus even further towards environmental protection, removing a number of exemptions that were in place to protect the competitiveness of energy intensive industries.

Table 2.2: Overview of objectives and rationale for the introduction of carbon and energy taxes

Country / region	Objectives and rationale
AU	Support objective to reduce GHG emissions by 25 per cent by 2020 and by 80 per cent by 2050 compared to 2000 levels.
BC	Support objective to reduce GHG emissions by at least 33 per cent by 2020 below 2007 levels.
DK	Energy taxes increased to support reduction in taxes on personal income, employers' social security contributions and pension savings. CO_2 tax introduced to support objective to reduce GHG emissions by 25 per cent by 2005 and subsequently by 21 per cent in 2008-2012 both compared to 1990 levels.
FI	Partly compensate fall in revenues from reduction in income tax rates and employers' social security contributions, influence energy production and promote energy efficiency.
DE	Reduce labour costs by decreasing employers' and employees' statutory pension contributions and thus mitigate negative impacts on competitiveness.. Also encourage more efficient use of energy by incentivising energy savings and promoting renewable energy.
IE	Contribute towards revenue raising objectives necessitated by the fiscal crisis. Also help reduce GHG emissions in non-ETS sectors by 20 per cent by 2020 compared to 2005 levels.
NL	Incentivise energy efficiency improvements among small-scale consumers with the ultimate purpose of reducing GHG emissions by 30 per cent by 2020 compared to 1990 levels.
NO	Reduce CO_2 emissions from the petroleum industry and stimulate low carbon technologies in the sector. Committed to the objective of becoming carbon-neutral by 2050.
SE	Goals changed from reducing revenue losses caused by cuts in personal income tax towards supporting environmental targets including reducing energy intensity by 20 per cent, achieve a share of at least 50 per cent renewable energy in gross final consumption and 10 per cent in transport, and reduce GHG emissions by 40 per cent all by 2020.
UK	Integral part of the UK climate change programme for meeting Kyoto target and domestic goal to reduce GHG emissions by at least 34 per cent by 2020 and at least 80 per cent by 2050 compared to 1990 levels.

Sources: For references, please see country case studies in Annex 1

2.3 Tax base

2.3.1 Introduction to the issue

The tax base of an environmental tax represents the 'cause of the environmental impact that the tax seeks to discourage' (Herrera Molina 2012). It is measured in monetary units (e.g. price of a vehicle) or in units of the taxed good (e.g. volume of fossil fuels produced) and can be distinguished from the taxable event which defines (in legal terms) the environmentally damaging conditions which trigger the tax (e.g. the atmospheric pollutants on which a tax is applied) (Herrera Molina 2012).

The tax base is affected by considerations of administrative costs. For instance if marginal administrative costs increase with an expansion in coverage of the tax (e.g. to cover non-CO_2 GHG emissions), there is a trade-off between the tax's emission coverage and its administrative feasibility (Metcalf and Weisbach 2009 cited in Heine et al 2012). Moreover, administrative considerations also influence where the tax is applied and depend on the structure of the economy (e.g. levying a tax upstream may be preferable in cases where there are many small-scale stationary emitters) (Heine et al 2012). The tax base should be designed in such a way as to ensure it is effective (i.e. in meeting its objectives) and practical (i.e. it can be assessed and controlled without disproportionate resources) (Herrera Molina 2012).

2.3.2 Examples from practice

The tax base varies across countries (see Table 2.3 for an overview). Some countries focus on a narrow set of energy carriers and users, for example in Australia the carbon tax only applies to around 500 of the countries 'large emitters' (i.e. those which generate over 25,000 tonnes of CO_2-e emissions each year). While others adopt a much wider approach, for example in British Columbia the carbon tax covers GHG emissions from the combustion of all fossil fuels in the province (plus peat and used tires when used to produce heat or energy).

In certain countries, the tax base has gradually expanded over time to cover a wider number of energy products and/or users. For example in Ireland, the carbon tax has been implemented in three phases: it applied to transport fuels (petrol and auto-diesel) from December 2009; to non-transport fuels (kerosene, marked gas oil, fuel oil, LPG and natural gas) from May 2010; and to solid fuels (coal and commercial peat) on a phased basis from May 2013. In Denmark, when introduced in May 1992, the CO_2 tax only applied to energy products consumed by households, it was expanded in January 1993 to also cover businesses. In the Netherlands the tax base of the regulatory energy tax has been broadened since its introduction in 1996 to include consumption by intermediate firms. Such gradual expansions in the tax base allow actors time to adapt to pricing signals and enable learning from experiences in the application of the tax.

How the tax rate is calculated is another important issue. In some countries the rate is determined by the energy and/or CO_2 content of the fuels to which it applies. For example in Finland, the fuel duty is divided into an energy component (largely based on energy content but differentiated according to local emissions of CO_2) and a CO_2 component (based on a lifecycle approach to CO_2 emissions). The structure of the Finnish carbon tax was revised in 1994 to introduce an energy component so as to take into account the externalities involved in nuclear power and reduce the fiscal advantage to nuclear energy (Sairinen, R., 2012). In others, such as Germany, the energy tax rate is based on quantity and does not take account the CO_2 content or energy intensity of the fuel, in Norway the tax rate is not fixed per tonne of CO_2 but is set at specific rates per fuel, while in the UK the CCL is based on the energy content of each energy product and does not reflect the carbon content (EEA, 2005). If the rates of the CCL are expressed as an implicit tax per tonne of CO_2, the tax on coal is considerably less (GBP 4.30/tonne of CO_2) than on electricity and gas (both of which are approximately GBP 8.10/tonne of CO_2). While the lower tax on coal reflects a political decision to avoid adverse effects on the mining industry, it penalises switching from coal to lower-carbon fuels (Fullerton, 2008).

Table 2.3: Cross-country comparison of tax bases

Country / region	Tax base
AU	- 'Large emitters' (which generate over 25,000 tonnes of CO_2-e emissions /year). - Based on tonnes of CO_2 equivalent emissions produced by a liable entity in a year.
BC	- GHG emissions from combustion of all fossil fuels (peat and used tyres when used to produce heat or energy). - Based on CO_2 equivalent emissions of the fuel.
DK	- Energy tax: all fossil fuels and electricity. Tax rate applied varies according to energy content of fuel and indexed to inflation. - CO_2 tax: oil, coal, gas and electricity, where rate based on CO_2 content.
FI	- Motor petrol, diesel oil, light and heavy fuel oil, kerosene, aviation petrol, coal, natural gas, bio-substitutes. - Rate based on energy content component and CO_2 component.
DE	- Mineral oil products, natural gas, liquefied natural gas, and electricity. Minimum tax rate on coal used for heating introduced in 2006. - Rate based on quantity and does not take into account CO_2 content or energy intensity of the fuel.
IE	- Transport fuels (petrol, auto-diesel), non-transport fuels (kerosene, marked gas oil ('green diesel'), fuel oil, LPG, natural gas), solid fuels (coal, commercial peat). - Rate based on carbon content of the fuel.
NL	- Fuel tax: all refined mineral oils, coal, coal products, natural gas. Since 1992, fuels are taxed according to energy and carbon content. - (Regulatory) energy tax: energy products used for heating and electricity generation by households and small businesses. Rates partly based on carbon content of fuels and raised in line with inflation.
NO	- Consumption of petrol, auto diesel oil, mineral oil, offshore petroleum sector, natural gas, LPG. - Rate set at specific rates per fuel.
SE	- Fossil fuels for heating purposes, motor fuels and electricity use - Rate based on energy content component and CO_2 emission component
UK	- Consumption of electricity, natural gas, LPG and solid fuels by industry, business and public sector. - Rate based on energy content of different energy products.

Sources: For references, please see country case studies in Annex 1

The CO_2 emissions covered by carbon taxes vary substantially between countries (see Table 2.4). When considering the GHG or CO_2 coverage of a tax, one needs to keep in mind the explicit and implicit carbon taxes imposed on energy products (see discussion in section below on tax rates). For example in the Netherlands, 'most energy products that contribute to climate change emissions are taxed either directly or indirectly' (Vollebergh 2008). The CO_2 emissions covered by carbon taxes vary substantially across different countries, ranging from around 30 per cent in Finland and the UK to above 70 per cent in British Columbia and Norway.

Table 2.4: Proportion of CO_2 emissions covered by carbon taxes

Country / region	Estimated proportion of CO_2 emissions covered by carbon tax[5]
AU	60 per cent of GHG emissions[6]
BC	70 per cent[7]
DK	59.1 per cent
FI	32.6 per cent
DE	*N/A –energy tax with no carbon component*
IE	60.4 per cent[8]
NL	58.5 per cent – *energy tax with a carbon component*
NO	75.2 per cent[9]
SE	41.2 per cent
UK	35.4 per cent
CHE	35.3 per cent

Source: Own calculations based on data in OECD (2013) on the taxation of energy on a carbon emission basis and tax base – energy use – expressed in thousands of tonnes of CO_2 in respective countries complemented by additional literature – See Box 2.1 for explanation of calculations.

Box 2.1: Calculating $C0_2$ emissions covered by carbon taxes and understanding CO_2 taxes in the wider context of energy taxation

The figure below (replicated from OECD 2013) presents the implicit CO_2 tax rate for different fuel uses in Denmark (represented by the height of the grey bars). The implicit CO_2 tax rate is equal to total taxes in place on the fuel (most elements are generally not set using CO_2 criteria) and CO_2 emissions associated with that fuel (which is calculated based on the carbon content of the fuel). The width of the bars shows the amount of CO_2 emissions from that fuel source (and hence the area of the bar indicates revenues from the tax).

The figure also indicates the explicit CO_2 tax rate in place in Denmark – shown by the dark horizontal line for transport fuels, some heating and process fuels and for electricity. Where there is no grey bar, there are no taxes in place. Where there is no dark horizontal line, there are no CO_2 taxes in place. The levels of the bars show the different tax burdens in place on fuels. The dark horizontal lines indicate the different CO_2 tax rates in place which in this case is relatively uniform across fuels and not dissimilar to the 2010-11 EU ETS price (marked with an 'x' in the figure).

One can calculate the proportion of CO_2 emissions covered by the CO_2 tax in place by summing the breadth of the horizontal lines and calculating its share of the total CO_2 emissions from energy use. For Denmark, according to this calculation, the CO_2 tax covers 59.1 per cent of CO_2 emissions from fossil fuels as indicated in Table 2.4 above. This includes emissions from the transport sector which represents 25 per cent of all energy use and emissions from fuel use in Denmark (OECD 2013).

The figure also shows the relatively small contribution of the CO_2 tax within the wider energy tax context. Note that there is no tax applied on oil products linked to heating and process use as Denmark grants exemptions for those processes covered by the EU ETS.

[5] Calculations of carbon tax coverage of fossil fuels while other estimates indicated in references look at overall taxes on GHG emissions which can include other GHGs and also non-fuel sources of CO_2.

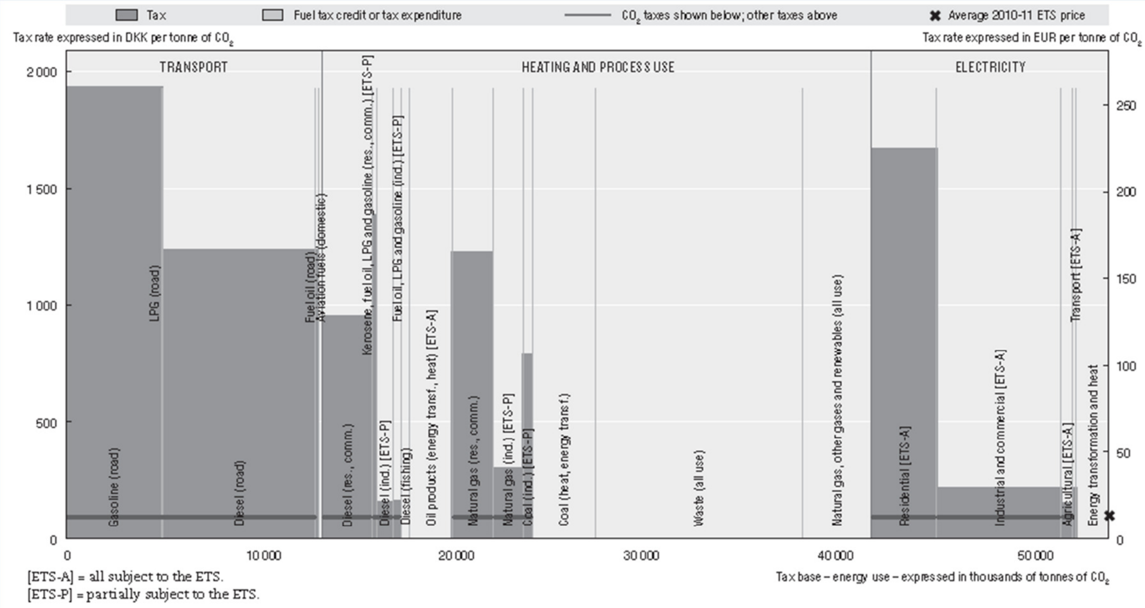
[6] Based on estimates by the Australian Government in Australian Government 2011.

[7] Based on figures in Harrison 2012.

8 According to an estimate by the Irish National Economic and Social Council, the Irish carbon tax covers round one third of total GHG emissions (NESC 2012).

[9] According to estimates by the IEA, the Norwegian CO_2 tax covers about 68 per cent of CO_2 emissions from the economy and 52 per cent of all GHG emissions (IEA, 2013a).

Figure 2.1: Taxation of energy in Denmark on a carbon emission basis



Source: OECD (2013) Taxing Energy Use – A Graphical Analysis, OECD Publishing, 28 Jan 2013

2.4 Tax rates applied

2.4.1 Introduction to the issue

In principle, there are different ways of deciding upon the tax rate to be applied. The tax rate can be set based on technical criteria which take into account the external costs of the polluting activity (i.e. in line with Pigouvian principles such that the tax rate is set at a level at which marginal social costs equals the marginal benefit from emitting an additional unit of pollution), or alternatively given data and methodological difficulties in measuring such externalities, at a level considered necessary to limit polluting emissions to meet particular environmental targets (i.e. in line with the Baumol-Oates 'standard price approach' which offers a more pragmatic way of setting tax rates) (Speck 2013). Alternatively, the tax rate can be set based on political considerations (i.e. a level which is considered acceptable to taxpayers or the wider public) (Herrera Molina 2012).

In reality the level of taxation set and its evolution over time often reflects a combination of both technical and political aspects. It is generally a type of negotiated outcome which is often low in early years and increased over the years to give companies, consumers and the market time to respond to the pricing regime and hence avoid potential negative effects of the abrupt imposition of new tax burdens.

2.4.2 Examples from practice

The tax rates applied in different countries varies significantly. High energy taxes on fuel and electricity as well as high CO_2 taxes on fossil fuels effectively steer demand through environmental signals, putting an implicit price on carbon, while at the same time providing a source of state revenue (IEA, 2013). As most countries impose relatively high energy or excise taxes on fuels, the implicit tax (also sometimes referred to as the effective tax) applied on carbon tends to be higher than the explicit nominal carbon tax (NESC 2012). The overall incentives on energy demand, fuel use, and fuel switching, is affected by the relative tax burdens rather than the level of CO_2 tax alone.

Thus, an assessment of CO_2 taxes in isolation of energy taxes is distorting in particular when one examines the total tax burden on different energy products (Speck 2013).
The explicit CO_2 tax rates applied in the 10 OECD countries examined are set out in Table 2.5. For comparison purposes, the carbon tax rate in Switzerland and the average EU ETS price for 2012 are included in the table. The rates applied vary both across countries and within countries in terms of the energy product to which the tax is applied. Rates range from a rather high level in Sweden of SEK 1080 (EUR 118)/t CO_2 and for certain products in Finland (transport fuels) and Norway (petrol); to more moderate rates of between EUR 20-30/t CO_2 for example in Australia, British Columbia, Denmark, Finland (heating fuels), and Ireland (petrol, auto-diesel, kerosene, marked gas oil, LPG, fuel oil, natural gas); and lower rates of between EUR 6-18 /t CO_2 for example in UK and Ireland (solid fuels). For a more detailed overview of energy and CO_2 tax rates applied in the 10 countries, see Annex 3.

Table 2.5: Explicit CO_2 tax rates applied in selected OECD countries

Country/ region	**Explicit CO_2 tax rate where applied** (in EUR per tonne CO_2)
AU	AUD 23 (EUR 18.6)/t CO_2 on 1/7/2012
BC	CAD 30 (EUR 23.3)/t CO_2 on 1/7/2012
DK	EUR 21.3/t CO_2 in 2012
FI	EUR 60/t CO_2 (transport fuels), EUR 30/t CO_2 (fuels for heating) from 1/1/2012
DE	*No carbon tax*
IE	EUR 20/t CO_2 (petrol, auto-diesel, kerosene, marked gas oil, LPG, fuel oil, natural gas) in 2012; EUR10/t CO_2 (solid fuels) from 05/2013
NL	*No carbon tax*
NO	Depend on energy product, range from NOK 101 (EUR13.7)/t CO_2 (heavy fuel oil), to NOK 225 (EUR 30.5)/t CO_2 (natural gas, light heating oil) and NOK 384 (EUR 52.1)/t CO_2 (petrol) in 2012
SE	SEK 1080 (EUR 118)/t CO_2 in 2012
UK	CCL equivalent to EUR 12.0/t CO_2 (natural gas), EUR 8.8/t CO_2 (petroleum), EUR 6.4/t CO_2 (coal)
CH	SFR 36 (EUR 30)/ t CO_2 in 2013
EU ETS rate	Between EUR 6 and 10/t CO_2 eq. in 2012[10]

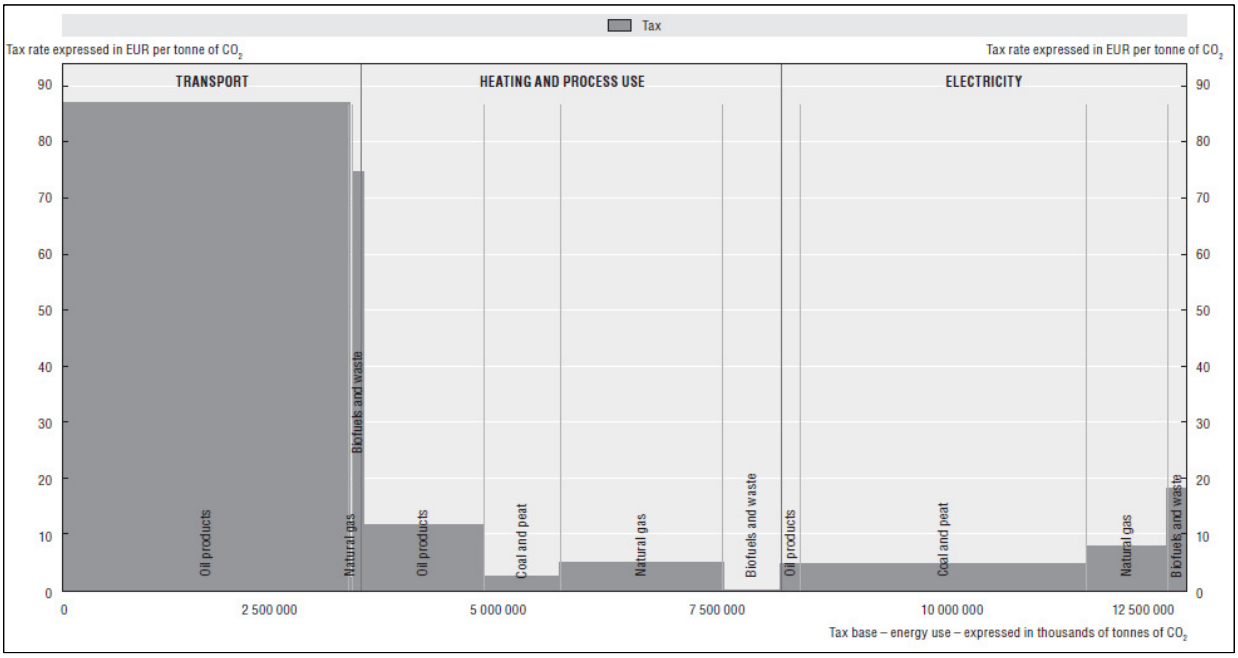
Source: See country studies and associated references in Annex 1.

Energy and CO_2 tax rates applied also tend to vary significantly across fuel types and fuel uses. The CO_2 tax in British Columbia is an exception as the same price is applied to every unit of GHG emissions from fossil fuel combustion across the economy (Jaccard 2012), thus all sectors and activities are treated the same (British Columbia Ministry of the Environment 2012). Figure 2.2 provides an illustration of the weighted average implicit tax rate across five fuel categories in terms of carbon content in OECD countries (recall also Figure 2.1 for Denmark for a country specific example). Figure 2.3 provides an illustration of implicit tax rates applied on different energy products in seven OECD countries. For more detail, see country profiles in OECD 2013,[11] case studies in Annex I and overview table in Annex 3 of this study.

[10] EC (2012) Report from the Commission to the European Parliament and the Council - The state of the European carbon market in 2012 , (COM(2012)652)

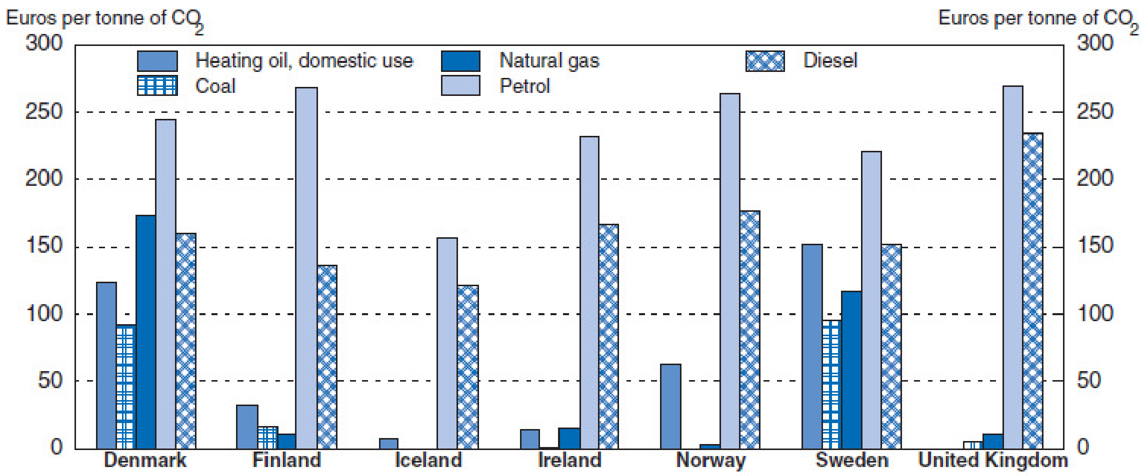
[11] Note that OECD 2013, converts taxes levied on energy products on a physical basis such as volume or weight (including carbon taxes) into implicit tax rates per gigajoule of energy and per tonne of CO_2 emissions. A number of caveats should be kept in mind when comparing such figures. For example, the publication calculates the average implicit tax rate on CO_2 based on overall energy consumption across different energy uses (transport, heating and process, electricity). While this provides an average figure, it can be misleading as it does not reflect differences across energy uses. Furthermore, OECD calculations are not consistent across countries as they do not include taxes set by reference to the value of products or that apply to a broad range of goods, royalties and other levies, and taxes related to energy use but not imposed directly on the fuel, e.g. vehicle taxes and road user charges (OECD 2013). This has implications on how one interprets figures. For

Figure 2.2: Implicit taxes on energy in the OECD on a carbon content basis



Source: OECD (2013), Taxing Energy Use: A Graphical Analysis, OECD Publishing, see pg. 36

Figure 2.3: Implicit tax rates in selected OECD countries (in EUR/tonne of CO_2, 2010 figures)



Source: Braathen 2001 cited in OECD (2012) OECD Economic Surveys – Denmark

Figures 2.2 and 2.3, as well as the data provided in Annex 3 illustrate the variation in tax rates applied on different energy products. On average, implicit taxes on transport seem to be relatively high across OECD countries whereas implicit taxes on heating and process fuels and electricity are relatively low. There also tends to be substantial variation in rates across users, in particular between households and industry. In Denmark for example, the CO_2 tax rate varies between households and industry, with the actual implicit tax rate for industry is lower than the rate applied to households, and considerably lower when voluntary agreements are in place (Speck et al 2006).

example the exclusion of road user charges leads to overstated figures for countries which do not apply road charges but use a certain proportion of revenues from energy taxes for financing road infrastructure (such as in Switzerland) and provides lower estimates for those countries which rely heavily on road charges for financing road infrastructure.

This approach has had more to do with political issues than economic ones as it was seen as a necessity in a small country with high export ratios in trade-sensitive industries (Andersen 2005).

In several countries, the tax rate applied has been adjusted over time – see Box 2.2. In some cases these adjustments have been gradual and scheduled to minimize potential adjustment costs (Rivers and Schaufele 2012). For example in British Columbia the tax rate had four scheduled annual increases of CAD 5 (EUR 4) per tonne of CO_2 while in Australia, the carbon price is set to rise by 2.5 per cent each year in real terms during the fixed price stage (July 2012 - June 2015). In other countries, regular reviews of taxes have led to increases in the rate applied as for example has been the case in Norway where tax rates are reviewed annually and changed on a regular basis. A number of countries have also indexed increases in tax rates to inflation, for example energy taxes in the Netherlands (since 1999), Sweden (since 1995) and Denmark (since 2008).

Box 2.2: Evolution of tax rates over time

- In **Australia** during the fixed price stage (1 July 2012 - 30 June 2015), the carbon price will start at AUD 23 (EUR 18.6) per tonne and rise by 2.5 per cent each year. From 1 July 2015, the price will be set by the market; a price ceiling will be set at AUD 20 (EUR 15.6) above the expected international price for the first three years, rising by 5 per cent each year.

- In **British Columbia** the tax rate applied was CAD 10 (EUR 8) per ton of CO_2 equivalent on 1 July 2008 with four scheduled annual increases of CAD 5 (EUR 4) to reach CAD 30 (EUR 24.2) on 1 July 2012.

- In **Denmark** energy and carbon taxes increased throughout the 1990s however nominal tax rates were frozen from 2002-2007 which led to a reduction in the real value of the tax rates. From 2008, energy taxes have been indexed to inflation and the CO_2 tax rate increased by 1.8 per cent each year.

- In **Germany** ETR was designed for gradual introduction between 1999 and 2003. No further increases were foreseen at the time. Since energy taxes have remained unchanged since 2003 (apart from some changes in 2006), taxes have decreased in real terms since then.

- In **Finland** the tax rate increased from EUR 1.12/tonne CO_2 in 1990 to EUR 20/tonne CO_2 in 2010 influenced by various factors including EU policy, concerns regarding violation of trade agreements and party political aims.

- In **Ireland** when the tax was introduced in 2010 (at a rate was EUR 15 per tonne of CO_2) it was envisaged to increase to EUR 30 by 2014.

- In the **Netherlands** since 1999, rates for all energy taxes have been indexed to inflation.

- In **Norway** tax rates are reviewed annually and have been changed on a regular basis since their introduction in 1991. Tax rates are usually set as a result of political negotiation, except in the vehicle sector.

- In **Sweden**, the Government has adjusted energy tax or CO_2 taxes to achieve the desired environmental steering effect on the consumption of fuels. Since 1995 energy taxes have been indexed and linked to the CPI.

- In the **UK**, the CCL rates on natural gas, coal, LPG and electricity remained constant until April 2007 since then they have increased in line with inflation annually (except in 2012).

Sources: For references, please see country case studies in Annex 1

2.5 Exemptions

2.5.1 Introduction to the issue

Tax exemptions, reduced rates and refunds are granted to specific activities, sectors and groups affected by the tax. Such provisions are introduced for a number of reasons including distributive and competitiveness concerns. They are sometimes included out of political expediency, i.e. to help get a tax bill through parliament or generate favour (or avoid disfavour) among voters. They can also be introduced as a response to calls from certain interest groups, i.e. energy-intensive industry. In some cases, the provision of such exemptions develops over time towards a more restrictive system as opportunities to reduce such favourable tax treatments are understood to no longer be needed (e.g. if it becomes clear that competitiveness concerns are less than initially assumed).

Exemptions, tax reductions and other special provisions contravene the principles of conventional economic theory and generally tend to undermine the environmental effectiveness of the tax (Barde 2004). However, such provisions are often necessary for political and public acceptability of the ETR as governments have to make trade-offs between economic efficiency and political reality when making decisions (Speck and Jilkova 2009). A critical issue is how such exemptions are designed and their development over time as this will influence the effectiveness of a given ETR.

2.5.2 Examples from practice

A number of special tax provisions or exemptions from the carbon or energy tax are granted to certain sectors and industry (in particular energy-intensive industry) – see Table 2.6 for an overview of exemptions granted in the 10 cases examined in the study for more information, please see Annex 1. In certain cases, countries with high explicit carbon tax rates (e.g. Denmark and Sweden) have introduced such far-reaching tax exemptions and provisions that the actual tax rate experienced by industry are similar to those in other countries (Speck and Jilkova 2009).

Such special provisions include reduced tax rates (or full exemptions) for certain groups, in particular energy-intensive industry. For example in Germany full tax exemptions are granted for some energy-intensive industry processes and reduced tax rates for certain manufacturing businesses, in Denmark the CO_2 tax is partly refunded for energy used for heavy energy-intensive process purposes, while in the Netherlands energy-intensive industries are exempted from energy and fuel taxation or subject to low rates. Transport fuels also receive exemptions in a number of countries, for example in Australia the CPM does not apply to on-road use of fuels by households and light commercial vehicles nor does it currently apply to heavy on-road vehicles; while in Norway natural gas and LPG used in domestic shipping are exempt from the CO_2 tax. In the agriculture sector certain users are often granted partial or full exemptions from the tax, for example commercial greenhouses in British Columbia and in the Netherlands, and farmers in Ireland and Australia.

Sectors covered by the EU ETS also often receive exemptions of varying degrees. After Norway joined the EU ETS in 2008, CO_2 tax rates were adjusted and some installations covered under the scheme exempted from the CO_2 tax, e.g. the petroleum sector – however the tax rate was increased in January 2013 by NOK 200 (EUR 27) per tonne of CO_2 in light of the low EU ETS allowance price. In Germany there are overlaps between the energy tax and the ETS including direct overlaps for power plants and industrial facilities covered under the ETS, and indirect affects for private households and businesses which bear the costs of emission allowances under the ETS in final electricity prices and additional taxes introduced under the ETR. However, some overlaps may be justified given that the goals pursued under the ETR and the ETS are not the same. Moreover, substantial derogations granted to industry and the power generation sector minimises potential negative impacts from double regulation.

In some countries, electricity from renewable energy sources is exempt from carbon and/or energy taxes as a means of promoting the development of renewable energies. In the UK, electricity generated from renewable sources (excluding large-scale hydro > 10 MW) and in combined heat and power plants (CHP) is exempt from the CCL (EEA, 2005). In Norway, electricity consumption is not subject to the CO_2 tax given the low carbon nature of electricity (which is almost entirely reliant on hydropower) but only to (modest) excise duties. In the Netherlands, electricity from renewable sources used to be exempted from the regulatory energy tax, however since 2003 the exemption has been changed to a lower tax rate. This was triggered by significant increases in imported hydro and to a lesser extent wind power, for which the tax exemption had become an implicit subsidy and thus failed to benefit the development of the domestic renewables sector. Decentralised (for own-use) solar and wind power continues to be exempted from the regulatory energy tax and since 2013 renewable power produced by (citizen) cooperatives for consumption within the same postal code area is also exempted (Personal communication).

Exemptions often evolve over time and in certain cases are adjusted to become more demanding. Some countries start their ETR process with a high level of exemptions and try to reduce these over time. For example this has been the case in Sweden where in 2009 the Parliament decided to gradually limit CO_2 tax exemptions for energy-intensive industries and others outside the EU ETS between 2011 and 2015. The special CO_2 tax break granted to some industrial installations outside the EU ETS was abolished while energy taxes on heating fuels were reformed to reflect energy content (IEA, 2013). In addition, the CO_2 fuel tax for industries under the EU ETS was abolished in 2011 while the energy tax for industry both within and outside the EU ETS was increased (Bahr et al, 2010). In others, exemptions creep in over time. For example in British Columbia there were few exemptions in place when the carbon tax was initially introduced. However as it became clear that other regions in Canada and the US were not progressing with their carbon taxes, certain exemptions were added and the rise in tax rates halted until other jurisdictions, especially those in North America, introduce similar carbon taxes or carbon pricing (British Columbia Ministry of Finance 2013).

In some cases, exemptions are conditional on voluntary agreements by the company to predetermined improvements (e.g. energy efficiency, CO_2 reductions etc.). These are sometimes introduced to avoid State Aid complications. Such agreements include for example:

- In the **UK**, energy-intensive sectors that have concluded 'Climate Change Agreements' (CCAs) with the government and commit to legally-binding targets for reduced energy use or reduced emissions are entitled to a reduction in the CCL (see Box 2.3).
- In the **Netherlands**, large industrial electricity consumers (>10 million kWh/year per electricity connection) are exempted from the (regulatory) energy tax if they have entered long-term agreements on energy efficiency with the Government.
- In **Germany**, partial refunds for the manufacturing industry ('Spitzenausgleich') were initially linked to voluntary climate mitigation agreements between government and industry (with GHG emission reduction targets which expired at the end of 2012) and now to energy efficiency agreements which require companies to implement an energy management and auditing system to be eligible for the derogation as of 2014 (BMWI, 2012).
- In **Denmark**, since 1996, CO_2 tax reimbursements to industry have been conditioned on the conclusion of voluntary energy efficiency agreements between companies and the Danish Energy Agency (see Box 2.3).

Although such agreements have had a number of shortcomings and are not seen as particularly effective tools overall (see Box 2.3), they do have the potential to be useful where used with due conditionalities such as the requirement for environmental management systems and energy audits (e.g. requirements for implementing low payback period initiatives within a certain timescale) Where there has been interest from the European Commission in the context of State Aid concerns, this can also lead to the communication of useful information about the industry, thus helping to address the information asymmetry between industry and public authorities which can in turn help future policy design.

Box 2.3: Experiences with voluntary agreements

In the **UK** energy intensive businesses that enter into Climate Change Agreements (CCAs) are eligible to receive a discount from the CCL in return for meeting energy efficiency or carbon-saving targets. These agreements allow eligible companies to receive a discount from the CCL of 90 per cent for electricity and 65 per cent for other fuels in return for meeting energy efficiency or carbon-saving targets. CCAs cover a wide range of industry sectors, from major energy-intensive processes such as steel, chemicals and cement, to agricultural businesses, such as intensive pig- and poultry-rearing.

While such agreements have been considered useful by firms for *inter alia* helping win managerial attention to energy efficiency, they have also been criticised for being weaker than necessary. Several sources suggest errors were made in the design of the agreements and the way targets were negotiated which resulted in agreements which have not been very demanding. For example the fact that sectors were allowed to choose their own baseline years meant that more than two thirds chose baseline years of 1999 or earlier, thus any emission reduction that occurred before the policy was instituted could be applied to the CCA targets. This meant that in the first target period, 88 per cent of units met their targets while in the second and third periods, 98 per cent and 99 per cent of units met their targets (OECD, 2010). Businesses missing their targets were able to use the UK ETS to purchase allowances, which given low prices arguably meant they were not strongly motivated to transform industry processes to more efficient energy use.

In addition, the case for CCAs on competitiveness grounds and protecting energy-intensive industries is considered weak as there has been no sign of an impact of the full CCL on output, jobs or productivity, while the full CCL rather than the agreement has been found to be successful in promoting energy efficiency and innovation (Bowen and Rydge, 2011).

The **Danish** scheme of voluntary agreements (VAs) on energy efficiency in industry was launched in 1996 and aimed to encourage energy efficiency in industry so as to reduce CO_2 emissions. The agreement mainly targets energy-intensive industries that have the option to enter into VAs with the Danish Energy Authority (DEA). Under the VAs, companies commit to undertaking a number of tasks promoting energy efficiency, in return for a rebate on the CO_2 tax rebate.

In order to enter a VA the company must implement an energy management system (EMS) and (before the VA tool was revised) an energy audit. The purpose of the audit was to identify all 'profitable' energy measures (defined as those with a payback period of less than four years for heavy processes and less than six years for light processes). All profitable energy saving projects generally have to be listed in the VA and carried out. The obligation to undertake an energy audit before signing a VA was removed in the revised scheme (to reduce the administrative costs of the scheme); however any profitable energy saving projects identified during 'special investigations' or the EMS should be carried out during the contract period (Ericsson 2006).

Evaluations by the DEA show that the VA scheme has reduced energy use in participating companies and led to an estimated CO_2 emission reduction of 6 per cent over 1996-2005. The majority of the CO_2 emission reductions (60 per cent) are assumed to be a result of implementing and maintaining an EMS (Ericsson 2006).

Sources: For references, please see UK, DK and DE case studies in Annex 1. For wider discussion on VAs see ten Brink et al. 2003 and ten Brink ed. 2002.

Table 2.5: Overview of key exemptions from carbon and energy taxes (for more detail see Annex 1)

Country / region	Sector	Exemptions	Degree of exemptions and related conditions (where relevant)
AU	***Transport***	On-road use of fuels by households and light commercial vehicles; Heavy on-road vehicles (aim to cover from 1/7/2014) Gaseous fuels such as LPG, LNG and CNG used for on-road transport	Exempt from CPM
	Energy	Renewable fuels such as ethanol, biodiesel and renewable diesel	Exempt from CPM
		Coal-fired electricity generators	Free carbon units allocated and cash payments ***Conditions*** Conditional on strongly affected electricity generators publishing Clean Energy Investment Plans which show how they will reduce pollution and meet power system reliability standards.
	Agriculture	Off-road fuel use by agriculture, forestry and fishing industries	CPM does not apply
BC	***Industry***	Emissions from non-combustion sources including industrial processes such as cement, lime and aluminium production	Exempt from tax
	Energy	'Fugitive' emissions from coal, oil and natural gas extraction and exports of fossil fuels that produce emissions outside BC	Exempt from tax
	Agriculture	Commercial greenhouse vegetable and floriculture growers	From 2013, carbon tax relief grant set at 80 per cent of carbon tax paid on specified fuels
		Farmers purchase of coloured (red) motor fuel for use in on-farm equipment and farm vehicles	Carbon tax exemption from autumn 2013
	Other	Local governments and schools	Carbon tax payments rebated ***Conditions*** Sign Climate Action Charter which require commitment to have carbon neutral operations by 2012
DK	***Industry***	Industry	Since 1996, partial refund of CO_2 tax and exemption from energy tax depending on purpose of energy use: - Energy used for space and water heating granted tax refund of 22 per cent of energy and CO_2 taxes; - Energy used for process use granted tax refund of around 24,4 per cent of CO_2 taxes + 100 per cent of energy taxes; - Energy used for heavy process use granted refund of around 96, 7 per cent of CO_2 taxes + 100 per cent of energy taxes. ***Conditions*** Voluntary energy efficiency agreements between companies and the Danish Energy Agency.
		Sectors covered by EU ETS	Since 2001, full refund of CO_2 tax on energy used for heating purposes. As a general rule, fuels used for generation of power are not covered. However, a CO_2 component is still levied on

			electricity consumption through the energy tax
	Transport	Oil and gas used for fishing vessels, vessels in foreign trade and transport of passengers or goods by ferry; jet fuel for aircrafts for business purposes; coal etc. used in steamships and trains	Exempt from tax
	Energy	Biofuels	Exempt from CO_2 tax
FI	***Industry***	Energy-intensive industry	Where CO_2 and energy taxes paid by a company for electricity, coal, natural gas, and other products exceed 0.5 per cent of the company's value added during the accounting period, the company is entitled to apply for a refund of 85 per cent of the amount of the excise duties paid for the products or the excise duties contained in their acquisition price. Only the part exceeding EUR 50 000 of the thus calculated tax refund is repaid. The maximum refund can only be as high as the excise duties paid
	Energy	Fossil fuels used in CHP production	CO_2 tax lowered by 50 per cent
		Biofuels	50 or 100 per cent exemption from CO_2 tax ***Conditions*** 100 per cent exemption if they meet the sustainability criteria
		Natural gas	Until 2010, no energy tax applied, only a carbon tax. Since 2011, application of energy tax staggered until 2015 when full tax rate will apply.
		Peat	Lower energy tax rate applies which will increase progressively in 2013 and 2015
DE	***Industry***	Manufacturing	As of 2011, tax relief of 25 per cent of standard tax rate for all energy products other than transport fuels, including electricity is granted when more than EUR 1000 is spent per annum on electricity and heating fuels ('*Sockelbelastung*').
		Manufacturing	As of 2011, 90 per cent environmental tax refund for those tax payments more than 20 per cent per cent of reduction in the statutory pension contributions received ('*Spitzenausgleich'*) ***Conditions*** Linked to a voluntary climate mitigation agreement ('Klimaschutzvereinbarung') between government and industry which initially ran until 2012 under which industry committed to decrease GHG emissions by 35 per cent by 2012 compared to 1990 levels. Derogation now linked to an agreement on energy efficiency (*'Effizienzvereinbarung'*) (until end 2022) which requires companies to implement an energy management and auditing system to be eligible for the derogation as of 2014 (BMWI, 2012).
		Energy-intensive processes	Full exemption from energy taxes including electricity tax
	Transport	Local public transport	Reduced standard tax rates: 60.048 Cent/litre for gasoline (standard rate: 65.45 Cent/litre), 41.638 Cent/litre for diesel (standard rate: 47.04 Cent/litre), 16.695 Cent/kg for liquid gas (standard rate: 18.03 Cent/kg) and 1.29 Cent/kWh for natural gas (standard rate: 1.39 Cent/kWh)
		Public railways	Reduced electricity tax of 1.142 Cent/kWh amounting to 56 per cent of the regular tax rate (2.050 Cent/kWh)

	Energy	CHP plants	With a minimum utilisation rate of 70 per cent are partially exempt from the energy tax, the minimum tax rate pursuant to the Energy Taxation Directive applies. Highly efficient CHP plants (defined in Annex III of Directive 2004/8/EC) fully exempt from energy tax
		Power plants	Exempt from the energy tax
		Natural gas and liquid and natural gas when used as fuel until 31/12/2018	Reduced tax rate of EUR 13.90 per MWh natural gas and of EUR 180.32 per 1,000 kg liquefied natural gas compared to standard tax rate of EUR 31.80 and EUR 409 respectively
		Advanced and high blend biofuels	Exempt from the energy tax until 31/12/2015
		Electricity from renewable sources meant for the use of the producer	Exempt from electricity tax
	Agriculture	Agriculture, fishery, and forestry	As of 2011, tax relief of 25 per cent of standard tax rate for all energy products other than transport fuels, including electricity granted when more than EUR 1000 is spent per annum on electricity and heating fuels (*'Sockelbelastung')*
IE	***Industry***	Companies participating in the EU ETS	Carbon tax does not apply
	Energy	Biofuels or the biofuel content of blended fuels.	Carbon tax does not apply
		Certain high efficiency CHP with a capacity of 50 kW.	Partial relief from the carbon tax
		Coal and peat	Were exempt until May 2013
		Fuel used for generation of electricity	Relief from carbon tax
	Agriculture	Farm diesel	Exempt from further increases in the carbon tax
		Farmers	Double income tax relief provided for additional carbon tax liabilities from 1/5/2012
NL	***Industry***	Large industrial electricity consumers (>10 million kWh/year per electricity connection)	Exempt from (regulatory) energy tax ***Conditions*** Participation in long-term voluntary agreements with the Dutch Government to improve energy efficiency (until the end of 2012 this was under the 'Energy Efficiency Benchmarking Covenant')
		Energy intensive industries (ETS)	Exempt from energy and fuel taxation or subject to very low rates ***Conditions*** Participation in voluntary Long-Term Agreement on Energy Efficiency (LEE) with the Government to improve energy efficiency
	Energy	Renewable power produced by (citizen) cooperatives for consumption within the same postal code area	Exempt since 2013
		Energy distribution firms for the deployment of CHP, energy-saving technologies and renewable electricity	Rebates and subsidies
		Decentralised (for own-use) solar and wind power	Exempt from energy taxes
		Renewable electricity	Since 2003, lower rate of (regulatory) energy tax applied (prior to this, exemption)
	Agriculture	Horticulture (greenhouses)	Reduced natural gas tax rates again on the condition of participating in energy efficiency agreements ***Conditions*** Participation in agreements with the Dutch

			Government to improve energy efficiency
	Other	Households	Tax credit per electricity connection of EUR 319 as of 2009 (lump sum refund on household's electricity bill)
		Religious and non-profit organisations	Rebates
NO	***Industry***	Industrial processes	Exempt from CO_2 tax
		Wood processing industry, herring meal and fishmeal industries	Reduced tax level of 50 per cent
		Installations in EU ETS	Since 2008, exempt from paying CO_2 tax on heating oil
		Petroleum sector	Since 2008, benefit from reductions in the CO_2 tax (although the tax rate was increased from January 2013 by NOK 200 per ton (EUR27). CO_2 taxes paid by the petroleum industry offshore classified as a deductible operating cost which reduces ordinary tax and special tax paid.
		Manufacturing sector	Lower CO_2 tax rate on natural gas and full CO_2 tax exemption on LPG
	Transport	Natural gas and LPG used in domestic shipping	Exempt from the CO_2 tax
	Energy	Biofuels	Exempt from CO_2 tax
		Electricity consumption	Exempt from CO_2 tax
	Agriculture	Fishing in distant and coastal waters	Exempt from CO_2 taxes
		Fishing and hunting industry	Since 2013, rebate on CO_2 tax rate reduced leading to an effective CO_2 tax of around NOK 50 (EUR 6.7) /tonne
		Natural gas and LPG used in the greenhouse sector	Exempt from the CO_2 tax
SE	***Industry***	Energy-intensive industries (outside EU ETS)	*Before 2011:* 0 per cent energy tax; 21 per cent CO2 tax; 0.8 per cent rule under which industries could apply for a tax reduction for the share of taxes that exceed 0.8 per cent of the sales value *Since 2011:* 30 per cent energy tax = EUR 0.0025 per kWh 30 per cent CO2 tax (rising to 60 per cent in 2015) 0.8 per cent tax reduction limit increased to 1.2 per cent and will be abolished in 2015
		Industry within EU ETS	*Before 2011:* 0 per cent energy tax 15 per cent CO2 tax *Since 2011:* 30 per cent energy tax = EUR 0.0025 per kWh 0 per cent CO2 tax
	Energy	Heat production in CHP plants	*Before 2011:* 0 per cent energy tax 15 per cent CO2 tax *Since 2011:* 30 per cent energy tax = EUR 0.0025 per kWh 7 per cent CO2 tax. Proposed to be 0 per cent in 2013.
		Other heat plants	100 per cent energy tax; 94 per cent CO2 tax
	Agriculture	Forestry, fisheries and agriculture,	A number of exemptions applied before 2011. Since 2011, 30 per cent energy tax and an increase in the CO_2 tax by 30 per cent (and an increase by 60 per cent as of 2015) from 2011.
UK	***Industry***	Energy intensive businesses	From April 2013, discount of 90 per cent for electricity and 65 per cent for other fuels.

			Conditions Climate change agreements with government which include commitment to meet energy efficiency/carbon reduction targets.
	Transport	Transport	Exempt from levy
	Energy	Electricity generated from renewable sources (excluding large-scale hydro > 10 MW)	Exempt from levy
		Electricity generated from combined heat and power plants (CHPs)	Exempt from levy
	Other	Households	Exempt from levy

Sources: For references, please see country case studies in Annex I

The **criteria for granting exemptions** differ across countries, for example:

- In **Denmark** special tax provisions are only granted to specifically designed production processes (Speck and Jilkova 2009). To be included on the list of 'heavy processes', a CO_2 tax rate of EUR 6.7 on the energy consumption of a particular process should not result in a tax that exceeds 3 per cent of the value added or 1 per cent of the turnover. Competitiveness issues and concerns about administration and control also play a role (UCD 2008).
- In **Finland**, the indicator assessing whether a company is energy-intensive and thus eligible for a refund from energy taxes is based on whether CO_2 and energy taxes paid for electricity, coal, natural gas, and other products exceed 0.5 per cent of the company's value added during the accounting period. Only the part exceeding EUR 50 000 of the thus calculated tax refund is repaid with the maximum refund as high as the excise duties paid (OECD 2013a).
- The **German** system of exemptions applies to all companies that belong to specific statistical classifications (see Box 2.4).
- In the **UK**, energy-intensive industries were initially defined as industries covered by Part A1 or A2, in Part 1 of Schedule 1 of the Pollution Prevention and Control (England and Wales) Regulations 2000 (as amended).

Box 2.4: Criteria for granting exemptions – Some examples from Germany

In Germany, manufacturing industry eligible for the '*Spitzenausgleich'* is defined by reference to the standard definition and classification of German national statistics office (Article 2(3) of the electricity taxation law): *„Unternehmen des Produzierenden Gewerbes: Unternehmen, die dem Abschnitt C (Bergbau und Gewinnung von Steine und Erden), D (Verarbeitendes Gewerbe), E (Energie- und Wasserversorgung) oder F (Baugewerbe) der Klassifikation der Wirtschaftszweige zuzuordnen sind, sowie die anerkannten Werkstätten für behinderte* Menschen *im Sinne des § 136 des Neunten Buches Sozialgesetzbuch, wenn sie überwiegend eine wirtschaftliche Tätigkeit ausüben, die den vorgenannten Abschnitten der Klassifikation der Wirtschaftszweige zuzuordnen ist*".

In Germany – since the 2006 energy taxation reform, energy-intensive processes benefit from a complete exemption from energy taxes including electricity tax (Article 51 of the energy taxation law, Article 9(a) of the electricity taxation law). These include electrolysis and chemical reduction processes, the production of glass and ceramic products, and metal production and processing, the latter two being defined as follows (Article 51 of the energy taxation law, Article 9(a) of the electricity taxation law):
"für die Herstellung von Glas und Glaswaren, keramischen Erzeugnissen, keramischen Wand- und Bodenfliesen und -platten, Ziegeln und sonstiger Baukeramik, Zement, Kalk und gebranntem Gips, Erzeugnissen aus Beton, Zement und Gips, keramisch gebundenen Schleifkörpern, mineralischen Isoliermaterialien, Asphalt, Waren aus Graphit oder anderen Kohlenstoffen, Erzeugnissen aus Porenbetonerzeugnissen und mineralischen Düngemitteln zum Trocknen, Brennen, Schmelzen, Erwärmen, Warmhalten, Entspannen, Tempern oder Sintern der vorgenannten Erzeugnisse oder der zu ihrer Herstellung verwendeten Vorprodukte" und „für die Metallerzeugung und -bearbeitung sowie im Rahmen der Herstellung von Metallerzeugnissen für die Herstellung von Schmiede-, Press-, Zieh- und Stanzteilen, gewalzten Ringen und pulvermetallurgischen Erzeugnissen und zur Oberflächenveredlung und Wärmebehandlung".

Sources: For references, please see German case study in Annex 1

Information on the **share of GHG emissions covered by exemptions** is limited. In Germany, before the threshold was increased in 2011 (from EUR 512.50 to EUR 1000), 100,000 out of 630,000 eligible manufacturing companies benefitted from the 'Sockelbelastung' derogation (DIHK, 2011). With the revisions, the number of firms benefiting from the derogation will decrease. According to preliminary figures, in 2011 around 34,000 companies benefitted from the derogations (Deutscher Bundestag, 2012). In Norway, no CO_2 taxes are levied on industrial processes which made up about 18 per cent of total emissions in 2006 (Bruvoll and Dalen, 2009).

2.6 Revenues raised

2.6.1 Introduction to the issue

ETR has the potential to raise significant levels of revenue for a government. Modelling results by the IMF suggest that *[e]fficient carbon-pricing schemes could raise ¾ per cent of GDP in advanced economies and 1½ per cent of GDP in emerging economies within the next ten years, while targeted transfers could offset any impact on the poor* (IMF 2010). According to the OECD, (building on a modelling exercise) GHG levies could raise revenues equivalent to up to 2 per cent of GDP (OECD 2010).

2.6.2 Examples from practice

Energy and carbon tax reforms in the 10 OECD countries examined indicate the revenue raising potential of such taxes – see Table 2.6 for an overview. For example, the CO_2 tax raised around EUR 300 million in Norway in 2010, in the UK almost EUR 800 million was raised from the CCL in 2011, in Finland EUR 3,300 million was raised from energy and CO_2 taxes and a strategic stockpile fee in 2010, in Denmark revenues raised from increased energy taxes during the first phase of ETR (1994-8) amounted to EUR 1 billion, while in Sweden EUR 8.38 billion was raised from energy and CO_2 taxes in 2011.

ETR is a subset of wider energy and environmental tax revenue and thus should be seen in this context. For example, in the UK the total revenues from energy and environmental taxes are more than fifty times (ca. EUR 44 billion in 2008) the level of revenues from the CCL noted above. Total revenues from energy and environmental taxes in Finland and Germany in 2008 of around EUR 5 billion and EUR 55 billion respectively were also significantly larger than the formal ETR element, though in these two cases ETR is a more significant part of the tax landscape.

As noted in the section above, a number of countries gradually ramp up the tax rates applied as well as broaden the tax base over time, which in turn often results in increasing revenues over time. For example in Ireland, EUR 246 million was raised in 2010, EUR 330 million in 2011, EUR 400 million in 2012 and is expected to raise about EUR 500 million in 2013. In the Netherlands, revenue from the energy tax increased from EUR 400 million when it was introduced to EUR 4.2 billion in 2010. In British Columbia, revenues from the carbon tax gradually increased from CAD 306 million in 2008-2009 (EUR 228 million) to CAD 959 million (EUR 716 million) in 2011-2012.

Table 2.6: Overview of revenues raised from carbon and energy taxes

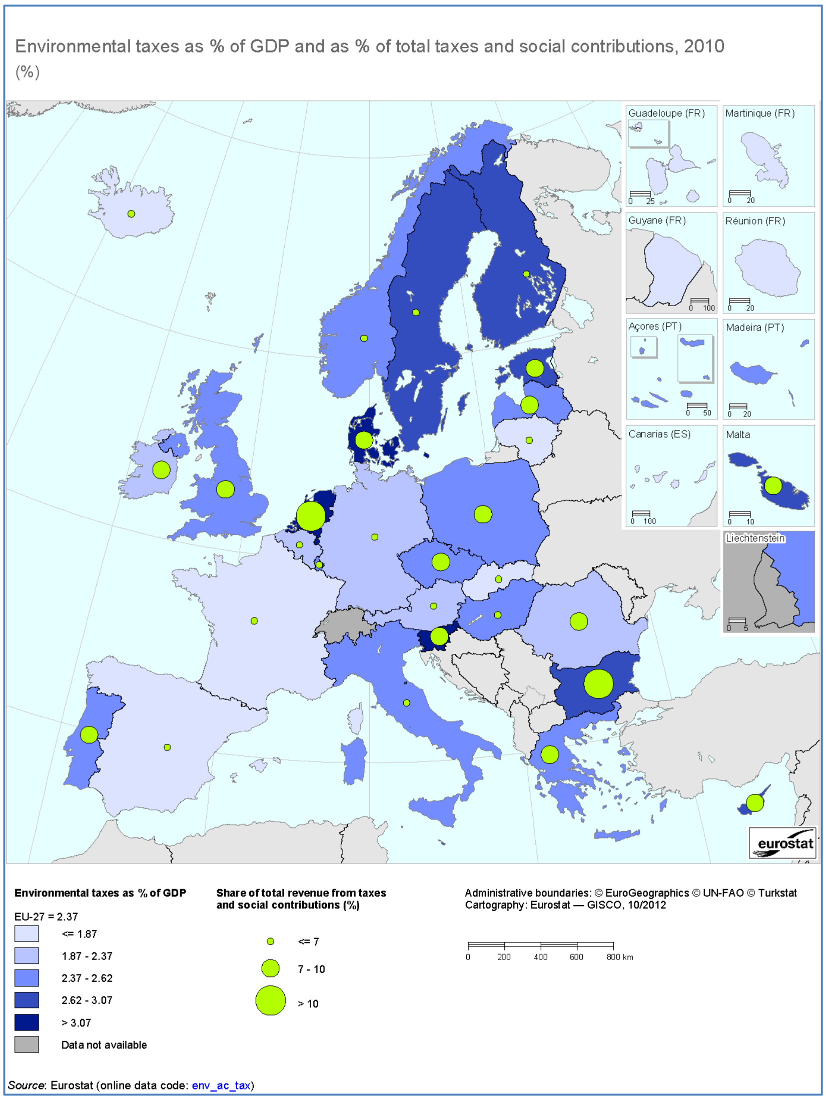
Country/ region	EUR millions	% of GDP	% of total tax revenues
AU	The Government estimates that the CPM will raise AUD 7,690 million (EUR 5.360 million) (2012-2013), AUD 8,610 million (EUR 6 million) (2013-2014) and AUB 9,200 million (EUR 6,410 million) (2014-2015)	Estimated to be 0.5 per cent (2012)	Estimated to be 2 per cent (2012-2013)
BC	Revenues from the carbon tax gradually increased from CAD 306 million in 2008-2009 (EUR 228 million), to CAD 741 million (EUR 543 million) (2010-2011), CAD 959 million (EUR 716 million) in 2011-2012 and are estimated to reach CAD 1,273 million in 2015-16.	Estimated to be 0.04 per cent (2010-2011)	Estimated to be 5.5 per cent (2012-2013)
DK	Revenues raised from energy taxes during the first phase (1994-8) were DKK 7.5 billion DKK (EUR 1 billion), during the second phase (1996-2000) DKK 2.45 billion (EUR 330 million) and during the third phase (1999-2002) DKK 6.4 billion (EUR 850 million).	2.35 per cent (2011)	4.92 per cent (2011)
FI	EUR 3,300 million from energy and CO_2 taxes and strategic stockpile fee (2010)	1.8 per cent	4.4 per cent
DE	Electricity tax revenues were EUR 7.2 billion (2011), expected to be EUR 6.9 billion (2012) and 6.4 billion (2013) respectively. Energy tax revenues were around EUR 40 billion (2011), expected to remain at this level in 2012 and 2013.	0.3 per cent electricity tax (2011) 1.5 per cent energy tax (2011)	2.9 per cent electricity tax (2011)16.1 % energy tax (2011)
IE	EUR 246 million (2010), EUR 330 million (2011), EUR 400 million (2012).	1.46 per cent (2010) (Eurostat 2013)	5.18 per cent (2010)
NL	EUR 12 billion (2010) from energy taxes (RT, FT and MOE).	2 per cent (2010)	8.8 per cent (2002)
NO	In 2010, the CO_2 tax generated estimated revenues of NOK 2.5 billion (EUR 286 million). Revenues from energy taxes amounted to around EUR 3.8 billion in 2010.	1.2 per cent (2010) - energy taxes	2.8 per cent (2010) – energy taxes
SE	EUR 3.04 billion (2011) from CO_2 taxes; EUR 8.38 billion (2011) from energy and CO_2 taxes	2 per cent (2011) - energy and CO_2 taxes	4.8 per cent (2010) - energy and CO_2 taxes
UK	GBP 678 million (EUR 792 million) (2011) from the CCL, which rose from GBP 555 million (EUR 651 million) in 2001-2002.	0.04 per cent (2011)	0.12 per cent (2011)

Sources: For references please see country case studies in Annex 1

It should however be noted that the overall share of the contribution of revenues from ETR to national tax revenue and GDP is relatively small (in the order of a few percentage points of GDP and tax income - see Table 2.6) and existing ETRs can only be seen as an initial step in the structural changes of tax systems (ILO et al 2011). Among the 27 EU Member States, revenue raised from environmental taxes and charges amounted to EUR 292 400 million in 2010 which equates to 2.4 per cent of GDP and to 6.2 per cent of total revenues from taxes and social contributions – see Figure 2.4. A smaller but nevertheless often important share is from explicit carbon taxes.

It is worth noting that when taxes are not indexed to inflation, the level of revenue raised goes down in real terms over time. In practice many countries have introduced indexation while some have scheduled increases to tax rates and a broadening of the tax base over time, thus to date the concern of falling revenues has not materialised in the countries examined. Over time however as taxes start to have an increasing impact on behaviour one can expect revenues to fall. In such cases tools such as indexation, broadening of the tax base, raising of tax rates and reducing exemptions could be useful.

Figure 2.4: Environmental taxes as % of GDP, total taxes and social contributions in EU-27 in 2010



Source: Eurostat (n.d.)

When considering revenues raised from carbon and energy taxes, one should keep in mind the administrative costs associated with the implementation of the tax. However one should also note that all instruments, whether environmental taxes, emissions trading schemes, voluntary agreements or regulations, require mechanisms for administration, monitoring and in all cases bar purely voluntary schemes, enforcement. The costs of these arrangements can be important for national and local budgets and relative costs should be taken into account in choosing between different instruments (Bovenberg and Goulder, 2002).

Information on the administrative costs of the 10 carbon or energy tax systems examined is limited. In BC, the carbon tax is applied and collected in essentially the same way that motor fuel taxes are applied and collected which minimises the administrative cost to the government and the compliance cost to those collecting the tax on the government's behalf. In the UK, the CCL is collected by energy suppliers at the point of sale in a similar way to VAT. The part of the total energy cost accounted for by the CCL is itemised on the energy bill to business customers. Other than that there is no difference from paying a normal bill so there is a minimal administrative burden on businesses subject to the Levy. The estimated cost of collection of the CCL is 0.4 per cent of revenue. The administrative costs for the Swedish Tax Administration are estimated to be 0.1 per cent of total revenues for energy and CO_2 taxes. In terms of administrative costs associated with the collection of wider environmental taxes - the administrative cost for environmental taxes in Germany is estimated to be 0.13 per cent of additional revenues while administrative costs for environmental taxes in the UK over the period 2005-2009 are estimated to be in the range of 0.34-0.21 per cent.

2.7 Revenue use

2.7.1 Introduction to the issue

The effectiveness of an ETR is due not just to the design and level of the taxes and charges, but also importantly what is done with revenues raised. How revenues raised are used is a key issue in the design of carbon or energy taxes. Depending on the underlying rationale of the tax, the revenue raised from carbon and energy taxes can be used in different ways. Revenues can for instance be pooled into the general state budget, used as part of a wider tax-shifting programme to offset revenue losses from tax reductions elsewhere (e.g. on labour), raise revenues linked to specific environmental expenditures or as a means to raise revenue to help with fiscal consolidation. Revenues can also be recycled (whereby revenues are returned either in full or in part to the taxpayers from whom they were raised by financing reductions in other taxes), or earmarked for specific expenditure purposes (e.g. an environmental programme) (Soares 2012). A revenue-neutral approach (whereby revenues from the environmental tax are used to reduce other tax burdens) can lead to the so-called double dividend – the first being the environmental impact of the tax and the second the economic impact generated by the use of tax revenues to reduce other taxes (Milne and Andersen 2012), although there are caveats that may reduce the likelihood of achieving such dividends (EEA 2005).

2.7.2 Examples from practice

Countries have used revenues raised from carbon and energy taxes in various ways – for an overview see Table 2.7. The frontrunner Nordic countries introduced CO_2 taxes as part of a wider tax shifting programme which sought to balance some of the revenue losses caused by a reduction in relatively high income taxes. For example in Finland and Denmark, ETR was part of a wider tax reform programme which aimed to reduce taxes on labour and employers' social security contributions as a means of stimulating employment. In Sweden revenues from the energy and CO_2 tax are set aside to partly offset revenue losses caused by the reduction in income taxes. For instance, the second ETR aimed to increase revenue generated from environmental taxes by up to SEK 30 million over the 10-year period to offset the shortfall in revenue from planned reductions in labour and capital taxes (Speck and Jilkhova 2009).

In contrast, revenue neutrality has been a broad principle underlying ETR in Australia, British Columbia, Germany, Netherlands, and UK. For example in British Columbia there is a legislative commitment to return all revenues from the carbon tax to individuals and firms through reductions in other taxes (and a threat to cut the Minister of Finance's salary by 15 per cent if this is not done) (Harrison 2012).

A number of mechanisms are used for revenue recycling including in particular reductions in income tax rates and/or a reduction in social security contributions. Many also include a range of other measures which seek to address social concerns (e.g. lump-sum transfers to those who do not pay income tax or social security contributions but face higher energy bills, such as pensioners in Australia and tax credits for households in the Netherlands provided as a lump sum refund on electricity bills), environmental objectives (e.g. incentives for cleaner energy and energy efficiency improvements in British Columbia, Denmark, Ireland, Netherlands, Germany and UK). In Australia for example revenues are recycled via an increase in the tax-free threshold for income taxes, a boost in pension and family tax benefits, incentives to invest in cleaner energy programmes and shift to cleaner production processes (see Box 2.5 for further details). Successive increases in taxes sometimes necessitate further cuts to achieve revenue neutrality; this is for example the case in British Columbia as specific tax credits have been added over the years to reflect increases in tax rates (Harrison 2012).

Some countries have deviated from the revenue neutrality principle, in some cases temporarily. For example in Germany, ETR was planned to be revenue neutral but the government diverged from this by using a small fraction of revenues to consolidate the fiscal budget as a temporary measure (Speck and Jilkova 2009). In Ireland, although the carbon tax was initially envisaged to be revenue neutral, the revenues generated by the carbon tax has gone to the general exchequer (NESC 2012). While revenues raised from the carbon tax do not allow a major reduction in labour taxes, they help prevent (further) increases in labour taxes (Convery 2012).

In some cases, despite revenue neutrality ambitions, taxes have been revenue negative. For example in British Columbia, the carbon tax has been revenue negative as tax cuts and credits have exceeded revenues generated from the carbon tax. The threat to the Minister's salary has created an incentive to err on the side of tax cuts; there has also been a growing share of revenues going to corporate income tax cuts as well as lower than anticipated revenues from the carbon tax revenues (Harrison 2012). The Government's review of the carbon tax concluded that the principle of revenue neutrality will be maintained however it does not discuss how to deal with the issue of negative revenues. Similarly in the UK, while revenue neutrality was the original intention of the CCL, in the period 2001-2007, the CCL was actually revenue negative as the revenue collected through the levy was less than reductions in national insurance contributions (National Audit Office, 2007).

Box 2.5: Revenue recycling mechanisms in Australia

Australia has introduced a rather detailed system of revenue recycling. Households are supported through various recycling measures including the following:

- Pensioners and self-funded retirees will get up to AUD 338 extra per year if they are single and up to AUD 510 per year for couples;
- Families receiving Family Tax Benefit Part A will get up to AUD 110 extra per child
- Eligible families will get up to an extra AUD 69 in Family Tax Benefit Part B;
- Allowance recipients will get up to AUD 218 extra per year for singles, AUD 234 per year for single parents and AUD 390 per year for couples;
- Taxpayers with annual income under AUD 80, 000 will receive a tax cut with most receiving at least AUD 300 per year.

Around 40 per cent of revenues are to be used to help businesses and support jobs. Revenues are returned to industries through incentives to invest in cleaner energy programmes and shift to cleaner production processes through the Jobs and Competitiveness Program (JCP) which provides assistance targeted to around 40-50 of 'emissions-intensive trade-exposed' industrial activities such as steel, aluminum, cement and zinc manufacturing (which produce over 80 per cent of the manufacturing sector's emissions).

The most 'emissions-intensive trade-exposed' activities will receive assistance to cover 94.5 per cent of industry average carbon costs in the first year of the CPM, while less emissions-intensive trade-exposed activities will receive assistance to cover 66 per cent of industry average carbon costs. Assistance will be reduced by 1.3 per cent each year. Regular reviews of the JCP are planned.

In addition, a number of other programmes are being implemented including a Clean Technology Program, a Steel Transformation Plan, a Coal Sector Jobs Package and an Energy Security Fund which all seek to support industry's transition to a clean energy future.

Sources: See Australian Government 2011 and 2012 and AU case study in Annex 1

Table 2.7: Cross-country comparison of the use of revenues from carbon and energy taxes

Country/ region	Social security contributions	Income tax cuts	Other
AU	Increase in pension allowances (lump sum transfer/year). Increase in family benefits (lump sum transfer/year).	Income tax cuts (for taxpayers with annual income < AUD 80, 000).	Support for 'emissions-intensive trade-exposed' industrial activities. Coverage varies according to degree of exposure and will be reduced by 1.3 per cent/year. Other support provided to manufacturing industries, coal and steel sectors.
BC	Various tax credits and lump-sum transfers (e.g. low income tax credit, Seniors' Home Renovation Tax Credit, Children's Fitness Credit, one-time Climate Action Dividend).	Various adjustments to personal and corporate taxes (e.g. reduction in personal income tax rates, reduction in corporate income tax rate and small business tax rate)	
DK	Reduction in employers' contributions to labour market pension fund. Reduction in employers' national insurance contributions.		Investment grants for energy saving measures Special fund for SMEs
FI	Revenues used to partly compensate for loss of revenues from reductions in employers social security contributions	Revenues used to partly compensate for loss of revenues from reductions in labour taxes	
DE	Equal reduction in employers' and employees' social security contributions		Small fraction used for a programme to promote renewable energy (0.1-0.2 per cent/year between 1999-2006). EUR 1 billion used to consolidate the federal budget as a temporary measure.
IE			EUR 50 million used to part-fund National Energy Efficiency Retrofit Programme. Increased fuel allowances and extended duration of payment

			scheme.
NL	Reduction in employers' social security contributions.	Lower income tax rates. Increase in tax free allowances (especially for pensioners). Increase in tax free allowances for SMEs. Reduction of corporate tax rates.	Until 2003, 15 per cent of RET revenues earmarked for energy premium system rewarding private households for the purchase of energy efficient appliances.
NO	Support National Insurance Scheme's expenditure on pensions.	Lower labour and capital income taxes. Lower employers' non-wage labour costs.	New fund for climate change mitigation, renewable energy and energy conversation set up in 2013.
SE		Revenues used to partly offset revenue losses caused by reduction of income tax rates.	
UK	Reduction in employers' National Insurance.		Part of proceeds initially earmarked to energy efficiency improvements through an Energy Efficiency Fund and activities of the Carbon Trust.

Sources: For references please see country case studies in Annex 1

Which recycling mechanisms are used and what share of revenues is distributed to households and to industry depends on the sectors targeted by the tax and political considerations. For example:

- In the UK, the CCL only affects industrial and commercial energy use, thus only these sectors benefit from associated recycling mechanisms.
- In terms of the share of revenues distributed between households and industry, in Australia, around 40 per cent of CPM revenues are redistributed to business.
- In Denmark recycling mechanisms reflect the contribution of different sectors with industry and households receiving the amount which they were expected to pay as a consequence of the ETR; in 2000 13 per cent of revenues were recycled to households and 85 per cent to business (Speck and Jilkova 2009).
- In Germany, between 2003 and 2008 between EUR 15 and 16 billion were recycled in the German pension system annually (Bach, 2009). Although the share distributed between households and industry is not known, according to Speck and Jilkova (2009), industry benefits more from the recycling mechanisms.

3. THE EFFECTIVENESS AND IMPACTS OF CARBON AND ENERGY TAXES – SOME LESSONS FROM INTERNATIONAL EXPERIENCES

3.1 Introduction and overview

ETR has the potential to lead to a 'double dividend' of reducing environmental impacts (e.g. reducing climate change through reduced GHG emissions) while at the same time addressing wider objectives such as encouraging employment (Pearce 1991, Oates 1991, Fullerton et al 2008). The potential for such benefits drove many of the early ETRs (e.g. Sweden, Finland, Denmark, and Germany). In recent years, the potential for another 'win'– that of raising revenue and supporting fiscal consolidation - has helped drive fiscal reform, as seen in Ireland. There are further potential 'wins' available from ETR including encouraging innovation and hence supporting long-term competitiveness by discouraging technological lock-in, improving fuel security and balance of payments by reducing fossil fuel use (as seen in Finland). Furthermore, there is the potential of suitably designed and implemented ETR to help address other objectives, e.g. increased renewable energies and energy efficiency - this is understood to be one of the key drivers of latest efforts in Switzerland in light of its decision to phase out nuclear.

This chapter provides some insights on the effectiveness and impacts of carbon and energy taxes, including on the environment (in terms of CO_2 emissions reductions, fuel use, energy intensity, renewable energy), the economy (including insights on GDP, competitiveness and employment) and wider social impacts (including on income distribution). The chapter draws on the results of the 10 case studies as well as wider evidence from the literature. For comparability, insights on Switzerland based on the 2012 Ecoplan study are integrated where relevant.

3.2 Environmental impacts and effectiveness

CO_2 emission reductions, fuel use and environmental effectiveness

A number of countries examined in the study have committed to significant CO_2 emission reduction targets that effectively imply the decoupling of CO_2 emissions from economic growth and a move towards a low carbon economy - see Table 3.1 for an overview. Carbon and energy taxes are expected to play an important role in reaching these targets in a range of countries. For example, in British Columbia, the carbon tax was introduced in 2008 to help reach the goal of reducing the province's GHG emissions by at least 33 per cent below 2007 levels by 2020, while the Climate Change Levy (CCL) is an integral part of the UK's climate change programme for meeting its Kyoto target and helping to achieve the goal of at least 34 per cent in GHG emissions by 2020 and at least 80 per cent by 2050 (against a 1990 baseline).

Insights from past experiences indicate that CO_2 taxes, in combination with existing energy tax schemes have led to reductions in CO_2 emissions and to reduced fossil fuel consumption (see Table 3.1, Box 3.1 and Speck et al., 2006). In Denmark for example, total CO_2 emissions decreased by 24 per cent between 1990 and 2001, with Danish industry reducing its CO_2 emissions by 25 per cent per produced unit from 1993 to 2000. Energy taxes on business are said to have contributed to an overall reduction in energy consumption of 10 per cent. In Sweden average 2008-11 emissions were 12.6 per cent lower than 1990 levels, well below the burden-sharing target of 4 per cent for the period 2008-12 and is considered to be the result of high CO_2 and energy taxes in place. Similarly in Finland, a government working group on environmental taxation found that energy and carbon taxes reduced CO_2 emissions by over seven per cent over the period 1990 to 1998. In Australia according to macro-economic modelling carried out by the Treasury, the CPM is estimated to lead to a reduction in 453 Mt CO_2-e in emissions in 2050, reduce electricity emissions by 60 per cent below current levels by 2050 and drive down transport sector emissions over time. See Box 3.1 on the contribution of carbon-energy taxes to CO_2 emission reductions.

Box 3.1: Policy instrument mixes drive change

National CO_2 emissions reductions are driven by a range of factors of which CO_2 taxes and other energy taxes are but two. The underlying price of energy plays a critical role – as seen by the effect of the 1970s oil price shocks. Those market shocks influenced prices and energy demand far more than most carbon and energy taxes. In addition, external factors such as income play important roles, as can be seen by lower CO_2 emissions from transport fuels in times of recession. In addition to these external factors, other policy instruments also play potentially important roles, sometimes in parallel to carbon and energy taxes, and sometimes as part of an integrated instrument mix. Other instruments include voluntary agreements (sometimes enabling instruments as part of a package[12]), environmental and energy management systems, energy audits (sometimes instruments linked to ETR packages), certification, labelling, subsidies (direct grants, preferential tax treatment, pricing et al.[13]), R&D, availability of substitutes (e.g. fuels for fuel switching; techniques and technologies for production, process or product change), standards (e.g. buildings standards) and green public procurement. Similarly, demand-side issues including purchasing habits and social norms play a critical role. In addition, the level of existing energy efficiency and CO_2 intensity is important as it defines the scope for change. For example there is more room for energy efficiency and CO_2 savings in a less efficient building stock.

In practice, what this means is that it can be very difficult to identify precisely the contribution of any one instrument to changes in CO_2 emissions or energy efficiency. Tax exemptions or reductions are often necessary 'enabling instruments' that allow the ETR package (or simply the carbon tax) to be agreed and implemented. The exemption/tax reduction may be seen as a subsidy reducing the effectiveness of the ETR by some and by others as a positive tool that can leverage progress on environmental taxation. The former de facto compares the ETR with the subsidy to an ETR without a subsidy. The latter compares the ETR with the subsidy to a status quo with no ETR. The former would see a reduction in effect (CO_2, energy use) while the latter would see an increase in effect. Both are right of course, and assessments should really answer both these questions, and importantly also the potential benefits of reforming the subsidy over time to be able to achieve maximum realisable benefits while taking competitiveness and political realities into account.

The range of different factors affecting change partly explains why there have been fewer ex post assessments of carbon and energy taxes and wider ETR than one would expect from a policy governance perspective. Many assessments have ex ante modelling perspectives, which compare two scenarios – one with and one without carbon and/or energy taxes – to assess the likely impact of the measures. One such study – the COMETR research project - looked directly at the impacts of ETR, by modelling impacts, partly ex post (as it covers the period where the taxes were in place) and partly ex ante (modelling future impacts from actual and planned ETR). While no model can capture all the complexity, their results are useful indicators of the scale and nature of effects. Key results of relevant studies are presented in the sections below.

The modelling results of the FP6 COMETR project found that the largest reductions in GHG emissions among a group of seven EU Member States that have implemented tax reforms have been in countries with the highest tax rates (i.e. Finland and Sweden) - see Box 3.2. In the UK, the CCL and CCA are estimated to have reduced CO_2 emissions by 3.5 and 1.9 MtC respectively in 2010, when compared with a business-as-usual scenario. In the UK only the EU ETS has contributed to greater carbon savings, with the second phase of the EU ETS projected to have saved 8.0 MtC in 2010. However as noted in the Box 3.1 above, one should keep in mind that the path to CO_2 emissions reductions is inextricably linked with reductions in fossil fuel use and in practice a combination of carbon and energy taxes (combined with other complementary and enabling instruments) helps drive this change.

[12] See ten Brink et al. 2003 and ten Brink eds 2002.
[13] See Withana et al. 2012 and Oosterhuis and ten Brink eds (forthcoming 2013)

Despite these positive trends, in a range of countries the CO_2 reduction impacts of the ETR have been relatively small and often less than what is needed to achieve the transition to a low carbon economy. The limited effectiveness of the taxes is often linked to the numerous exemptions and tax reductions provided to those sectors with the most potential to achieve emissions reductions (recall discussion in Chapter 2). For example, in Germany, derogations for the manufacturing and energy-intensive industry lowered the overall potential positive environmental impact of the ETR, although modifications to the derogations introduced in 2003 have been found to increase CO_2 emission reductions compared to previous calculations. Similarly, modelling of the effects of the Norwegian CO_2 tax in 1990–1999 concluded that the actual effect of the CO_2 tax on GHG emissions has been rather low (circa 2 per cent if CO_2 emissions reductions; Sterner 2007). This rather limited effect is explained by the fact that the CO_2 tax only accounted for a fraction of total fuel taxes, the extensive tax exemptions and lack of demand elasticity in sectors covered by the CO_2 tax. However, energy intensity is found to have been reduced from 1990 to 1999 and contributed to a reduction of CO_2 emissions while a sectoral analysis points to positive effects of the CO_2 tax. The link between ETR and EU ETS has also led to some weakening of incentives for GHG emissions reductions in certain countries where installations under the EU ETS are granted exemptions from carbon taxes (recall discussion in Chapter 2). This is especially the case given the current low EU ETS carbon price.

Table 3.1: Overview of emission reduction objectives, achievements and the role of carbon and energy taxes in selected OECD countries

Country/ region	Emission reduction objective	Emission reductions achieved	Role of tax and other measures
AU	To reduce GHG emissions by 25 per cent by 2020 and by 80 per cent by 2050 compared to 2000 levels.	Modelling by the Treasury suggests that by 2020 domestic emissions will reach 621 Mt CO_2-e with a carbon price in place compared to 679 Mt CO_2-e without a carbon price; and by 2050 emissions will reach 545 Mt CO_2-e with a carbon price in place compared to 1008 Mt CO_2-e without a carbon price. Moreover, a carbon price is projected to reduce electricity emissions by 60 per cent below current levels by 2050 and drive down transport sector emissions over time.	The carbon price is expected to be a major driver of change. The rate starts at AUD 23 per tonne, rising by 2.5 per cent each year in real terms assuming inflation of 2.5 per cent. After 2015, the tax will be replaced by a trading scheme, creating its own carbon price.
BC	The carbon tax was introduced in 2008 to help reach the goal of reducing BC's GHG emissions by at least 33 per cent below 2007 levels by 2020.	Emissions in BC went down by 4.5 per cent from 2007-2010; from 2008 to 2010, BC's per capita GHG emissions declined by 9.9 per cent, which outpaced the reductions in the rest of Canada by more than 5 per cent. According to another estimate, over the first four years of the policy, the carbon tax led to a total reduction in emissions of over 3 million tCO_2e when compared with a counterfactual scenario of no tax.	Although it is difficult to assess how much of this decline was due to the carbon tax as BC's GHG emissions were already declining relative to the rest of Canada prior to 2008, the reductions are consistent with expected effects of a carbon tax and are in line with reductions seen in fuel use during 2008-11.
DK	Under the Kyoto Protocol, DK committed to reducing GHG emissions by 21 per cent between 2008-2012 compared to 1990 levels. More recently, the government announced a target to reduce GHG emissions by 40 per cent in 2020 from the 1990 base.	GHG emissions (excluding emissions from Land Use, Land Use Change and Forestry – LULUCF) peaked in 1996 and have steadily declined thereafter, to just above 60 million tonnes in 2009, i.e. 10 per cent below their 1990 levels. Total CO_2 emissions decreased by 24 per cent between 1990 and 2001. Danish industry reduced its CO_2 emissions by 25 per cent per produced unit from 1993 to 2000.	An ex-ante assessment expected that the tax might contribute around 5 per cent of the 20 per cent of DK's CO_2 reduction target. Energy taxes on business are said to have contributed to an overall reduction in energy consumption of 10 per cent.
FI	Finland's long-term goal is a carbon-neutral society involving an increase in energy-efficiency and the use of renewable energy.	Carbon emissions decreased by over 7 per cent (57 million tonnes) between 1990-1998	In 1999, a government working group on environmental taxation assessed the effects of environmental taxes and found that energy and carbon taxes reduced carbon emissions by over

			seven per cent during 1990-1998 and have caused a reduction in fuel use of 4.8 per cent.
DE	No explicit CO_2 objective related to the ETR, rather objectives are for a more efficient use of energy by incentivising energy savings and promoting renewable energies.	Ex-ante assessment suggest that by 2010 CO_2 emissions could be around 3 per cent lower compared to the reference scenario without ETR in place. Furthermore, there has been a reduction in transport fuels by 3.8 million tons (or 6.8 per cent) between 1999 and 2003 sector.	Intense debate as to whether the reduction in transport fuels was a result of the ETR or other factors including increasing oil and gas prices which are independent of tax increases.
IE	Commitment to reduce GHG emissions in non-ETS sectors by 20 per cent by 2020 compared to 2005 levels.	Ireland is on course to meet this target through domestic emission reductions supplemented by carbon units and helped by the economic downturn which led to a significant drop in emissions in 2009. Between 2008 and 2011, consumption of petrol fell by 21 per cent, while consumption of auto-diesel fell by 13 per cent. Other environmental effects are expected in the buildings sector and through a reduction in fuel tourism.	The carbon tax was anticipated to contribute to an average reduction of 0.15 Mt CO2e each year over the Kyoto period. Whilst some of the decline in fuel consumption may have been as a result of the carbon tax, a drop in consumption was already underway in 2008-2009 and reflects wider economic factors. Moreover, complementary measures have played a role including the recalibration of the Vehicle Registration Tax (VRT) and annual motor tax.
NL	Under the Kyoto Protocol, NL has an emission-reduction target of 6 per cent below the emissions level in the base year for 2008-2012. For 2020, the target is to reduce GHG emissions, especially CO_2, by 30 per cent compared to the 1990 level.	The RET has led to a yearly average demand reduction of 8 per cent for electricity (over the years 1994-99) and 4.4 per cent for natural gas (over the years 1992-99). Energy intensity improvement in Dutch industry over 1990 to 2000 of 10-15 per cent, although it did start from a relatively high initial level of intensity.	Tax structure implies CO_2 emissions from the production of most final energy products are 'exempted either implicitly, as in the case of crude oil or [natural gas], or explicitly, as in the case of electricity production'. This has been an inefficient outcome for CO_2 abatement as it results in low or zero energy taxes for those sectors with the cheapest abatement options.
NO	CO_2 tax aims to reduce GHG emissions in particular from the petroleum industry and hence stimulate low carbon technologies in this sector.	Taxes contributed to a reduction in onshore emissions of only 1.5 per cent and in total emissions of only 2.3 per cent over the period 1990 to 1999. Energy intensity reduced by 7.2 per cent from 1990 to 1999 and	The tax was found to be effective in reducing CO_2 emissions per unit of production which fell by around 22 per cent between 1990 and 2001.

		contributed to a reduction of CO_2 emissions by 11 per cent. There has however been a 30 per cent reduction in energy intensity among private households mainly due to a more efficient use of gasoline which may reflect changes in consumers' vehicle choice as a result of higher fuel prices.	
SE	The government aims to achieve energy savings of 9 per cent by 2016 from 2001-05 levels, reduce the energy intensity by 20 per cent below 2008 levels by 2020, reduce GHG emissions (by 40 per cent) and achieve 2020 targets for renewable energy and energy efficiency (20 per cent savings).	Average 2008-11 emissions in Sweden were 12.6 per cent lower than 1990 levels, well below the burden-sharing target of 4 per cent for the period 2008-12. Projections indicate that Sweden is going to reach its Kyoto commitment by a considerable margin. Total final consumption (TFC) of energy has remained stable since the early 1970s as a result of improved energy efficiency across the economy.	The COMETR analysis (see Box 3.2) suggests that the Swedish ETR has been the most effective at reducing GHG emissions of the ETRs studied, reducing GHG emissions by 6 per cent compared to a "no ETR" counterfactual scenario.
UK	Domestic goal set in the 2008 Climate Change Act is to achieve at least 34 per cent in GHG emissions by 2020 and at least 80 per cent by 2050 (against 1990 levels)	Average 2008–2011 emissions in UK were 24.7 per cent lower than base year well below the burden-sharing target of -12.5 per cent for the period 2008–2012. In sectors not covered by the EU ETS, emissions were significantly lower than their respective target, by an amount equivalent to 11.8 per cent of base-year emissions.	The CCL and CCA are estimated to have reduced CO_2 emissions by 3.5 and 1.9 MtC respectively in 2010, when compared with a business-as-usual scenario. Only the EU ETS has contributed to greater carbon savings, with the second phase of the EU ETS projected to have saved 8.0 MtC in 2010. Research indicates the CCA generated additional emissions savings in terms of raising awareness among industry management in what has been labelled an "announcement effect". This effect is said to have a bigger impact on emissions reductions than those that a CCL alone might have generated.

Sources: For references see country case studies in Annex I

CO_2 and energy taxes have also been found to contribute to reductions in fossil fuel use in some counties. For example in British Columbia consumption of petroleum fuels fell relative to levels in the rest of Canada (as did the province's GHG emissions) (Sustainable Prosperity 2012, Rivers et al 2012). In Germany, there has been a reduction in transport fuels by 3.8 million tons (or 6.8 per cent) between 1999 and 2003 although there has been intense debate as to whether the reduction in transport fuels was a result of the ETR or other factors including increasing oil and gas prices independent of tax increases. Analysis of the role of ETRs in Sweden, Denmark, the Netherlands, Finland, Slovenia, Germany, and the UK show that ETR has led to reductions in fuel demand in all these countries (bar Slovenia), generally by between 2 to 6 per cent (see Box 3.2).

The exact contribution from the carbon tax on these changes can be difficult to identify precisely as there are a range of instruments and factors in place that drive such developments (see Box 3.1). For example in Ireland, between 2008 and 2011, the consumption of petrol fell by 21 per cent, while the consumption of auto-diesel fell by 13 per cent over the same period. Whilst some of this may have been a result of the carbon tax, a drop in consumption was already underway in 2008-2009 before the introduction of the tax and reflects wider economic factors and the general downturn in the economy. Moreover, complementary measures have played a role in this decline for example the Vehicle Registration Tax (VRT) and annual motor tax were re-calibrated in July 2008 to be based on open market selling price and CO_2 rating and have had a significant impact on the composition of the new car fleet.

Distinguishing the contribution of the carbon and energy tax from the wider set of policy instruments can be non-trivial exercise (see discussion in Box 3.1). Similarly, distinguishing between the role of the tax rate and the use of the revenues can be a complex exercise and it is important to be wary of misleading analysis. For example an analysis of ETR that does not take into account the choice of revenue recycling can lead to false estimates – as this would only look at the tax burden and not the benefits of any reduction in other tax burdens and/or benefits of using the revenues raised. Box 3.2 presents some key findings of an in-depth EU research project that sought to identify specific impacts associated with ETR.

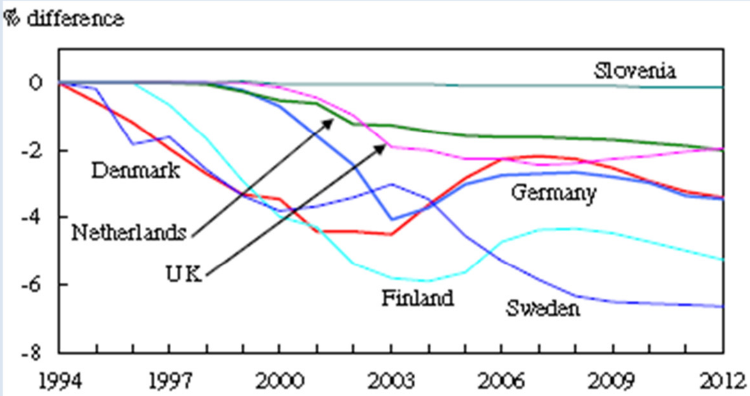
Box 3.2: Evaluating the impacts of ETR on GHG emissions and energy use – some results from the COMETR project

By 2007, seven EU Member States had implemented tax reforms which to some extent shift the tax burden from taxation of labour to carbon and/or energy: Sweden (1990), Denmark (1993), the Netherlands (1996), Finland (1997), Slovenia (1997), Germany (1999), and the UK (2001). The reforms included tax shifts towards energy and transport taxes, as well as in some cases a restructuring of energy taxes to reflect CO_2 emissions.

The FP6 COMETR project modelled the likely effects of fiscal reform on GHG emissions, energy use, GDP, employment, prices and competitiveness. With respect to GHG emission and energy use its conclusions were that:

- There are reductions in GHGs in six of the seven countries (Finland, Sweden, Germany, Netherlands, UK, Denmark) with the largest reductions occurring in regions with the highest tax rates (i.e. Finland and Sweden) - see Figure 3.1.

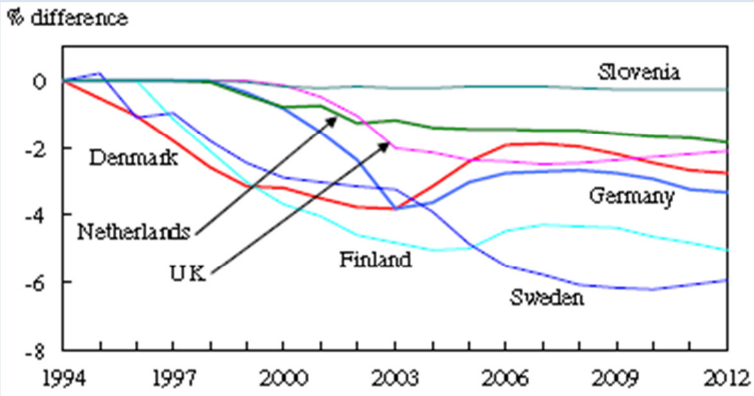
Figure 3.1: Effect of ETR on GHG emissions



Source: Andersen et al 2007, page 382

- There are also reductions in fuel demand from the ETR in these six countries – between 2 to 6 per cent for most countries – see Figure 3.2.

Figure 3.2: Effect of ETR on Fuel Demand



Source: Andersen et al 2007, page 381

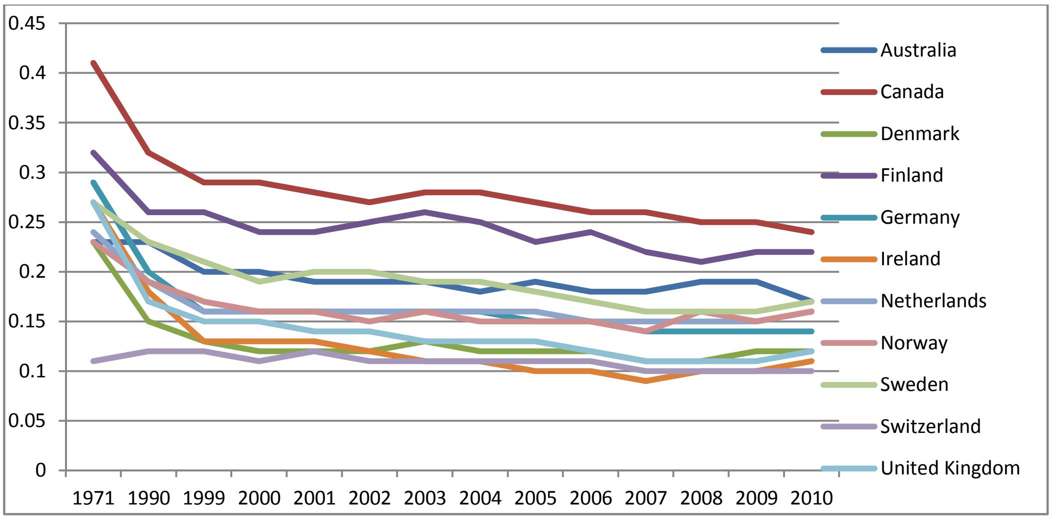
Source: Andersen et al (2007), complemented by Barker et al (2009)

Impacts on energy intensity

The energy intensity of the countries examined in the study has fallen over the last forty years, with substantial reductions starting before the introduction of energy tax reforms which were triggered by the oil shocks in the 1970s (see Figure 3.3). The energy intensity in Switzerland is among the lowest in the countries examined. This reflects the structure of the economy which is heavily reliant on high value-added services, with limited energy intensive industries; as well as a strong reliance on nuclear and renewable energy (in particular hydropower) in the energy mix (IEA 2012). This low energy intensity does not however suggest that there is little room for improvement - there remains potential for energy efficiency savings in the buildings sector as well as in the area of transport.

It has generally not been possible to show to what extent ETR has driven changes in the level of energy intensity at a national level. Some insights from the cases include for example Norway where energy intensity reduced by 7.2 per cent from 1990 to 1999 and contributed to a reduction of CO_2 emissions by 11 per cent. Among private households a 30 per cent reduction in energy intensity was reached, mainly due to a more efficient use of gasoline which may reflect changes in consumers' vehicle choice as a result of higher fuel prices (Bruvoll and Larsen 2004).

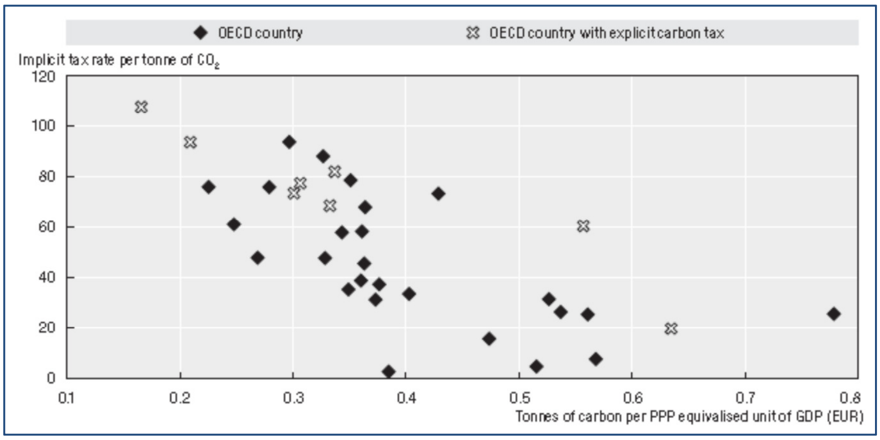
Figure 3.3: Energy intensity by country



Source: OECD (2011) - Factbook 2011 - Economic, Environmental and Social Statistics, Energy and transportation - Energy requirement - Energy intensity, Total primary energy supply per unit of GDP

While the focus in this report is on ETR, many countries with or without ETR have quite high levels of taxes on fuels, which lead to incentives to reduce fuel use (and in cases fuel switch), and hence reduce the carbon intensity of the economy. To put the above ETR related insights into a wider context, Figure 3.4 presents an OECD overview of carbon intensities and implicit carbon tax rates[14] which shows that countries with higher implicit tax rates on CO_2 tend to have lower carbon emissions per unit GDP.

Figure 3.4: Energy intensity by country compared to implicit tax rate per tonne of CO_2



Source: OECD 2013, page 51

With regard to wider decoupling, one concrete example on decoupling is that of Swedish SO_2 emissions – achieved through fuel switching and decreasing energy intensity, catalysed *inter alia* by the SO_2 tax launched as part of the Swedish ETR in 1991 (Hammar and Loefgren, 2001 in Mueller et

[14] Even without explicit carbon taxes in place a country's energy taxes can be converted into a tax rate per tonne of CO_2 to illustrate the implicit tax.

al 2012). Similarly there was decoupling of CO_2 emissions from industry and business in Sweden[15], with structural change playing a role as well as the CO_2 tax (Loefgren and Muller 2010). The own price elasticities of energy sector demand for energy were estimated to be between -0.35 and -0.44 for Denmark, Norway and Sweden, suggesting that environmental taxation contributes considerably to energy consumption reductions (Enevoldsen et al 2007a) – a 10 per cent increase in price should in principle lead to a 3.5 per cent to 4.4 per cent reduction in energy demand.

There are, arguably, also long-term positive impacts of ETR which should be taken into consideration given the influence of the reform on economic incentives (the 'invisible hand' of the market), the signalling value of taxes (on awareness, integration into company report and accounts, wider management board awareness), and via the wise use of incentives (e.g. grants for energy savings) and measures (e.g. requirement for energy audits and management systems).

3.2 Economic impacts

Impacts on GDP

The general perception in certain spheres of public debate about environmental measures is that they will have negative effects on GDP growth. There is however, a growing evidence base that ETR does not necessarily or generally lead to negative impacts on GDP. On the contrary, there is increasing evidence and analysis that suggests that ETR can have on the whole positive effects on GDP growth, although there are also cases of negative effects, with changes over time (Andersen 2007, Kohlhaas 2005, Bach et al. 2002).

The economic impacts of a particular carbon or energy tax reform depend on the design of the ETR (e.g. where the taxes are levied), where the burden falls (e.g. on important domestic activities), the timescale (e.g. phased approach, impacts on long-term competitiveness by encouraging resource efficiency and innovation) and the use of revenues (e.g. investing in energy efficiency improvements in affected industries). The use of revenues in particular is important as some studies look at impacts of tax rates without integrating considerations of how and where to reduce revenues so as to have a no net burden assessment. These types of studies will generally lead to results showing negative impacts on GDP, at least in the short-term. However, concluding that ETR is a bad policy on these grounds risks misinterpreting the meaning of the results. These studies often focus on the relative burdens of different tax policies, instruments and revenue raising approaches. For example, recent work by Vivid Economics (2012) compares the effect of different revenue raising taxes in Spain, Poland and Hungary and concludes that 'energy and carbon taxes perform well in comparisons against labour and indirect taxes like VAT when assessing their impacts on GDP and employment' (Vivid Economics 2012, pp. 123).

In Finland for example, the ETR is found to lead to an average increase in GDP of around 0.5 per cent in 2012. The increase in GDP occurs without any revenue recycling, with the main reason being that the taxes fall almost exclusively on imports of energy products and thus when energy demand falls there is an improvement in the international trade balance (Andersen et al 2007). In Ireland, data is limited given the recent introduction of the tax; however ex-ante simulations suggest that the

[15] While not the direct focus of the current study, it is useful to note that empirical analysis of the decoupling of NOx emissions per GWh in Sweden provides evidence that supports the conclusion that the main cause of extensive emissions reductions observed (a 40 per cent reduction in mean emission rates) was mainly due to the use of refunded emission payment (tax with refund). NOx tax revenues were refunded, net of administrative cost for the government, with firms receiving output based refunds rather than emissions based refunds (Sterner and Hoeglund Isaksson 2006 and Hoeglund Isaksson 2005 in Muller et al 2012).

introduction of a carbon tax with revenues recycled through a reduction in income taxes leads to increases in GNP and employment. However, if revenues are instead used to repay government debt, GDP and total employment is expected to decrease, at least in the short term. In British Columbia, economic analysis conducted by the BC government indicated that the carbon tax has had, and will continue to have, a small negative impact on GDP in the province. However, a recent assessment of British Columbia's GDP growth shows that it was higher than the rest of Canada raising questions of the earlier prediction that the CO_2 tax will negatively influence GDP growth (Sustainable Prosperity 2012).

It is useful to underline that impacts on GDP do not necessarily provide the whole story of the economic impacts of an ETR. The reform can also lead to a number of wider economic benefits. For example, BC has attracted green investment and green technologies at twice the Canadian average adoption of hybrid vehicles, 20 per cent of all Canadian LEED gold building registrations since 2007, and a 48 per cent increase in clean technology industry sales from 2008-10 (British Columbia Ministry of the Environment 2012). Moreover, as a result of the corresponding tax cuts, BC now has one of the lowest income tax rates and general corporate income tax rates in North America. There are also wider, long-term positive impacts which should be taken into consideration given the influence of the economic incentives provided by a carbon price.

For an overview of impacts on GDP and wider economic impacts, see Table 3.2 and detailed case studies in Annex 1. Some of these results are based on ex-ante assessments, few ex-post assessments have been carried out to date. Given the importance of ETR and its future potential, it seems sensible for there to be regular ex-post assessments of carbon energy taxes as well as wider ETR. Box 3.3 provides further evidence on economic impacts of ETR from the COMETR study.

Table 3.2: Country cases: Impacts on GDP and other economic impacts

Country/ region	GDP	Other impacts
AU	Ex ante modelling by the Treasury estimates that GNI per person will decrease by around 0.1 of a percentage point per year.	Ex ante modelling by the Treasury estimates that emission intensity of GDP will decrease by 2020 from 0.39 kg CO_2-e/AUD without carbon pricing to 0.36 kg CO2-e/AUD with carbon pricing and in 2050 from 0.28 kg CO2-e/AUD without a carbon price to 0.15 kg CO2-e/AUD with a carbon price.
BC	BC's economy outperformed the rest of the country over the period that the carbon tax has been in place. Assessments differ as regards the economic effect of the tax - economic analysis by the BC government indicates that the carbon tax has had, and will continue to have, a small negative impact on GDP in the province. Others note that the data does not appear to suggest that any negative effect has taken place.	BC has attracted green investment and green technologies at twice the Canadian average adoption of hybrid vehicles, 20 per cent of all Canadian LEED gold building registrations since 2007, and a 48 per cent increase in clean technology industry sales from 2008-10. Moreover, the carbon tax has had a significant impact on the capital project decisions of local government officials.
DK	An assessment of the CO_2 tax carried out by the Ministry of Finance in 1999 found that the tax has an overall positive impact on economic growth (additional burden vs. lower labour costs/social contributions), but it became a minimal additional burden of 0.03 per cent of GDP over the period 2000-2005.	Positive correlation between energy use and economic growth has been broken - economic growth is no longer accompanied by a corresponding increase in energy use.

FI	According to the results of the COMETR study, ETR leads to an increase in GDP which varies over time, but averages at around 0.5 per cent in 2012. The GDP impact is positive even without revenue recycling.	Taxes fall almost exclusively on imports of energy products and thus when energy demand falls there is an improvement in the international trade balance and thus a positive impact on GDP.
DE	Ex ante modelling suggested that GDP would be 0.45 per cent higher in 2003 with ETR than without ETR, 0.3 per cent higher in 2005 and 0.13 per cent higher in 2010.	By 2008 around half of the price increases for diesel and gasoline is related to ETR, whereas its influence on gas and heating oil is rather low. The impact is highest on electricity which was however to a certain extent compensated by decreasing electricity prices after the liberalisation of electricity markets.
IE	Ex ante simulation of a carbon tax of EUR 20/tonne of CO_2 found that where the revenue from a carbon tax is used to cut income taxes, GNP is estimated to grow 1.1 per cent faster than in the baseline (that assumes no tax reform).	If revenue from a carbon tax is used to repay government debt on international markets a double dividend will not arise. In such a scenario, ex ante simulation finds that the volume of GDP at market prices would decrease by 0.21 per cent as a result of the carbon tax with just under half of the effect of the tax in terms of lost output arises in manufacturing and the remainder occurs in market services.
NL	According to the results of the COMETR study, the ETR has been estimated to lead to a small positive impact on GDP.	ETR made investments in clean technologies more attractive. However, it is not clear whether this has led to measurably more innovative activities by Dutch firms that would give them a competitive advantage.
NO	No recent assessments could be found on impacts of the carbon tax on GDP.	Early work noted closures of firms in energy-intensive industries (metal, petroleum and chemical industries), while other more recent evidence suggests positive innovative effects.
SE	According to the results of the COMETR study, ETR has led to an increase in GDP of around 0.5 per cent, though this benefit took many years to materialise. There were some short term economic losses associated with the ETR.	One assessment noted that the losers of the CO_2 tax will be larger, carbon intensive companies while winners are likely to be SMEs that can quickly adapt and innovate. Later analysis noted that large companies have higher financial potential to invest in changes and hence mitigate effects. The CO_2 tax has led to increased use of biomass, supporting forest and forest industries, and lesser imports of fossil fuels.
UK	Ex-ante modelling suggested that the combination of the CCL and the NIC reduction together has little effect on the main macro variables. By 2010, GDP is only 0.06 per cent higher than without the CCL. An audit by the UK National Audit office in 2007 concluded that GDP and employment were slightly higher and average industrial costs were lower although the balance of payments were slightly negative.	Companies that paid the full CCL and companies with CCAs do not seem to be significantly affected in terms of job losses, output or productivity. A 2009 assessment of the impacts of the CCL did not find any statistically significant impacts of the tax on employment, gross output or total factor productivity.
CH	From the ECOPLAN study: GDP impacts of ETR are scenario/instrument dependent. Under the moderate policies, POM, scenario GDP effects are estimated to be between +0.3 per cent to -0.6 per cent depending on the time horizon and redistribution mechanisms. Under the	The ECOPLAN study notes that there may be some significant impacts on exports in the ambitious policy scenario (NEP). However, those are largely limited to sectors with a small share in overall exports (except for metallurgy). The study finds that rather than the design of the

	ambitious, new policies, NEP, scenario, GDP effects are estimated to be between +0.9 per cent to -2.8 per cent. Overall, it is shown that GDP losses are higher the larger the share of revenues redistributed via lump-sum payments (ECOPLAN 2012).	redistribution mechanism it is the design of the tax system, notably the higher level of taxes in the ambitious policy scenario that yields more significant impacts. This also holds for imports, where most significant decreases are found for energy-intensive goods, as well as for impacts on sectoral output, where the impact on energy and electricity intensive sectors is evident (apart from the transport and the chemical sectors) (ECOPLAN 2012, p66-70).

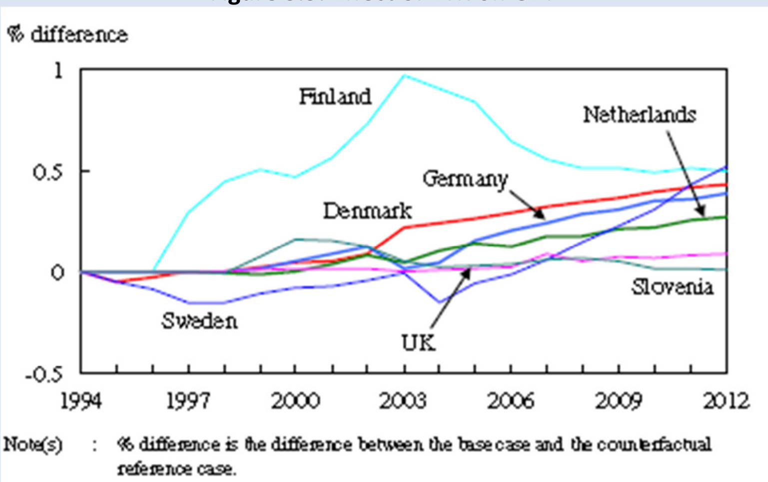
Sources: For references, please see country case studies in Annex I

Box 3.3: Evaluating the impacts of ETR on GDP – some results from the COMETR project

The FP6 COMETR project modelled the likely effects of fiscal reform on GDP. Some of its conclusions were that:

- As a general rule, the effects of ETR will be positive on economic activity, depending on how the revenues from environmental taxes are recycled. However, it is likely that there will be transition costs, so the gains may not be immediate.
- Five of the seven countries examined have seen a real increase in GDP as a result of the ETR: Finland, Sweden, Germany, Netherlands, and Denmark – see Figure 3.5. The UK and Slovenia saw a more marginal increase, but still positive. All seven saw a small double dividend in the sense of CO_2 reductions and GDP gain from their ETR (Ekins and Speck 2012).
- For Sweden there was initially a decline in GDP – as large electricity price rises put downward pressure on household income in the short term – but in the end a relatively significant positive impact was seen from the ETR.
- Finland had a very positive short term impact as there was a reduction in national fuel imports which improved its trade balance.

Figure 3.5: Effect of ETR on GDP



Source: Andersen et al 2007, page 383

- ETR in Germany and the UK has very little effect on exports; similarly there was little effect on exports in Finland and Sweden. However Denmark and the Netherlands see a small increase in exports over the period, in the case of Denmark this is the result of lower labour costs as revenues are recycled by reducing social security contributions.

Source: Andersen et al (2007), complemented by Barker et al (2009)

Competitiveness impacts and energy-intense sectors

ETR has the potential to affect (positively or negatively) a nation's overall competitiveness, the competitiveness of a particular sector, and the competitiveness of individual enterprises within the economy (see Box 3.4 for definitions). It is possible to have competiveness benefits for a sector, but losses for individual enterprises, and also gains at a national level but losses at a sector level.

Box 3.4: Competitiveness: Some definitions and issues to keep in mind

The OECD states that competitiveness denotes 'the degree to which a country can, under free and fair market conditions, produce goods and services which meet the test of international markets, while simultaneously maintaining and expanding the real incomes of its people over the longer term' (OECD 2003). Competitiveness is defined differently at the national, sector and firm level.

- **At the firm level** - 'competitiveness' can broadly be seen as 'being able to produce products [or provide services] that are either cheaper or better than those of other firms [in a competitive market)' (OECD 2003). The issue is therefore about price and quality, measured in sales and within global markets, the level of trade. Note that a product can be more expensive yet still competitive. The impact is then on the product margins/profitability but not one of competitiveness. In practice, 'competitiveness' is used as a proxy for 'profitability'. Carbon-energy taxes can and will affect short-term firm profitability, generally negatively, but this does not necessarily lead to an effect on competitiveness as such. That depends on the scale of the effect (i.e. whether there is still sufficient rate of return in competing in markets) and the relative price effect (i.e. whether prices can compete).
- **At a sector level** competitiveness translates into maintaining or expanding market share – which can be a national or international issue. The sector performance can be seen as an aggregate of all the firms' performance. The OECD, after recognising that exemptions and tax reductions avoided competitiveness effects, observe that: '…skills and capital investment largely determine sectoral competitiveness' (OECD 2001, pp. 10).
- **At a national level,** competitiveness is seen as equivalent to the ability to produce goods and services in internationally competitive markets and have a sustainable rise in standards of living and low level of involuntary unemployment (OECD 2003 and EC 2007). This is beyond the sector that faces the carbon-energy tax and considers impacts across different sectors in the economy**.**

Issues affecting competitiveness at the international level include trade barriers, import tariffs, exchange rate variation (Ekins and Speck 2012). At the national level, issues include wages, availability, and costs of inputs, including transport costs, taxes, subsidies and regulation. There are natural comparative advantages that lead to competitiveness advantages, e.g. abundance of land, fertile soil, fuel and quality raw materials for products and processes, infrastructure and production methods. Similarly skills and education can affect productivity, innovation and hence competitiveness as can the rule of law and corruption which can facilitate or distort markets, market access and pricing. Carbon and energy pricing is therefore one factor among many that affect competitiveness.

In addition to distinguishing between competitiveness at the national, sector and firm level, is useful to distinguish between short-term competitiveness and long-term competitiveness. Taxes may create a burden in the short-term but serve as a catalyst for innovation that supports long-term improvements including in the use of resources, help to reduce costs of factor inputs, product price and hence support profit margins and eventually competitiveness in the long-term. It is also useful to distinguish between different players in a sector as a new tax burden will burden efficient and well-managed firms less than it will affect inefficient poorly managed ones.

The competitiveness impacts of ETR, particularly for energy intensive industries whose products compete in international markets, have been a concern across several countries and been the main reason for granting partial or full tax exemptions. Depending on the point of application of the tax and the potential to pass through costs, carbon and energy taxes can lead to increased production costs. Where the tax is implemented unilaterally there may be a relative increase in production costs with respect to competitors. If this takes place in competitive markets with highly traded goods then the ETR could lead to a potential disadvantage vis-a-vis competitors and hence affect market share and profitability. Taxes can also lead to consumer price impacts, which can suppress demand, and reduce profitability. Whether this leads to competitiveness impacts depends on whether the price impacts feed through to the different producers to the same extent and how this affects the ability of their products to compete in domestic and international markets. Other issues that may affect a firm's competitiveness include labour costs, quality of the workforce, infrastructure, regulatory and fiscal frameworks and their implementation, access to natural resources and pricing (of resource inputs and pricing regimes for outputs such as electricity).

The level of competitiveness impacts depends not only on ETR design and the range of other factors mentioned above, but also on the use of the revenues raised by the tax (i.e. whether recycled and in what way; or in the case of a tax shift, which other taxes may be reduced). See Box 3.5 for an overview of the results on competitiveness impacts of ETR from the COMETR study (Andersen et al 2007). Recycling revenues can avoid major impacts and indeed even help improve competiveness among more advanced companies where the mechanism is linked to performance (as was the experience of the NOx tax in Sweden). In the case of tax shifts, the competitiveness impact will depend on what other taxes are reduced. For example where labour taxes or social security payments are reduced then there will be gains to those companies that have high labour intensity and losses for those that have low labour intensity but high energy intensity. This may lead to competitiveness losses in some companies in the sector targeted and gains more widely for the economy as a whole. Note that competitiveness gains are likely to be higher in particular when employers' social security contributions are lowered as part of the tax shift; lowering employee social security contributions or income taxes can not only be a social means of compensating for higher environmentally-related taxes by increasing disposable income, but also over time help reduce the costs of labour which can in turn support competitiveness.

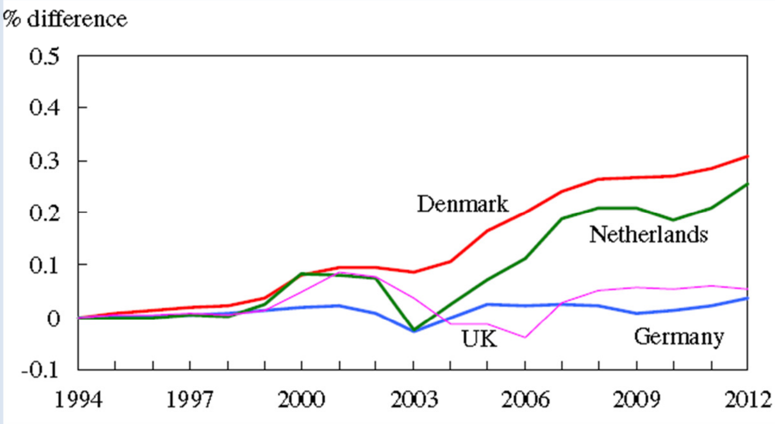
Box 3.5: Evaluating the impacts of ETR on competitiveness– some results from the COMETR project

The FP6 COMETR project modelled the likely effects of ETR on competiveness. The study looks at the changes to export levels linked to the ETR as an indicator of competiveness, the share of energy costs as a percentage of turnover to give an indicator of potential sensitivity to ETR, and effects on price to see actual effects that might lead to competitiveness impacts. Some conclusions of the study are set out below:

National level

- ETR has been estimated to lead to a small increase in exports over the period in Denmark and the Netherlands. In the case of Denmark this is the result of lower labour costs as revenues are recycled by reducing social security contributions. ETR has very little effect on exports in Germany and the UK and an insignificant effect on exports in Finland and Sweden.
- Imports are broadly unaffected in Germany, fall slightly in the UK, fall quite significantly in Finland (reduced fuel imports), while they rise in Denmark and most significantly in Sweden (by 0.8 per cent). The authors of the COMETR study do not see the Swedish rise in imports as an indicator of competiveness loss, but instead as a result of increased consumer demand linked to reduced labour taxes through revenue recycling and GDP growth.

Figure 3.6: Effect of ETR on exports



Source: Andersen et al 2007, page 406

Sectoral competitiveness

- Energy does not generally represent a large share of inputs for the sectors looked at - food, drink and tobacco; wood and paper; pharmaceuticals; other chemicals; non-metallic minerals' basic metals. Only in the case of 'Other Chemicals' in the Netherlands, does the share of energy inputs in turnover exceed 10 per cent. In most cases the figure is around 5 per cent, with non-metallic minerals and basic metals having slightly larger shares.
- For a 5 per cent share, even a 50 per cent increase in price would lead to only a 2.5 per cent increase in input costs, with the effect on output dependent on price elasticities, which as they are typically less than 1, would lead to a demand effect of less than 2.5 per cent. The COMETR study's conclusion is that even for energy-intense industries (of the set examined) large falls in output are not expected.
- The estimated price effect from the actual ETRs (generally lower than the hypothetical 50 per cent used to illustrate and scope the issue above) show that the highest prices rises are about 1 per cent for only two sectors in Sweden – non-metallic minerals and food, drink and tobacco. Wood and paper costs fall (given savings on labour costs). Effects on other sectors are generally between 0.2 and 0.4 per cent.

Table 3.3: Energy as a share of turnover (%)

	DK	DE	NL	FI	SE	UK	SI
Food, Drink & Tobacco	1.5	2.0	1.5	1.4	1.0	1.5	1.9
Wood & Paper	1.9	3.3	2.9	5.1	3.7	3.0	6.5
Pharmaceuticals	0.4	7.2	0.0	6.5	0.3	0.9	0.0
Other Chems	4.2	6.5	17.5	8.9	8.4	3.9	4.3
Non-Metallic Minerals	5.4	5.8	4.2	3.5	4.4	4.4	8.9
Basic Metals	3.0	8.7	5.8	6.6	4.5	4.7	9.4

Source(s) : CE, E3ME database.

Source: Andersen et al 2007, page 408

Table 3.4: Effect of ETR on Exports

	DK	DE	NL	FI	SE	UK	SI
Food, Drink & Tobacco	0.01	0.05	0.00	0.46	1.69	0.00	0.04
Wood & Paper	-0.57	-0.40	-0.34	-0.26	-0.33	-0.48	-0.32
Pharmaceuticals	0.01	-0.09	-0.01	0.87	0.05	0.09	-0.02
Other Chems	0.32	0.72	0.11	0.36	0.28	0.36	0.08
Non-Metallic Minerals	0.33	0.46	0.26	0.77	1.06	0.29	0.16
Basic Metals	0.51	0.43	0.50	0.53	0.48	0.62	0.46

Source: Andersen et al 2007, page 408

Source: Andersen et al (2007), complemented by Barker et al (2009)

The message in the COMETR study is largely the same as an earlier study by Baron and ECON-Energy (1996) which modelled the likely effect of a USD 100/t carbon tax. Cost increases were seen as generally being between one and five per cent, with costs less than two per cent for most countries, bar USA, Canada and Australia which are all more energy intense. The potential impact on production costs were, however, very significant (more than 10 per cent) for the non-ferrous metals sector in Belgium and Australia, and significant (five per cent or more) for the iron and steel sector in Belgium, Australia and Canada, and for the pulp and paper sector in Canada. This is a result of static modelling (i.e. not allowing for innovation), so in reality with long enough lead times, the costs would be less (see OECD 2001). The Baron and ECON-Energy analysis assumed no exemptions or tax reductions. Where these are in place the impact will be less. For example, analysis of the German ETR suggested that the existence of derogations has led to sectors generally facing an additional tax burden of less than one per cent of turnover (OECD 2001).

The ETR may also help companies identify and implement cost-effective energy efficiency measures, innovate and actually improve their competitiveness position (Ekins and Speck 2012). This effect is also known as the 'Porter hypothesis' – environmental regulation can induce efficiency and innovation, and these gains can in cases more than fully offsets the costs of complying with regulation and hence help competitiveness (Porter and van der Linde 1995). If the timing is right with respect to production cycles, opportunities for technological change or innovation, then taxes can lead to competiveness gains in the short term and particularly in the longer term. The experience with the UK Climate Change Agreements where companies met targets eight years early (see Box 2.3), suggest there were short term advantages to the companies in making use of energy efficiency opportunities. This experience also demonstrates that companies do not always work at the 'efficiency frontier' for energy use – i.e. they do not automatically work as efficiently as they could and there are potential efficiency gains to be realised (Ekins and Etheridge 2006 and Ekins and Speck 2012). With respect to the long-term, early warning of fiscal reform and expectation of a long-term commitment to ETR can lead to more fundamental changes as more innovation and technology change is embraced in production processes[16].

The literature on concerns of negative impacts on competitiveness, exports, trade flows, relocation of companies due to environmental regulation does not come up with statistically significant or robust evidence to support the claim (see Jaffe et al 1995, OECD 1996, Smarzynska and Weil 2001, Sijm et al 2004, Oikonomou et al. 2006 - in Ekins and Speck 2012). The main reason for this lack of effect has been the successful integration of competitiveness concerns into the design and implementation of policy instruments. While the logic of arguments of the risk of carbon leakage, industry displacement, competitiveness losses though an increased tax burden is not wholly wrong; there has been a "successful" response to these arguments which have reduced the risk of their occurrence. Furthermore, a range of other factors (such as innovation gains) have not been fully taken into account in the arguments (see Box 3.6 on carbon leakage).

Box 3.6: ETR, carbon leakage and pollution havens: what does the literature say?

Carbon leakage is where carbon emissions are emitted abroad. This can take place as products are imported rather than produced domestically and hence CO_2 emissions associated with the product purchase are outside the country; this is known as "embedded emissions". Looking at a nation as a whole, this leads to the concept of "Balance of Emissions Embodied in Trade (BEET)" where developed, countries usually have a

[16] Long-term elasticities are usually significantly larger than short-term elasticities as changes in demand can benefit from more areas of change – e.g. not just fuel switching or demand reduction which are short-term responses, but also changes in process technologies, techniques, new products and changes in habits, which can take longer.

negative balance, i.e. are net importers (de Melo and Mathys, 2010). Carbon leakage can also be linked to the relocation of industries (e.g. to 'pollution havens' if and where the relocation is linked to lesser environmental standards) or to an increase in production from abroad (i.e. with loss of national producers' market share).

There is no risk of direct leakage for building stock, little for domestic transport, and some limited leakage potential for power generation (to the extent of potential imports, which depend on the level and capacity of interconnectivity of networks). The potential for leakage is greater in sectors facing high international competition with highly traded goods, where costs cannot be passed onto consumers and where there is no border tax adjustment in place to mitigate risks of leakage. The Fourth Assessment report of the IPCC, published in 2007, stated: *'Critical uncertainties remain in the assessment of carbon leakage. Most equilibrium modelling supports the conclusion in the TAR* [third assessment report] *of economy-wide leakage from Kyoto action in the order of 5-20%, which would be less if competitive low-emissions technologies were effectively diffused.'* (Pachauri and Reisinger 2007, p. 59).

Pollution havens - this term emerged in response to environmental regulation in the 1970s and suggests that environmental policy would lead polluting industries to relocate from countries with relatively high environmental standards to those with lower standards and/or lower enforcement. As noted in Ekins and Speck (2010, pp.7): 'the "pollution haven" literature that has since emerged has, like that on firms, arrived at some conflicting conclusions but at an overall consensus that if there are such displacement effects, they are not very great', and any relations are statistically weak (Sijm et al. 2004, pp. 165). A similar conclusion was reached by de Melo and Mathys, (2010) with regard to $SO_{2,}$ which noted that 'post econometric estimates trying to disentangle the environmental effects from other determinants of bilateral trade volumes across a broad range of manufacturing activities have also failed to detect significant [relocation] effects' (de Melo and Mathys**,** 2010, pp. 25). For CO_2, however, analysis suggests that there could be considerable leakage for highly traded products produced via energy-intense processes. Leakage risks occurr mainly via product embedded CO_2 emissions. Note that the risk only applies to a subset of a nation's CO_2 emissions (the traded energy-intense goods), but is potentially important for others– notably for chemicals, aluminium, cement (de Melo and Mathys, 2010, Annex 1, pp57-61). This risk decreases the lower the effective tax rate and reduced by border tax adjustments. No cases of relocation driven by CO_2 taxation has however been found in the case studies examined in this study.

The literature on pollution havens and competitiveness suggests that while there are risks, in reality they tend to be small or negligible given mitigating measures. Furthermore, relocation risks tend to be less than feared or argued as it is generally other factors that drive relocation (notably wage rates) than environmental regulations. Jaffe et al. (1995) for example examined over a hundred studies on the potential effect of environmental regulations (i.e. not only taxes) on the competitiveness impact on US industry and found that, 'overall there is relatively little evidence to support the hypothesis that environmental regulations have had a large adverse impact on competitiveness'. This is seen to be due to the fact that costs associated with environmental regulations have been relatively modest, that environmental conditions (at least as regards OECD countries) are broadly comparable, and where not then outside investors tend to have somewhat stricter standards than those in the country (which reduces the incentive to relocate). While this conclusion relates to environmental regulation as a whole, it is relevant for environmental taxes, as what matters is the scale and nature of the burden, which can come from regulation and standards as well as taxes.

The literature on carbon leakage, however, points to a real risk of impacts that would imply a response to changing competitiveness differentials. While much of the literature present ex ante assessments of the risks of effects rather than ex post confirmations of impacts, the risk is real, and would become increasingly real with higher CO_2 tax rates for energy-intense products that are traded in highly competitive markets. Even here though, other factors such as labour costs are likely to remain at least as important, and only a fraction of carbon leakage will be directly due to carbon tax policies. Border tax adjustments are one instrument that could potentially address this risk (Vivid Economics 2012), as could suitable use of tax exemptions or tax reductions. Over time, innovation at the domestic level as well as technology diffusion and innovation at the international level could help reduce the risk of carbon leakage.

In practice policymakers have listened to concerns of business regarding the impact of environmental taxes on competitiveness and have designed instruments to reflect these concerns, e.g. by granting a range of (partial) exemptions, special tax provisions, refund systems to the sectors, different rates for different users and fuels (e.g. lower rates for natural gas and electricity for high-users in the Netherlands) (Speck and Jilkova 2009). These exemptions are also known as mitigation measures (e.g. mitigating impacts by reducing taxes) or as compensation measures such as refund systems (OECD 2001). Such measures reduce the environmental effectiveness of the tax by reducing the level of incentives for investment and consumption (OECD 2001) – see discussion on exemptions in Chapter 2.

As the ETRs assessed in this report generally have such exemptions in place, it is most likely that their effectiveness and efficiency is less than it could have been without these measures. Given insights on competitiveness impacts outlined above, it appears that more exemptions and favourable tax treatments have been offered than absolutely necessary as exemptions and reductions are in place not only for energy-intensive sectors with highly-traded products in competitive international markets. Such provisions may have been (deemed) politically necessary for the ETR to be accepted, however lessons should be learnt for future ETRs and their reform. Any special provisions should be carefully examined to assess whether they are actually needed to avoid competitiveness impacts, they should be minimised to the extent politically necessary for the ETR to be launched, and reduced over time (recall Chapter 2 on level and timing of exemptions).

It is useful to note that granting tax exemptions and/or partial reductions to certain sectors can increase the cost of meeting CO_2 emissions reductions targets (Boeringer and Rutherford 1997[17]) in OECD 2001) which in turn create a wider risk for national competitiveness. This underlines the need to address competitiveness concerns by partial tax reductions only for those sectors at risk and proportional to the risk. One potential solution to address competitiveness impacts and carbon leakage often mentioned but difficult to put into practice is that of border tax adjustments. This is the focus of a parallel study to this one (see also discussion in Vivid Economics 2012).

Employment impacts

Employment impacts from ETR seem to be generally positive overall for a country, although this depends on whether and how revenues are recycled – for an overview see Table 3.5. In Australia, for example, modelling by the Treasury estimates that carbon pricing is expected to slow Australia's average income growth by around 0.1 of a percentage point per year, however average incomes are expected to increase by about 16 per cent from current levels by 2020 while national employment is projected to increase by 1.6 million jobs by 2020. ETR has been shown to contribute to a growth in employment by up to 0.5 per cent in Denmark and Sweden, and lower but still significant levels of benefits in Germany (circa 0.2 per cent) - see Box 3.7 (Andersen et al 2007). These modelling results are similar to those of ex-post assessments, for example the ETR in Germany with recycling was found to have positive employment effects of between 0.15 to 0.75 per cent (Truger 2008) which also fits with other modelling analysis, for example the ex-ante assessment by Kohlhaas (2005) which found positive effects from ETR on employment in the order of 0.25 million additional jobs. Analysis in other countries supports this message. For example, a hypothetical carbon tax in Estonia was estimated to lead (under all scenarios), to a positive impact on employment of up to 1 per cent (Kiuila and Markandya 2005).

[17] Modelling by the authors suggest that meeting a 30 per cent reduction in CO_2 emissions from 1990 levels would lead to abatement costs being one fifth higher than without potential exemptions (this assumed low carbon leakage rates).

It is generally understood that the best job-related outcomes for green tax revenues are obtained as a result of lowering taxes and social security contributions paid by employers and/or employees (European Commission 2012). It is important to note that the level of impacts on employment will be sensitive to the nature of the wider ETR, what other taxes or charges are reduced (e.g. labour taxes) and what is done with the revenues. Similarly the point of application of the tax will be important with regard to where job losses may take place - as even if there will be positive impacts for the country as a whole, there may be losses for specific companies in a given sector.

Table 3.5: Insights from case studies on ETR impacts on employment

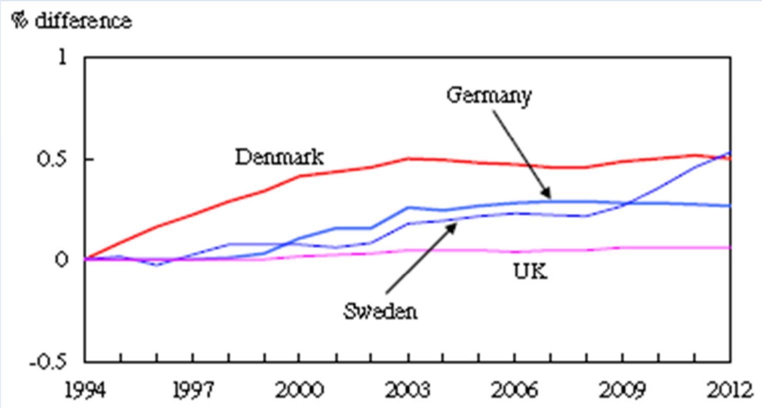
Country/region	Employment impacts
AU	Ex ante modelling by the Treasury estimates that average incomes will increase by about 16 per cent from current levels by 2020 while national employment will increase by 1.6 million jobs by 2020.
BC	No data was found on the impact on employment.
DK	CO_2 tax is considered to have had a positive effect on employment: the COMETR study estimates that the ETR contributed to a growth in employment by up to 0.5 per cent.
FI	There was no evidence found on either a positive or negative impact on employment.
DE	Modelling shows that employment could be 0.46 per cent higher in 2010 compared to a reference scenario without ETR.
IE	Ex-ante simulation of a carbon tax of EUR 20/tonne of CO_2 finds that where the revenue from a carbon tax is used to cut income taxes, employment will grow by 1.1 per cent. Total employment is found to fall by 0.07 per cent if revenue from the carbon tax is used to repay government debt.
NL	Recycling of tax revenues found to have led to a small, positive employment impact of 9000 new jobs (or ~0.1 per cent of the Dutch workforce).
NO	No evidence of impacts was found. This is not surprising given the low labour intensity of the sector targeted.
SE	Employment is higher due to the ETR - by around 0.5 per cent, though it took some years for this effect to be felt. The revenues were used to reduce income tax, which helped support employment change.
UK	Employment slightly higher, but this is arguably only a very marginal gain and less than for most other ETR countries, and due to the size of the CCL.
CH	The Ecoplan study found that under the POM scenario, +0.7 per cent to -0.4 per cent change in employment compared to the reference scenario depending on the redistribution channel time horizon. Under the NEP scenario, the change is found to be +1.5 per cent to -1.1 per cent (p55). It is shown that losses in employment (as well as in net real wages) are higher the larger the share of revenues that is redistributed via lump-sum payments (p106) (ECOPLAN 2012).

Sources: For references please see country case studies in Annex I

Box 3.7: Evaluating the impacts of ETR on employment– some results from the COMETR project

The COMETR project also looked at the social impacts of ETR including on employment. The ETR was shown to contribute to a growth in employment by up to 0.5 per cent in ETR countries – notably Denmark and Sweden, and with still significant albeit lower levels of benefits in Germany (circa 0.2 per cent). The employment benefits are due to the use of ETR revenue to reduce labour costs. The Danish benefits occur in the short term and benefits in Germany and Sweden take longer to be realised. Benefits in the UK are smaller as the level of revenue recycled was smaller.

Figure 3.7: Effect of ETR on employment



Source: Andersen et al 2007, page 384

Source: Andersen et al (2007), complemented by Barker et al (2009)

3.3 Social impacts

The social impacts of ETR (including distributional impacts, impacts on consumer prices, and household income levels) strongly depend on the use of revenues from the taxes within the wider revenue recycling mechanisms of the ETR (e.g. to facilitate reductions in labour taxes), or via the use of funds themselves (e.g. to increase pensions and family tax benefits in Australia).

Price impacts related to ETR include higher fuel prices, which can also manifest itself in a higher consumer price index (an effect seen in Sweden and to a lesser extent the Netherlands). In some cases the tax shift (e.g. reduced labour costs) in the ETR compensates for higher prices in one area (fuel) but increases income or lowers prices in another thus leading to a positive net impact on income (see Australian case in Table 3.6). The upward pressure from the tax can also be compensated such that there is no net impact on CPI (e.g. Denmark - see Box 3.8 for further details). The impact on real income from increased taxes was the subject of research in the PETRE research project which found that at an aggregate EU level, reforms entailing higher energy taxes with recycling measures in place would generate positive changes in real income for all socio-economic groups under consideration and under all scenarios (Pollitt & Barton, 2011 in Vivid Economics 2012).

The experience with regards to **distributional impacts** (i.e. whether the ETR is progressive or regressive) is mixed across the countries examined– see Table 3.6 for an overview. The schemes in Denmark, Finland, Germany and Ireland have been found to be regressive. For example in Denmark, CO_2 taxes are found to be regressive, with regressive impacts of indirect CO_2 taxation (price effects in the purchase of energy-intensive goods and services when CO_2 taxes are imposed on industry) generally less pronounced than effects of direct CO_2 taxation.

Distributional impacts can also change over time with increases in tax rates and broadening of the tax base. For example in BC, the impact of the carbon tax on lower-income households was initially fully offset by corresponding tax cuts and credits – i.e. it was initially a progressive tax regime. However successive increases in the tax rate have not been matched by sufficient increases in the low income tax credit and this has resulted in an increasingly regressive carbon tax regime. In Ireland the recent extension of the carbon tax to coal and commercial peat has in particular raised concerns about potential impacts on low income households and fuel poverty.

In some countries, the regressive impacts of the ETR have been compensated by specific recycling measures and the proper use of revenues on well targeted initiatives. For example in the Netherlands, the regressive design of the tax rates is nearly neutralised given exemptions applied. The Dutch case is put forward in an EU-wide review of ETR by the EEA as a good example of policy options to avoid negative distributional effects of ETR on private households (EEA 2011a). In the Netherlands, households benefit from a tax credit per electricity connection of EUR 319 as of 2009. The credit is provided as a lump sum refund on household's electricity bills and was introduced to mitigate the adverse effects of energy taxes on poorer households. In addition, a special tax allowance is granted for older people (EEA 2011a). Similarly, means-tested heating benefits are offered in Germany which mitigates the impact of energy price increases on the poorest households (EEA 2011a). The 2012 ECOPLAN study found that impacts of ETR in Switzerland are influenced quite substantially by the choice of distribution mechanism. The study concludes that a mix of redistribution channels should be chosen including progressively operating but inefficient lump-sum redistribution to households as well as more efficient reductions of labour and earnings taxes (ECOPLAN 2012).

Table 3.6: Insights from case studies on ETR impacts on income distribution and changes over time

Country/ region	Impacts on income distribution and changes over time
AU	According to modelling by the Treasury, although carbon pricing will lead to a small increase in overall prices - the Government estimates that households will experience cost increases of AUD 9.90 per week, but receive assistance of AUD 10.10 per week. Millions of households, particularly pensioners and low income households are expected to be better off from the assistance received.
BC	The impact of the tax on lower-income households was initially fully offset by corresponding tax cuts and credits, including a 5 per cent reduction in personal income taxes for the lower two tax brackets – making the ETR progressive overall initially. However, successive increases in the tax rate have not been matched by sufficient increases in the low income tax credit and have resulted in an increasingly regressive carbon tax regime.
DK	CO_2 tax is found to be regressive with regressive impacts of indirect CO_2 taxation (price effects in the purchase of energy-intensive goods and services when CO_2 taxes are imposed on industry) generally less pronounced than effects of direct CO_2 taxation. The higher direct tax burden on rural households is partly offset by their lower indirect tax payments. A net disadvantage for rural households remains but is fairly small (adding an additional 0.04 per cent to the CO_2 tax's share in disposable income).
FI	CO_2 tax found to have negative impacts on distribution of income among social groups, on low-income groups and, mobility or rural areas
DE	Low-income households are most exposed to the ETR with 1 per cent of their

	income being affected, compared to only 0.5 per cent among the high income households. Unemployed and pensioners are not exposed to net negative impacts of ETR.
IE	Some ex ante assessments show that the carbon tax has regressive impacts. Despite efforts by the government to ameliorate the impact of the tax increase on certain groups, the decrease in the length of the fuel season in the Fuel Allowance, the increase in the carbon tax and its extension to coal and commercial peat from 2013 raises concerns about impacts on low income households and fuel poverty.
NL	While a priori regressive in design, the regressivity of the tax rates is nearly neutralised by recycling measures and exemptions that apply, e.g. tax free allowances, tax reductions and ceilings. The refund on electricity bills is seen as a good example of avoiding negative distributional effects on private households.
NO	No significant impacts on income distribution found.
SE	As the CO_2 tax is regressive, the Government is keeping the option open of using increased tax revenues to potentially support low income households in the future.
UK	No evidence has been found of impacts of the CCL on income distribution. This probably reflects the fact that the CCL does not apply to households.
CH	The ECOPLAN study found that under the POM scenario household welfare (from consumption and leisure) compared to the reference scenario changes by -1.2 per cent to +1.8 per cent. Under the NEP scenario, welfare changes by -4 per cent (for poorer households) to +4 per cent (for richer households). Most significant impacts (both positive and negative) are found for retirees.

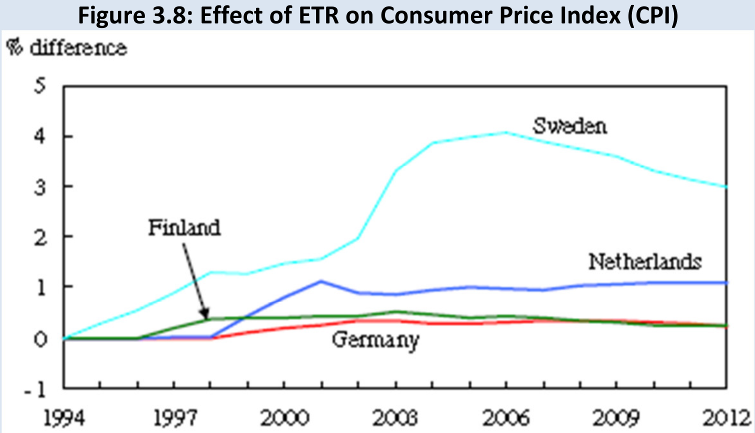
Sources: For references please see country case studies in Annex I

Box 3.8: Evaluating the impacts of ETR on prices – some results from the COMETR project

The COMETR project also looked at ETR impacts on prices. Key results include:

- The ETR lead to higher fuel prices – notably higher electricity prices for consumers in Sweden.
- The effect of the ETR on CPI was significant particularly for Sweden, somewhat for the Netherlands and marginally so for Germany and Finland (see the Figure 3.8). In Denmark and the UK there were no significant impacts on the CPI - in the UK this was due to the fact that the tax was relatively small and cheaper labour costs compensated for this. In Denmark, while the tax was larger, the reduced labour costs from the ETR tax shift again compensated for the upward pressure from the tax.

Figure 3.8: Effect of ETR on Consumer Price Index (CPI)



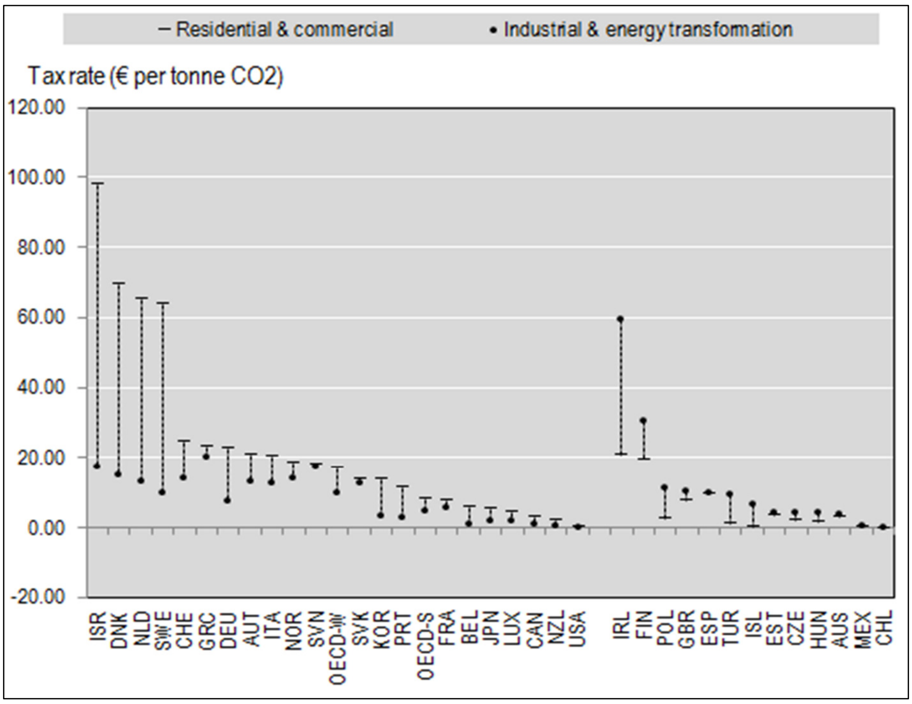
Source: Andersen et al 2007, page 386

Source: Andersen et al (2007), complemented by Barker et al (2009)

Figure 3.9 presents country choices with regard to where to place the taxation burden. In some countries a higher tax burden is placed on the residential and the commercial sector; in others on industry and energy transformation. This offers some useful insights on government priorities with regard to social and economic concerns in the context of affordability and competitiveness. The tax burden on households is highest in Israel and in three countries examined in this study, i.e. Denmark, the Netherlands and Sweden.

It is also worth noting that the tax burden in a country is not just a factor of the price effect itself (i.e. increase in fuel and heating costs) but also the share of fuel expenditure as part of household income. The share of fuel expenditure of household income is lower on average in Switzerland given its higher per capita income than for most other OECD countries. For example, in Switzerland expenditure on fuels constitute 2.3 per cent of household income on petrol, 2.4 per cent on diesel, 3.0 per cent on gas and 0.9 for heating oil (Eurostat 2005 in Green Budget Germany n.d.). Thus, an increase in carbon-energy taxes would have a lesser impact on household disposable income in Switzerland than in other countries.

Figure 3.9: Effective tax rates and country differences between residential & commercial and industrial & energy transformation



Source: OECD 2013, page 45.

4 FUTURE PLANS TO INTRODUCE CARBON TAXES

4.1 Introduction

A number of countries across the globe are planning to introduce or have recently introduced new carbon taxes, are considering implementing some form of environmental tax reform, or are planning to extend existing carbon or energy taxes. These countries include OECD countries such as Japan, the US and the Czech Republic. In addition a number of emerging and developing economies have recently announced plans to introduce carbon taxes, these include China which announced plans to introduce a carbon tax on industry before 2015 targeting large users of coal, petrol or natural gas; India which introduced a nationwide carbon tax of 50 rupees per tonne of CO_2 on coal in 2010 and South Africa which is planning to introduce a carbon tax in 2013-14[18]. There are also some countries where the introduction of a carbon tax has been attempted in the past and has failed for example in France, or stalled for example in Italy with recent initiatives in both countries to revive the agenda.

This section provides a brief overview of plans (or recent initiatives) to introduce new or revised carbon or energy taxes in the Czech Republic, Italy, Japan, UK, and the USA. The case of France is also examined as an example of a ‘failed’ attempt to introduce a carbon tax. Short, descriptive analyses of the proposals in each country are set out as brief case studies in Annex 2. These cases provide a brief description of the plans, the proposed design of the new or revised tax, planned exemptions / derogations where this is known, and the proposed timeline for introduction.

Table 4.1: Overview of plans for new carbon taxes in selected OECD countries

Country	Brief description of plans
Czech Republic	In 2012, as part of the Czech Convergence Programme, the government announced proposals for the introduction of a carbon tax on mineral oil, solid fuels and natural gas. Excise tax exemptions on mineral oils for agricultural producers and natural gas used for household heating are also to be abolished.
Italy	In April 2012, the Italian government approved a project on General Tax Reform, which included an explicit element of Green Fiscal Reform including a carbon tax on non-ETS sectors. This follows the introduction of a carbon tax in 1999 which was suspended by the government in 2001 in response to rising global oil prices.
Japan	In October 2012, Japan introduced a new “Tax for Climate Change Mitigation” on the use of all fossil fuels. The tax aims to limit energy-related CO_2 emissions to help meet Japan’s objectives to reduce GHG emissions by 80 per cent by 2050 and to reduce its reliance on nuclear power. The tax is expected to result in a -0.5 per cent to -2.2 per cent reduction of CO_2 emissions by 2020 compared to 1990.
UK	A carbon price floor (CPF) will replace the exemption under the existing Climate Change Levy (CCL) for the use of fuels to generate electricity with a carbon price support (CPS) rate which electricity generators are required to pay in addition to their obligations under the EU ETS. The CFP aims to provide an incentive to invest in low-carbon power generation by providing greater certainty on the carbon price in the UK’s electricity generation sector; however the overall EU wide implications may be disputed.
USA	In February 2013, a draft bill to tax CO_2 emissions was put forward by Senators Boxer and Sanders. The bill sets a goal to reduce carbon emissions by 80 per cent below 2005 levels by 2020.

[18] For further details, see: http://www.sbs.com.au/news/article/1492651/Factbox-Carbon-taxes-around-the-world [accessed 21/4/2013]

4.2 Overview of future plans for carbon taxes

A number of plans and interesting initiatives are underway in several OECD countries to introduce new carbon taxes or amend existing systems – see Table 4.2 for an overview of the five cases examined. These developments are motivated for various reasons including environmental objectives (e.g. Japan and the USA) and fiscal concerns (e.g. in the Czech Republic and Italy). The proposed design of the taxes vary across the plans, from what can be considered to be more 'traditional' carbon taxes such as the planned introduction of a carbon tax on mineral oil, solid fuels and natural gas in the Czech Republic to a more innovative approach of a carbon floor price in the UK.

The ambition of the plans vary from a rather low level of (initial) ambition such as in Japan where the tax rate is set at a rate of JPY 298 (approximately EUR 3) per tonne of CO_2 with rates progressively increasing over 3.5 years. Other plans have higher stated ambitions such as the proposed introduction of a carbon price floor in the UK and a proposal for a CO_2 tax in the US starting at USD 20 per tonne of CO_2 emitted, rising by 5.6 per cent annually over a 10-year period to reach USD 33 per tonne. In reality, ambitions can sometimes weaken from plan to agreement and implementation.

In some cases, revenues from the taxes are to be used to finance renewable energy production, energy efficiency and eco-innovation (e.g. in Italy, the USA and Japan), while in others, the taxes are introduced for revenue raising purposes to boost government coffers (e.g. in the Czech Republic). In some cases, revenues were planned to be recycled back to firms and households as was the case with the planned carbon tax in France.

Table 4.2: Proposed design and timeline for implementing carbon taxes in selected OECD countries

Country	Proposed design of tax	Proposed use of revenues	Envisaged timescale for implementation
Czech Republic	The proposed rate of the carbon tax is EUR 15/t CO_2.	The proposed carbon tax has been introduced for revenue raising purposes and is expected to be raise about CZK 6 billion (EUR 231,466 million).	It was initially envisaged that the proposed carbon tax would be implemented from 2014; however its implementation has now been postponed until adoption of the proposed revision of the EU Energy Tax Directive 2003/96/EC.
Italy	The proposed carbon tax is to impose excise duties on energy products depending on their carbon content and is to apply to non-ETS sectors only. The amount and modalities of the future carbon tax are not yet clear.	The revenues from the proposed new carbon tax are expected to be earmarked to finance renewable energy, low-carbon technologies and environmental protection.	Entry into force of the CO_2 tax is to be linked to the transposition date in other EU Member States of the revised EU Energy Tax Directive 2003/96/EC.
Japan	The tax rate corresponds to the CO_2 emission factor of each fossil fuel and is set at a rate of JPY 298 (approximately	Revenues from the tax are to be used to promote energy-saving measures, the use of renewable energy and the	The carbon tax came into effect on 1 October 2012. Increases in the tax rate will take place in April 2014 and

	EUR 3)/t CO_2. The tax rates are to be progressively increased in three stages over 3.5 years. A number of exemptions and refunds are applied.	clean and efficient use of fossil fuels.	April 2016.
UK	The CCL exemption for supplies of fuel to electricity generators is replaced with a carbon price support (CPS) rate. The target carbon price floor (CPS rate plus EU-ETS price) will start at GBP 16/t CO_2 in 2013, rising to GBP30/t CO_2 in 2020.	This measure is expected to have a negligible impact and the Government is expected to seek revenue neutrality.	The CPF came into effect from 1 April 2013. However the proposal is currently the subject of much discussion in the UK and it is not clear whether it will be implemented as planned. The plan is that the price will rise to GBP 30/t $CO_2$by 2020 and to GBP 70/t CO_2in 2030.
USA	The Bill proposes a tax starting at USD 20/t CO_2, rising by 5.6 per cent annually over a 10-year period to reach USD 33/t CO_2. The tax is to apply to the largest fossil fuel producers in the country. Power plants will not be covered but will remain regulated under the Environmental Protection Agency. It is also proposed that the tax apply to foreign companies who export fuels to the US whose home countries do not have equivalent measures.	The bill proposes that 60 per cent of revenues from the tax be allocated to a residential environment rebate programme, 25 per cent to deficit reduction measures and the remaining 15 per cent to weatherization of US homes, green energy and infrastructure investments.	Senator Boxer plans to bring the bill to her Committee for a vote in spring 2013 and to bring the proposed measure to the Senate by summer 2013. The proposed bill faces significant opposition particularly from Republicans and it is unclear whether it will be adopted.

The underlying political context is a critical factor to the successful introduction of a carbon tax and the design of the system. In other countries political concerns lead to a weakening of the ETR, for example via the introduction of various exemptions and derogations for sensitive sectors such as the case in Japan and a number of other countries as explored in chapter 2 and 3 of this report. In certain EU countries, implementation of the proposals has been stalled or postponed until progress is made at the EU level (e.g. with the adoption of a revised EU energy tax Directive), while in the US, the proposal is still at an early stage and given staunch opposition particularly from the Republican Party, it is unlikely that progress will be made.

In some cases, political or other factors can completely block or stall the introduction of a carbon tax. This was the case in France when the proposal to introduce a carbon tax in 2009 was deemed unconstitutional and cancelled (see Box 4.1). Similarly in Italy in 1999, a carbon tax was introduced to reduce Italy's emissions as stipulated by the Kyoto Protocol. The tax was foreseen to be phased-in over five years; however it was suspended by the government in 2001 in response to rising global oil prices (Barde 2004). Discussions on ETR are re-emerging in Italy, necessitated by new circumstances including a recent referendum in which Italians voted to abandon the use of nuclear in the country, as well as fiscal consolidation needs – see Table 4.2 and Italian case study in Annex 2. In France discussions on ETR continue, particularly since the election of Francois Hollande, and there are some plans to introduce environmental elements in upcoming fiscal reforms.

Box 4.1: The attempt to introduce a carbon tax in France in 2009

In autumn 2009, the French government put forward a proposal for a new carbon tax following a commitment in the first 'Grenelle de l'environnement' law (2009), which established that the creation of an eco-tax be examined further. The tax was to apply to sectors not covered by the EU ETS. The tax was to start at EUR 17 per tonne of CO_2 emitted from 2010, with a scheduled annual increase to reach EUR 100 per tonne by 2030.

Industrial firms under the EU ETS were excluded from the proposed tax. Reduced tax rates were contemplated for energy-intensive and internationally-exposed sectors, such as agriculture and fisheries, which were to be charged at 25 per cent of the initial rate. Road transport and shipping were to be fully exempted (National Assembly, 2009 and Sénit, 2012).

Two recycling mechanisms were contemplated. Firms were to be compensated with the suspension of the business tax ('taxe professionnelle') which was levied each year by local authorities. Households were to be provided financial compensation in the form of an income tax rebate or a 'green cheque' for non-taxpayers based on the households' composition and residential situation (urban vs. rural) (Sénit, 2012).

The proposal was to be implemented from 1/1/2010 but was ruled unconstitutional by the Conseil d'Etat as the proposed exemptions resulted in the exclusion of 93 per cent of CO_2 emissions (mainly emissions already covered by the EU ETS) from the tax base. The proposed compensation for households was also considered to represent a breach of tax equality. Thus the proposal was cancelled.

Sources:
Bureau, D., (2012) The political economy of the 2009 French Carbon Tax project, Working Party on Integrating Environmental and Economic Policies, 19-20 November 2012 OECD Headquarters, Paris,
Sénit, C. (2012) 'Taxation in France: preferences, institutions, and ideologies', WORKING PAPERS N°20/2012. IDDRI, 2012
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5 CONCLUSIONS, FUTURE NEEDS AND OPPORTUNITIES FOR ETR

Today, there is close to twenty five years of experience with the design and implementation of carbon-energy related ETRs. A growing number of countries are engaging in ETR for various reasons. Evidence of the range of positive and significant impacts of such reforms on GHG emissions, energy efficiency, jobs and GDP continues to grow, while the potential negative effects such as on competitiveness have not materialised or have been less than feared. How carbon-energy tax reforms are designed is instrumental in both facilitating associated benefits and avoiding potential negative impacts. Key design issues include the breadth of application of the tax (i.e. on which fuels and uses it is applied, and what share of a country's CO_2 emissions is covered), the point of application, the level of the tax, the schedule of implementation and its evolution over time, the use of exemptions and special treatments via tax reductions and associated conditionalities, links to other instruments including the EU ETS, the use of revenues and recycling mechanisms employed.

Despite a number of positive trends, ETRs have not been widely used across the global economy and the overall impacts to date have however been relatively small and often less than what is needed to achieve the transition to a low carbon economy. This limited effect is partly due to how carbon-energy taxes have been designed to date which often deviates from the economic ideal. While such deviations may be necessary for political and public acceptability issues, they influence the effectiveness of the tax. Moreover, the ETR tool itself arguably remains far from its potential and has only led to relatively marginal changes to the tax system and incentives within the economy. Thus, there remains scope for the increased application and more effective use of such instruments.

This chapter presents the conclusions, future needs and opportunities for ETR based on the analysis carried out for the study. It begins by setting out insights on ETR design and then on the impacts and effectiveness of ETR drawing on the results of the analysis of international experiences in carbon-energy tax reform. Finally it discusses future needs, opportunities and insights for Switzerland to feed into on-going discussions on carbon-energy tax reform in the country.

5.1 Insights on ETR design

The objectives behind the introduction of an ETR, the design of carbon-energy taxes and their implementation vary quite substantially across countries. Some key insights from the analysis of 10 country cases examined in this study are set out below:

The underlying **reasons behind the introduction of carbon-energy taxes** often reflect a combination of environmental, economic and social considerations, which evolve over time. In some countries, ETR has been part of wider packages aimed at catalysing growth and jobs as for example has been the case in the early reforms initiated in Finland, Sweden, Denmark and Germany. In others, environmental and climate change objectives including interest in reducing GHG emissions, saving energy and associated fuel costs, and encouraging more sustainable energy provision, have been the primary driver as for example has been the case in Australia, Norway and British Columbia. In recent years, ETRs have been initiated in response to fiscal necessities as for example has been the case in Ireland. While there is often one primary objective in a country which catalyses and drives the ETR process, there are usually multiple policy objectives that influence its final design and implementation. For example, concerns about the potential impacts of the new or reformed carbon-energy tax on the competitiveness of domestic industries (particularly energy-intensive, trade-exposed sectors) are often a key factor affecting the ambition and scope of a particular ETR.

The tax **base** covered varies across countries with some focusing on a narrow set of energy carriers and users (e.g. Australia which focuses on around 500 of the largest polluters in the country), while others adopt a much wider base (e.g. British Columbia which covers GHG emissions from the combustion of fossil fuels across the economy). There are currently no schemes that cover all GHG emissions in a country, this is partly due to the existence of other taxes (e.g. fuel taxes), other policy instruments (e.g. EU ETS), and political concerns (e.g. regarding social or competitiveness impacts). In several countries (e.g. Denmark, Ireland, Netherlands, Norway), there have been efforts to gradually broaden the tax base over time to cover a wider range of energy products and/or users. Such an approach helps to stagger implementation, allowing actors sufficient time to adapt (which may help secure their support for the reform at the start), and also provides the opportunity to learn from experience in application of the tax.

The **tax rate applied** should be high enough to ensure it is effective in meeting the underlying objectives of the tax (i.e. provide sufficient incentives to invest in emission reduction technologies and renewables), while also reflecting political considerations. In a number of countries there have been gradual increases in the tax rate applied over time, with some increases following a set schedule (e.g. British Columbia, Australia, Ireland) while increases in others have been indexed to inflation (e.g. the Netherlands, Sweden, Denmark). According to economic theory, CO_2 taxes should be applied uniformly (Speck 2013), i.e. all tax payers should be subject to the same tax rate and all energy products subject to the same CO_2 tax rate to ensure efficiency and cost effectiveness. However, as seen in the 10 cases examined, practice often deviates from this theoretical ideal and the tax rates applied vary substantially both across and within countries in terms of the energy product to which the tax is applied and the end user. This deviation reflects underlying political considerations relating to *inter alia* the economic and social impacts of the tax. The experience in British Columbia is an exception in this regard as a homogenous CO_2 tax has been introduced which applies to GHG emissions from the combustion of all fossil fuels in the province (although GHG emissions from non-combustion sources are not covered). There is thus room for improvement in terms of levelling tax rates applied across different fuel types and end users for the same pollution content as well as better aligning tax rates with estimates of environmental impacts (Heine et al 2012).

Exemptions are introduced for a number of reasons (competitiveness, distributional effects etc.) and have been used in all the countries examined to varying degrees. Such provisions are often applied to certain groups and sectors, in particular energy-intensive industry, and are granted on the basis of different criteria. Some form of exemptions and/or tax reductions are often a necessary component of ETR and are relied on as a politically expedient measure, however such practices often impair the effectiveness of the objectives of the reform as the cheapest emission reduction potential is not exploited. This makes the ETR a less efficient instrument than it would otherwise have been. For example in Germany, derogations from the energy tax granted to manufacturing and energy-intensive industries have limited the positive environmental impacts of the ETR as the rather high energy efficiency potential in this sector remains largely untapped due to insufficient price signals (Speck and Jilkova, 2009). Links between carbon-energy taxes and the EU-ETS has also led some countries to grant exemptions for those installations within the EU ETS, which given the current low EU ETS price has led to a weakening of incentives to reduce CO_2 emissions.

In certain cases, the exemptions have been found to be overly generous. For example, in the UK it was found that had the CCL been implemented at the full rate for all businesses, further cuts in energy use of substantial magnitude could have been achieved without jeopardizing economic performance (Martin et al, 2009). Moreover, the beneficial treatment of certain sectors or groups requires other economic sectors or actors to face higher energy tax rates if a predefined emission reduction goal is to be achieved (Speck and Jilkova 2009) which may result in advantages for some companies and sectors, but disadvantages to others. As noted by Heine et al (2012), 'concerns about impacts on vulnerable (or politically powerful) firms and households are better addressed through compensation schemes (e.g. scaling back other, redundant energy taxes, recycling revenues in tax cuts that benefit low-income households in particular, or output subsidies for vulnerable firms) rather than setting lower environmental taxes or imposing taxes downstream with exemptions for favoured sectors.'

In some countries, exemptions are linked to **conditionalities** which for example require companies to enter into (voluntary) agreements to benefit from the tax reductions. Examples include voluntary agreements in Germany and in the UK linked to the tax reductions within the German ETR and UK CCL respectively. These agreements are generally seen as having been constructive for encouraging change, and indeed essential mechanisms of the wider ETR package, but at the same time have been criticised for being weaker than necessary. In certain cases, concerns relating to **State Aid objections** for potential non-proportionate support via tax reductions have been an important driver behind the development of conditionalities and for better sharing information between the affected sectors and public authorities. This process can help to improve the information asymmetry between companies and authorities and aide deliberations on possible future revisions to the ETR.

Carbon-energy taxes have the potential to **raise significant revenues** which are in the order of billions of Euros in some countries (e.g. during the first phase of ETR in Denmark, Sweden, the Netherlands and Germany). As noted above, several countries gradually ramp up tax rates applied over time and broaden the tax base to stagger implementation, with the due result that revenues often increase over time. For example in Ireland the level of revenue raised in the 2012 was more than one and a half times that in the first year of the carbon tax. While ETR can raise significant levels of revenue, the overall share of its contribution to national tax revenue is still relatively small (generally only in the order of a few percentage points of GDP and tax income). Thus, existing ETRs do not represent a major shift in tax regimes, but rather an initial step in the structural change of tax systems (ILO et al 2011).

The effectiveness of an ETR is due not just to the design and level of the taxes and charges, but also importantly to what is done with revenues. **Revenues raised have been used for various purposes** including as part of a tax shift to off-set some of the revenue losses from a reduction in other taxes (often on labour) (e.g. Finland, Sweden, Denmark), for revenue raising purposes (e.g. Ireland) and to ensure revenue neutrality whereby revenues from CO_2 taxes are recycled back into the economy such that the overall tax burden remains the same (Speck 2013). Preferences for different approaches to revenue use (i.e. an economy wide tax shift, sector recycling and specific earmarking) vary by stakeholder group – see Table 5.1. The use of revenues is an important element in the design of the ETR and has implications for its impacts including on income distribution, employment and competitiveness. As noted in Heine et al (2012), without revenue recycling, the net benefits from carbon or energy taxes are reduced and their use over regulatory approaches on a cost-effectiveness basis is undermined.

Table 5.1: Overview of preferences for different approaches to revenue use

Economists & public policy	Companies	NGOs
1) Economy wide tax shift – as this is in principle the most efficient, can help with economic wide efficiency. **2) Recycling to the sector** – can help transform a sector and maintain international competitiveness. **3) Earmarking** – can help catalyse innovation.	**1) Earmarking** – can help encourage innovation and support the bottom line. **2) Recycling to the sector** (though not a preference by the laggard companies). **3) Economy wide tax shift** - as money leaves the sector..	**1) Tax shift** – can help nationwide transformation of the economy, decouple economic growth from resource use and GHG emissions and support employment. **2) Earmarking** - as this can ensure due resources are available for important initiatives (could be priority for issues specific NGOs). **3) Recycling to the sector –** as benefits would be limited to a specific group of actors.

Revenue/budget neutrality has been a broad principle underlying carbon-energy tax reforms in Australia, British Columbia, Germany, the Netherlands, and the UK. These countries have used various mechanisms to recycle revenues back into the economy, including in particular reductions in income tax rates and/or reductions in social security contributions, as well as lump-sum transfers to those who do not pay income tax or social security contributions but face higher energy bills, such as pensioners as well as incentives for energy efficiency improvements. Successive increases in taxes have sometimes necessitated further measures to achieve revenue neutrality as for example has been the case in British Columbia with specific tax credits added over the years to reflect the scheduled increase in tax rates applied (Harrison 2012). These reductions in social security payments and income taxes have been a driver behind some of the positive GDP impacts of ETR while the use of revenues for energy efficiency measures have proven valuable in encouraging fuel savings and reducing GHG emissions (recall discussion in Chapter 3).

5.2 Insights on impacts and effectiveness of ETR

The effectiveness of the carbon-energy tax reforms vary across countries and reflects the level and breadth of the taxes, the use of exemptions and related conditions, and how revenue raised is used. Some key insights from the analysis of 10 country cases are set out below:

In terms of **environmental impacts**, insights from past experiences indicate that CO_2 taxes, in combination with existing energy tax schemes have led to reductions in CO_2 emissions and to reduced fossil fuel consumption. While there are substantial variations across countries, carbon-energy tax reforms can be seen to have led to CO_2 savings of up to 1 per cent per year, with not dissimilar though generally slightly lower levels of energy savings (as GHG reductions stem from both demand reductions and fuel switching to fuels with lower CO_2 emissions). The modelling results of the COMETR study found that the largest reductions in GHG emissions among a group of seven EU Member States that have implemented ETRs have been in countries with the highest tax rates (i.e. Finland and Sweden).

The overall rate of emission reductions is however relatively small and insufficient to meet long term GHG emission reduction targets, climate change objectives of halting global temperature rise to 2 degrees and decoupling economic growth from GHG emissions. The limited effectiveness of the taxes is often linked to the numerous exemptions and tax reductions provided to those sectors with the most potential to achieve emission reductions. Furthermore, the impact of the carbon-energy taxes should be seen in the context of the wider set of related taxes and instruments in place as these also lead to GHG reductions and energy use savings. Generally CO_2 and ETR related energy taxes are only a relatively small subset of the overall tax burden and incentives in place and the contribution of the carbon-energy tax can be difficult to distinguish from the wider set of policy instruments and factors in place that drive change.

With regard to impacts on the **economy**, there is increasing evidence and analysis that suggests that ETR has had and can have on the whole positive effects on **GDP** growth, although there are also cases of negative effects, and changes over time (Andersen 2007, Kohlhaas 2005, Bach et al. 2002). This contrasts with the general perception in certain spheres of public debate that environmental measures will have negative effects on GDP growth. The economic impacts of a particular carbon or energy tax reform depend on design (e.g. where the taxes are levied), where the burden falls (e.g. on important domestic activities), timescale (e.g. phased approach, impacts on long-term competitiveness by encouraging resource efficiency and innovation) and the use of revenues (e.g. investing in energy efficiency improvements in affected industries). It is also useful to underline that impacts on GDP do not necessarily provide the whole story of welfare benefits or of the economic impacts of an ETR as the reform can also lead to a number of wider economic benefits such as stimulating investment and green technologies as for example has been seen in British Columbia.

Experience generally also shows a positive impact on **employment** overall from ETR, though this depends on whether and how the revenues are recycled as well as the nature of the wider ETR including what other taxes or charges are reduced (e.g. labour taxes). Similarly the point of application of the tax will determine where job losses may take place, as there may be losses for specific companies in a given sector but positive impacts for the economy as a whole. Where policies are well-designed and implemented then there is likely to be potential for further support for both green jobs and non-green jobs (ILO, EC and IILS 2011).

Competitiveness impacts have been a concern for ETRs across all countries examined, particularly for energy-intense industries whose products compete in international markets. These concerns have been the main reason behind many of the exemptions introduced in various countries. Competitiveness impacts depend on the design of the ETR, including for example the point of application of the tax and the potential to pass through costs, the taxes applied including carbon-energy taxes, as well as a range of other factors that may affect a firm's competitiveness including for example labour costs, quality of the workforce, infrastructure, regulatory and fiscal frameworks. The use of revenues raised by the tax (i.e. whether recycled and in what way; or in the case of a tax shift, which other taxes may be reduced) is also critical. Recycling revenues can avoid major impacts and indeed can even help to improve competiveness among the more advanced companies where the mechanism is linked to performance. In the case of tax shifts, the competitiveness impact will depend on what other taxes are reduced for example labour taxes or social security payments.

The literature examining concerns of negative competitiveness impacts, exports, trade flows, and companies relocation from environmental regulation does not come up with statistically significant or robust evidence to support the claim of actual competiveness effects of existing CO_2 taxes and wider ETR (see Jaffe et al 1995, OECD 1996, Smarzynska and Weil 2001, Sijm et al 2004, Oikonomou et al. 2006 - in Ekins and Speck 2012). The main reason for this lack of effect has been the successful integration of competitiveness concerns in the design and implementation of these instruments.

Policymakers have by and large listened to the concerns of business of the threat of ETR on competitiveness and have designed the taxes with this in mind. However, experience to date suggests that exemptions, tax reductions and other compensations have arguably been used in excess of needs related to competitiveness concerns, as exemptions are in place for a number of sectors, many of which are not highly energy-intense or with highly-traded products in competitive international markets. Such provisions may have been (deemed) politically necessary for the ETR to be accepted, however lessons should be learnt for future ETRs and their reform. Some countries started with a more cautious approach with a range of exemptions in place, but then seek to reduce these over time as evidence on impacts become clearer, this has for example been the case in Sweden. It is important to underline that a reduction in labour taxes can increase the competitiveness of sectors less affected by the ETR and thus the competitiveness of the overall economy, thus sectoral concerns need to be seen in the context of wider national transformation and benefits.

The risks of competitiveness impacts, despite not being an issue with current carbon and energy taxes and associated ETRs, is nevertheless a potential risk for future ambitious ETRS and should be examined carefully. The literature on carbon leakage suggests that the risk could be significant for a subset of goods, notably those highly energy-intense goods in competitive international markets. The additional carbon tax could contribute to a potential imbalance in comparative advantage of products, affected by *inter alia* other tax levels (including labour and corporate), wages, factor input costs, price regimes, subsidies, regulations on product standards and their enforcement.

The **social impacts** of ETR (including distributional impacts[19], consumer prices, and household income levels) strongly depend on the use of revenues within the wider revenue recycling mechanisms of the ETR (e.g. to facilitate reductions in labour taxes), or via the use of funds themselves (e.g. to increase pensions and family tax benefits in Australia). ETRs can lead to higher fuel prices (e.g. as seen in Sweden), which can also manifest itself in a higher CPI (an effect seen in Sweden and to a lesser extent in the Netherlands). In some cases, the tax shift (e.g. reduced labour costs) in the ETR compensates for higher prices in one area (fuel) but increases income or lower prices in another, thus there may be a positive net impact on income. The upward pressure from the tax can also be compensated such that there is no net impact on CPI (e.g. Denmark). The impact on real income from increased taxes was the subject of research in the PETRE research project which found that at an aggregate EU level, reforms entailing higher energy taxes with recycling measures in place would generate positive changes in real income for all socio-economic groups under consideration and under all scenarios (Pollitt & Barton, 2011 in Vivid Economics, 2012).

Experience with regard to **distributional impacts** (i.e. whether the ETR is progressive or regressive) is mixed across the case studies examined. The schemes in Denmark, Finland, Germany and Ireland have demonstrated some elements of regressivity. For example in Denmark, CO_2 taxes are found to be regressive with regressive impacts of indirect CO_2 taxation generally less pronounced than effects of direct CO_2 taxation. Distributional impacts can also change over time with increases in the tax rates and broadening of the tax base, as has been the case in BC. In some countries, the regressive impacts of the ETR have been compensated by specific recycling measures and the proper use of revenues on well targeted initiatives. For example, in the Netherlands, the regressive design of the tax rates is nearly neutralised through the use of tax free allowances, tax reductions and ceilings as well as a tax credit per electricity connection; while means-tested heating benefits in Germany help to mitigate the impact of energy price increases on the poorest households (EEA 2011).

[19] i.e. whether the ETR is progressive, favouring poorer deciles of society, or regressive, leading to higher relative burden on poorer households.

5.3 Future potential for ETR and insights for Switzerland

A growing number of countries and regions are implementing various forms of ETR including in particular carbon-energy tax reforms. While the tipping point of having enough countries adopting ETR such that it is 'the new normal' is still someway off, there is clear progress in this direction. As the number of countries and regions engaging in ETR increase and the benefits of ETR are better understood, one can expect more countries to join the ranks and for those that have implemented ETR to broaden, deepen and fine-tune their systems to realise their wider potential. The analysis of international experiences with carbon-energy taxes in this study indicates that there is scope for more ambitious ETR, which if well designed can have a positive impact on GDP, employment, and lead to long-term competitiveness gains. Some key issues that need to be reflected in the design and implementation of ETRs as set out below.

For those considering ETR, it is useful to start with as wide a **tax base** as is politically and technically possible and schedule gradual expansions to the coverage of the tax over time to increase the proportion of GHG emissions in the economy subject to the tax. Similarly there is a need to increase the **tax rate applied** over time (through indexation to inflation and a rate escalator). Observations to date on the lack of competitiveness impacts of ETR do not however mean that competitiveness is not an issue for future ETR. Were countries to launch increasingly ambitious ETRs (e.g. with a broader tax base and higher tax rates) then careful analysis would be needed regarding the potential need for tax reductions for certain sectors, and where these are granted to use constructive conditionalities to help encourage proportional progress in these sectors.

Exemptions should be carefully considered and designed to ensure they are linked to practical conditionalities that allow objectives to be supported. They should be well targeted (i.e. focused on a subset of actors that are most exposed such as energy-intensive and/or trade-exposed sectors). Exemptions to EU ETS installations should be limited given the current low ETS price; a review clause can be included to allow reassessment of the need for tax reductions when EU ETS price thresholds are eventually passed. Criteria for granting exemptions should be carefully developed together with tax authorities so that they are practical. It is recommended that partial tax reductions rather than full exemptions be used as this creates less of an entitlement to exemptions and provides an opportunity for review and reform of exemptions. Furthermore, even lower tax rates create a signal and information flow – both to companies (including their boards and finance directors) and to public authorities. Furthermore, using partial tax reductions helps ensure that the signalling effect is still there (keeping the marginal incentives positive) and facilitating links to conditionalities (Personal communication).

It is recommended that where partial or full exemptions are granted, they are linked to **conditionalities** which reflect the underlying objective of ETR. These conditionalities can take different forms, e.g. formal agreements (which can have varying degrees of ambition) or general commitments and can contain different elements such as audits, environmental management systems, and/or requirements for information flow. Conditionalities can be designed such that they are more demanding if exemptions granted are significant (e.g. full exemptions), and less demanding if only a small advantage is given. International experience has shown that requiring an environmental management system (e.g. with someone on the Board who is responsible for identifying energy savings and regular reporting) helps give the issue due executive attention. Similarly, having a requirement for regular energy audits and for those investments or initiatives that have a short payback period to be committed to (in order to be eligible for the compensation) has also been found to be useful (Personal communication). For example, requiring all initiatives with a pay back of less than one year to be carried out within two years and all initiatives with a pay back of less than three years to be carried out within five years, could be a pragmatic solution to encourage progress while taking into account investment and economic cycles.

Furthermore where conditionalities are set, the opportunity should be seized to ensure better **communication of information** by industry (e.g. ensure burden of proof on industry to demonstrate the merits of the tax reduction). This has for example been the case in the Germany where the ETR is considered effective in data provision requirements on companies (Personal communication). Any exemption granted (whether partial or full) should have some reporting agreement in place as such information provision can help address the information asymmetry between business and public authorities, feed into future evaluations of the tax and help authorities better understand the potential for reform that is both ambitious in terms of signalling and sensitive to industry realities.

With regard to the **use of revenues**, the majority of revenues should be allocated to the general budget and used to reduce other more distortionary taxes such as social security and employment taxes. Depending on needs, some recycling of revenues to the affected sector could be considered to help keep down overall pressure on the sector and encourage its transformation by supporting progressive companies. The recycling mechanism would need careful development to ensure the most effective incentives to encourage due dynamics in the sector. In addition the use of earmarking for a specified period can be important in some cases, e.g. to facilitate innovation or its uptake. However, earmarking should be used with consideration to the absorption potential in the area (otherwise it risks not being cost-effectives), payments should be linked to specific measures and where grants are given these should be in the form of partial investment grants to keep incentives positive (Personal communication).With regard to renewables, where they still need support to be competitive, there are arguments that they should have a partial exemption from new energy taxes to avoid dampening innovation and incentives promoted through other instruments. As technology costs start to approach those in the market, such support could be ratcheted down in a step-wise manner and in the long-term, energy taxes should cover all sources of energy.

The purpose of carbon taxes is to reduce GHG emissions by changing behaviour. If the taxes are successful in changing behaviour, the **revenue raised** will decline over time (Duff and Hsu 2010). One tool to help address the issue of possibly shrinking revenues over time is indexing rates to inflation, for example as done in the Netherlands where indexation of energy tax rates provides constant real incentives and support to avoid falling real tax revenues (European Commission, 2012). Another option is having a more dynamic development of tax rates including a scheduled increase per year. Inflation indexation and performance related escalator should be complemented with a monitoring system, which takes into account external factors such as changes in world oil prices. For example long term tax rate rises can be committed to with certain conditions, e.g if world prices rise above USD 125/barrel, the escalator would not be waved for that year. Alternatively a performance indicator can be used, e.g if CO_2 targets are not met in a given year a higher rate will be applied (which is similar to the existing scheme in Switzerland). This allows a high escalator to be set, but options to reduce it on need (e.g. high fuel prices) or where a carbon tax price rise is not needed (e.g. performance met), avoiding political fall-out while offering clarity to the market. It is generally more difficult to increase a rate yearly than to reduce it (Personal communication).

Other options include broadening the tax base over time and/or gradually reducing exemptions and tax reductions. Such preferential treatment can be considered an environmental harmful subsidy (EHS) needing reform if they no longer achieve their intended purpose (see Withana et al 2012 and Oosterhuis and ten Brink 2013 forthcoming). In the long-term a broadening of the energy elements of the tax will need to make up an ever greater share of the ETR if revenues are to be maintained, but revenues may also be eroded if energy demand falls. Other revenues may thus come from the ETS and auctioned allowances, as well as other sources.

All instruments have the potential to evolve over time, and indeed need to evolve as the economy, society, and environmental contexts change, as well as changes to the wider policy context in which the ETR is embedded. Long-term ambitions can usefully be signposted, progress towards these can be gradual and review periods are needed to make use of windows of opportunity as they arise. Thus, for all ETRs it is important to have **monitoring systems** in place to review progress every 3-5 years to assess how things are developing against set criteria and adjust the system as needed. Within the EU there is a requirement for environmental satellite accounts that note environmental taxes (EU Regulation No 691/2011) and similarly there is increasing support for developing inventories of EHS and creating and committing to road maps of their reform (Withana et al 2012). Such regular reporting on the state of taxes and EHS should prove to be important regular windows of opportunity for reviewing and revising ETR in light of progress and the priorities of the day.

Finally, all regions and countries will watch their neighbours, trading partners and what the vanguard countries are doing or planning to do. As others implement or revise ETR, new opportunities arise for mutual learning and considering new initiatives domestically. The Swiss choice as to how to the design and implement carbon-energy tax reform will no doubt spark interest in other countries. There is unlikely to be one country moving radically ahead of others, but there are major benefits of an on-going programme of ETR and of developing this to move towards a needed system change in economic signals. Progress will likely be a series of pragmatic steps forward, often small (relative to the overall goal), but each essential. Together they will have the potential to reach the range of objectives set by policy makers and needed on environmental, economic and social grounds.

Some insights for Switzerland

ETR can support Switzerland's objectives set out in the Energy Strategy 2050 by providing the necessary price signals to incentivise a reduction in energy consumption and reduce CO_2 emissions by facilitating fuel switching and innovation. As recommended by the IEA, 'broader use and higher rates of CO_2 taxes would encourage investments in new technologies and innovation' (IEA 2012). Thus, one option would be to **gradually expand the tax base** so as to increase the coverage of GHG emissions. For example, one could expand the CO_2 tax to cover transport fuels. Road transport is the largest emitter of CO_2 emissions in the country and has significant potential for further cost-effective emission reductions (IEA 2012). One could thus consider introducing a carbon component in the tax to provide better signalling and help incentivise fuel switching to less polluting fuels, encourage modal shift and change consumption patterns. However, the effective tax rate applied on transport fuels is already relatively high in Switzerland as in many other countries (which reflects high petroleum taxes applied), thus any further increase in the tax rate would have to be gradual and with due consideration to broader effects (e.g. fuel tourism), regressivity and affordability concerns.

In designing carbon-energy tax reforms, one should also keep in mind the need to **include both an energy and CO_2 component in the tax rate** so as to avoid giving an advantage to particular energy sources. For example in Finland the structure of the CO_2 tax was changed in 1994 so that 75 per cent of the tax was based on the carbon content of the primary energy source and 25 per cent on the energy content. An important reason for introducing an energy tax component into the tax system was to take into account the externalities involved in nuclear and reduce the fiscal advantage on nuclear power production.

Another option would be to further **increase the CO_2 tax rates applied** to heating and process fuels. Although the CO_2 tax rate has increased since its introduction in 2008 from a rate of CHF 12 per tonne of CO_2 to a rate of CHF 36 per tonne of CO_2 in 2012, emissions in the building sector remain high due to more than 50 per cent of oil in heating. Increased tax rates could thus help to further reduce consumption and should be complemented by efforts to replace oil heating with heat pumps or renewable energy sources through *inter alia* the existing building refurbishment programme (IEA 2012). Moreover, exemptions granted should be reviewed and reduced over time (e.g. for the use of renewable energy and waste as heating and process fuel.

It is understood that the current objectives of the carbon-energy tax reform in Switzerland are to achieve overall **revenue neutrality**. Meeting this objective requires careful design and can be supported by complementary EHS reform as this can help reduce environmental pressures and liberate funds (see Withana et al 2012). Potential revenue recycling measures could include tax reductions and/or redistributions to affected households and companies (using flat rates or other schemes). International experience provides insights on various recycling targets and mechanisms which can be used. An example of an innovative approach is the use of revenues to support pensions and family tax benefits in Australia. A share of revenues could also be earmarked for specific purposes, e.g. for energy efficiency improvements, although as noted above this should be done with caution, carefully designed and time limited. If the energy price already gives sufficient signals and steer for renewable energy and energy efficiency, then earmarking is arguably not necessary.

To **avoid regressive impacts** the design of the ETR and recycling mechanisms need careful consideration. This first requires an analysis of likely impacts, the potential for non-regressive tariff setting where possible (e.g through the use of rising block tariffs) or other tools to compensate any regressivity (e.g. refunds linked to electricity bills as in the case of the Netherlands). “Means testing” can be a useful way of avoiding inefficient use of refunds and reductions.

To avoid negative **impacts on competitiveness**, selected partial reductions[20] from the tax can be introduced targeted at the most exposed sectors, e.g. energy-intensive, trade-exposed sectors. These exemptions should however be carefully designed and entail partial tax reductions rather than full exemptions to keep the signalling effect positive and maintain a positive incentive. Furthermore, exemptions should be linked to conditionalities which can take various forms, for example requirements for environmental management systems and energy audits with associated investment requirements have proven useful in Denmark. Such conditionalities should also require the provision of information which can serve as an information gathering exercise, benefitting both the reform process as well as wider processes such as the development of environmental accounts.

Finally a **monitoring system** should be put in place to review progress every three to five years to assess how things are developing against a set criteria and adjustments to the system made where needed.

A combination of the above mentioned tools of broadening the tax base, increasing the tax rate, removing exemptions over time and wise use of revenues raised, could help to meet Swiss objectives to replace nuclear electricity production as well as wider objectives relating to climate change, competitiveness and social considerations.

[20] Another tool to minimise risks of competitiveness is the border tax adjustment. This is the focus of a separate study.

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