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ALIGNING PRICES AND POLICIES

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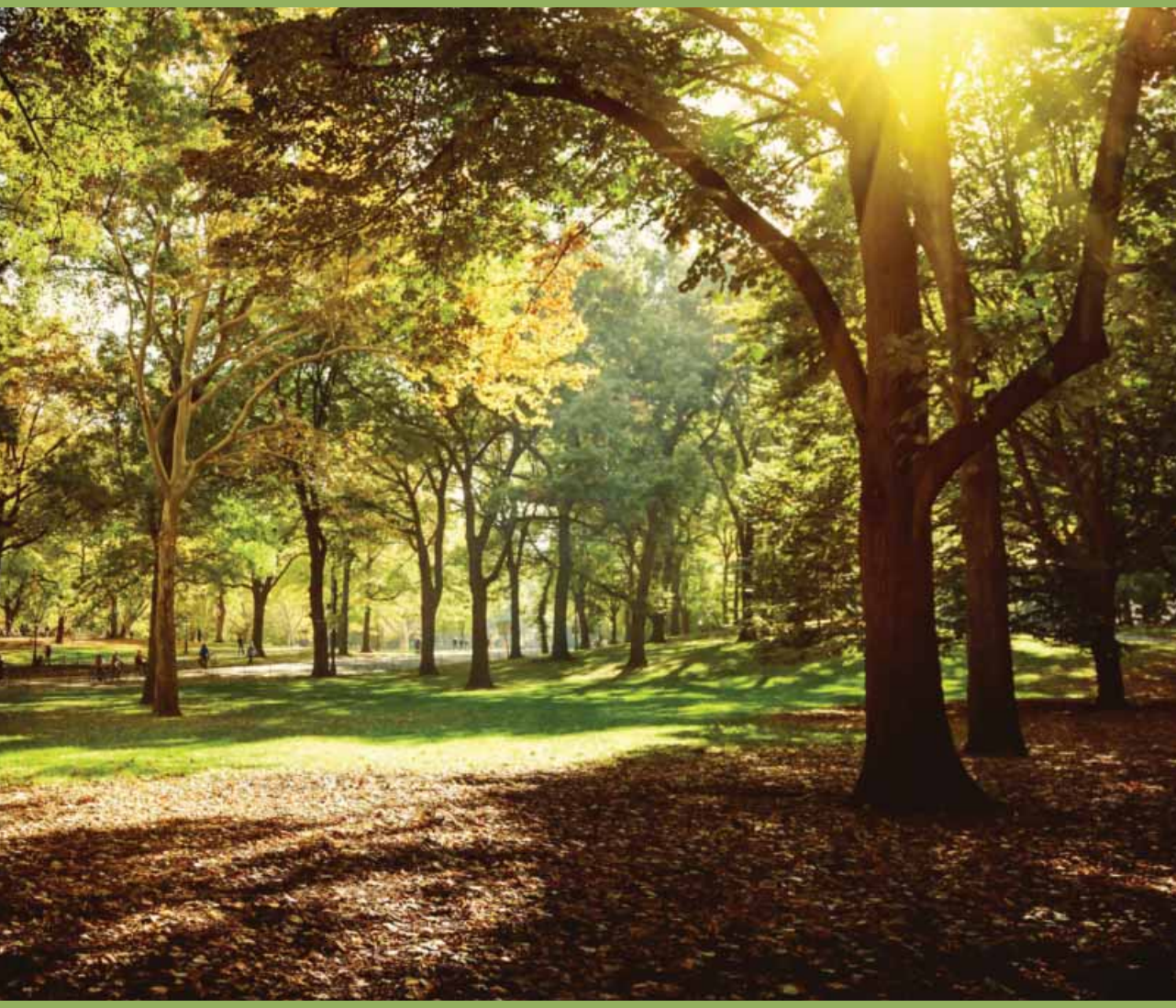
BETTER POLICIES FOR BETTER LIVES

Climate and carbon

Aligning prices and policies



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OCTOBER 2013

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BETTER POLICIES FOR BETTER LIVES

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A message from the OECD Secretary-General

In 2010, the international community agreed that deep cuts in global emissions would be needed to limit the increase in global average temperature as a result of human activity to 2ºC above pre-industrial levels. This is a manageable – and affordable – challenge to tackle, provided we act now. Given the long-lived nature of CO_2, and the fact that existing infrastructure has already committed us to decades of emissions to come, governments must act on this policy goal with a level of ambition that will eventually move us towards net zero emissions from fossil fuel combustion in the second half of this century.

The trajectory towards net zero carbon emissions will necessarily differ among countries, given their different stages of economic development and national circumstances. But common to all is the need for a coherent and consistent set of domestic policies that are credible in meeting the scale of the transformation needed. If governments are serious about climate change and about reducing the carbon entanglement, they must review the entire range of policy signals sent to consumers, producers and investors alike, and ensure that all avenues to price carbon cost-effectively are explored and conflicting signals eliminated. In particular, governments must take a hard look at policy measures that subsidise or encourage the exploration, production and consumption of fossil fuels.

This report brings together lessons learned from OECD analysis on a wide range of government experiences with carbon pricing, and identifies key elements for developing a coherent and consistent approach to meeting the climate challenge. Among the measures analysed are the adoption of policy instruments that put a price on every tonne of CO_2 emitted, as well as others that can cost-effectively spur innovation, and shift production and consumption decisions towards low-carbon choices. The report also highlights the adverse impact that some fiscal policies, such as subsidies and tax exemptions for fossil fuels, have on meeting the 2ºC target. These exemptions may sometimes be presented in response to a social need, but they are also often poorly targeted and come at a high economic cost to society, while at the same time undermining climate policy action.

As we look forward to 2015, every government must review its policy portfolio and rigorously assess if its overall impact is in favour or against climate action. We know that timeframes and levels of ambitions will be different across countries – starting points vary considerably – but all need to show how their policies are consistent with a pathway that moves us towards the 2ºC target.

The OECD stands ready to support countries in the process of designing and implementing coherent and consistent approaches to carbon pricing that are realistic and, at the same time, socially, economically and politically acceptable to the population at large.

Angel Gurría
OECD Secretary-General

Key messages

The global objective of limiting the average global temperature increase to no more than 2ºC above pre-industrial levels can only be achieved if countries worldwide take on the responsibility to gradually phase out their emissions of CO_2 in the second half of this century. This transition will depend on the clarity and consistency of the policy signals that governments provide to consumers, producers and investors alike. If governments are serious in their fight against climate change, the core message of this reform must be that the cost of CO_2 emissions will gradually increase, creating a strong economic incentive to reduce the carbon entanglement and to shift towards a zero carbon trajectory.

A central feature of such an approach is placing a price on carbon. Governments must look across the entire portfolio of policy measures that put a price on carbon and assess if they are effective in reducing CO_2 emissions and are consistent with their climate change objectives. Without a clear policy signal that there is a rising cost of CO_2 emissions over time, there will be little incentive for societies to undertake the needed shift away from fossil fuels. Moreover, it is crucial that the pricing mechanisms that are in place are credible, stable and sustainable over time in order to inspire the confidence to invest in the technologies and infrastructure needed to make a fundamental change. It is also important that carbon pricing policies are consistent with policies to address emissions from other greenhouse gases.

In moving the carbon pricing agenda forward, governments must address the following key issues:

Put an explicit price on carbon. Explicit carbon pricing mechanisms, such as carbon taxes and emissions trading systems, are generally more cost-effective than most alternative policy options in creating the incentive for economies to transition towards zero carbon trajectories. The use of these mechanisms is expanding in developed, emerging and developing economies, but there is considerable scope for further uptake by governments. Overcoming political opposition to putting an explicit price on carbon will often require close attention to the distributional and competitiveness implications on the domestic economy.

Identify other cost-effective policy instruments that put an implicit price on carbon. A number of other policies affect a country's CO_2 emissions and can effectively place an implicit price on carbon. Often these policies have been introduced to achieve objectives

other than climate-related goals (such as combatting air pollution or raising revenue), with the result that the CO_2 emissions abatement achieved may come at a relatively high cost. It is, therefore, paramount that the cost-effectiveness of these policies be carefully assessed and maximised. This calls for a clear understanding of what an optimal policy package should look like, given each country's economic and social context, and how far away current policies are from this package. In bridging the gap, governments should undertake an inventory of policies that explicitly and implicitly price carbon, and assess the impact of the policies and their interactions in order to ensure that they are mutually supportive in achieving CO_2 reductions as well as other social and economic objectives.

Review the broader fiscal policy to ensure that it is coherent with stated climate goals. Coherent carbon pricing should also include a review of the country's fiscal policy to ensure that budgetary transfers and tax expenditures do not, directly or indirectly, encourage the production and use of fossil fuels. In OECD countries, such support is less likely to come in the form of direct subsidies for fossil fuels and often takes the form of reductions in, or exemptions from, energy taxes. Coherent carbon pricing must include a reform of such support mechanisms in all countries to "level the playing field" for low-carbon technologies.

Ensure that any regressive impacts of carbon pricing measures are alleviated through complementary measures and a clear communication strategy is developed to explain them. In order to ensure public acceptance of carbon pricing, any carbon reform agenda must be accompanied by a clear communication strategy. This should not only outline the rationale of the reform process, but also make it explicit how revenues will be used, including in some cases to help address distributional or competitiveness concerns. A good communication strategy can raise awareness of the benefits of the reforms, and provide reassurance to those most affected (e.g. households vulnerable to energy price increases and energy-intensive businesses that compete in the global market) regarding any compensatory or other measures that might be used to mitigate the regressive impacts of reforms without losing the incentive to reduce emissions.

Coherence between stated climate goals and domestic policies. Consumers, producers and investors must get a clear policy signal of a rising cost for CO_2 emissions over time as a result of explicit and implicit carbon pricing policies. When taking on the climate challenge, government action must start today, but be planned for the long-term to achieve the global objective of limiting temperature increases to 2ºC above pre-industrial levels.

Abbreviations

BCA	Border carbon adjustment
CCS	Carbon capture and storage
CO_2	Carbon dioxide
EIT	Emission-intensive, trade exposed sectors
EU ETS	European Union Emissions Trading System
GDP	Gross domestic product
kWh	Kilowatt hour
NZ ETS	New Zealand Emissions Trading Scheme
ppm	Parts per million
RGGI	Regional Greenhouse Gas Initiative
tCO_2e	Tonne of carbon dioxide equivalent
VAT	Value-added tax

1. Global action on climate change

The climate is changing. The last three decades have been warmer than all preceding decades since 1850; the rate of sea level rise has exceeded the mean rate during the previous two millennia, and glaciers and ice sheets have continued to shrink (IPCC, 2013). These changes are in part caused by the large increase of anthropogenic concentration of greenhouse gases in the atmosphere, in particular the increase in the atmospheric concentration of CO_2 since 1750 (IPCC, 2013). Climate change is contributing to the increase in intensity and/or frequency of weather extremes with economic and social costs that continue to set new records. For example, Hurricane Ivan killed 28 people on the Caribbean island of Grenada in 2004 and caused overall damages estimated to be twice the GDP of Grenada, while Hurricane Sandy in 2012 is estimated to have resulted in damages of around USD 75 billion in the US (or around 0.5% of GDP). Similarly, the 2003 heat wave in Europe contributed to an estimated 50 000 excess deaths (IPCC, 2007), while drought conditions associated with the Russian heat wave in 2010 caused grain harvest losses of around 25% (valued at around USD 15 billion) (World Bank, 2012).

Recognising the potentially catastrophic impacts of climate change, the global community has agreed to limit the average global temperature increase to no more than 2ºC above pre-industrial levels (UNFCCC, 2011). A stabilisation of the concentration of greenhouse gases in the atmosphere at 450 parts per million (ppm), in CO_2 equivalent, would be consistent with this long-term global goal (IPCC, 2007). Although there are a number of possible trajectories for reaching the 2ºC target, they all imply a reduction to zero of the net global greenhouse gas emissions in the second half of this century (OECD, 2012a).

Despite a widespread understanding of what needs to happen, the current level of climate policy action is not consistent with a 450 ppm stabilisation pathway. Global emissions of CO_2 from the energy sector have grown by more than 1.5% per year since 1990, increasing from around 20 gigatonne of carbon dioxide equivalent ($GtCO_2e$) in 1990 to almost 32 $GtCO_2e$ by 2012 (IPCC, 2007; IEA, 2013). Many countries have adopted policies that directly or indirectly encourage lower greenhouse gas emissions. But other trends and policies are in place that lead to higher emissions. The 2ºC goal requires a stronger mobilisation of the international community together with the implementation of more coherent and cost-effective policies at the national and sub-national level to reduce greenhouse gas emissions. Governments are unlikely to succeed in this effort unless they manage to keep the cost of climate action to society to a minimum, particularly as many countries are still recovering from the worst economic crisis in decades.

Market-based instruments, such as emissions trading systems and carbon taxes, play an important role in promoting investments in zero carbon solutions. But such policy instruments must be part of a consistent and coherent government approach to carbon pricing that also takes into account the impact and cost-effectiveness of other policy instruments that discourage the emission of greenhouse gases as well as those policies which may inadvertently encourage emissions.

The focus in this report is on CO_2 from fossil fuel combustion. Although other greenhouse gases trap heat more effectively, the sheer volume of CO_2 emissions, and the fact that it stays in the atmosphere for an average of 100 years, mean that action to reduce its emissions must be focused and immediate. Reducing the emissions of other greenhouse gases is also important, but may require a different set of targeted policy responses. Furthermore, the urgent focus on CO_2 reflects the fact that investment decisions made today lock us into high carbon systems more strongly every year, resulting in high emissions for decades into the future. Unwinding such a "carbon entanglement" would be very expensive in the future and could result in stranded carbon assets. Starting immediately will reduce technological lock-in and assist in facilitating a more rapid shift to low-carbon alternatives.

This report synthesises recent OECD work on carbon pricing. Based on extensive analysis, it recommends that governments take a coherent approach to carbon pricing that ensures the price signals sent to consumers, producers and investors alike are consistent and facilitate the gradual phase-out of fossil fuel emissions by the second half of the century.

Box 1 | **OECD modelling on projected carbon reduction needs**

To meet the 2ºC target, the OECD estimates that emissions should be limited to 45 $GtCO_2e$ in 2020 and to 24 $GtCO_2e$ in 2050. Based on current action, it is projected that emissions will reach 51 $GtCO_2e$ in 2020 and 82 $GtCO_2e$ in 2050. Compared to the goal of limiting emissions to 450 ppm, this results in a gap of 6 $GtCO_2e$ in 2020 and of 58 $GtCO_2e$ in 2050. If action is delayed until 2020, and there is no global agreement on climate change, emissions levels are projected to reach 47 $GtCO_2e$ in 2020 but limiting the level of emissions to 450 ppm by the end of the century will then be much more expensive since emissions will need to be reduced to 19 $GtCO_2e$ by 2050.

Source: OECD (2012a), ***OECD Environmental Outlook to 2050: The Consequences of Inaction***, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264187610-en.

2. A coherent approach to carbon pricing

The cost of changing energy production and consumption infrastructure and of shifting the behaviours of producers and consumers to meet the climate challenge will be significant – and are one of the main barriers to action. Governments must bring forward policies to minimise such costs, starting with a coherent price signal on CO_2 emissions coupled with other mutually reinforcing policy instruments.

A key component of such an approach should be putting a price on every tonne of CO_2 emitted. Since producers and consumers would pay for each tonne of CO_2 emitted, explicit carbon pricing (e.g. carbon taxes and emissions trading schemes) provides an incentive to continuously improve the efficiency of energy use, and to develop and deploy technologies that substitute for existing carbon-emitting technologies.

While explicit pricing instruments should be the central policy instrument, they will need to be complemented by other policies where markets are not able to provide effective signals for reducing emissions. These include, for example, fuel economy standards for road vehicles, energy efficiency standards for appliances, and government support of research, development and deployment of non-fossil fuel energy technologies. Such policies can put an implicit price on carbon. Ensuring the cost-effectiveness of the range of policy instruments used, both on their own and in combination, is essential.

A coherent approach to carbon pricing must also ensure that policies affecting CO_2 emissions are mutually supportive and not working against each other. The prime example of incoherence in carbon policy is the use of tax exemptions and fossil-fuel subsidies that favour the production or consumption of fuel-intensive goods and services. Such exemptions and subsidies are often introduced in response to concerns over competitiveness or in order to address distributional concerns. However, they undermine

Box 2 | The landlord-tenant problem: An example of market failure

The landlord-tenant nexus is an example of how market failures can increase energy use. Although tenants usually pay their electricity bills, they may have limited control over them since it is the landlord that often selects and installs the major appliances affecting energy use (e.g. heating systems and in some cases also other household appliances such as refrigerators and washing machines). Unless regulatory measures are in place, there are few incentives for landlords to incur the additional cost of replacing current appliances with more energy-efficient alternatives.

the policies that seek to reduce dependence on fossil fuels and impede the transition towards zero carbon solutions, providing incentives to increase emission of greenhouse gases instead. Moreover, the support is often poorly targeted and thus inefficient in achieving the intended aims, as well as being costly in terms of foregone revenue or budgetary outlays.

3. Explicit carbon pricing: Carbon taxes and emissions trading systems

Explicit carbon pricing refers to market mechanisms and taxes that put a price on each tonne of CO_2 emitted. Pricing CO_2 emissions aims to minimise the cost of achieving mitigation targets while also catalysing innovation and investment in low-carbon technologies, providing local environmental and health benefits, and creating a source of government revenue. Although the history of explicit carbon pricing mechanisms is relatively recent and the experience of early carbon market initiatives has sometimes witnessed weak carbon prices, the pace of development of such initiatives is faster than ever before.

It is estimated that over 40 national and 20 sub-national jurisdictions, in both developed and developing countries, already have or are considering implementing explicit carbon pricing (World Bank, 2013). Together, these countries and regions account for around 21% of the total of 50 $GtCO_2e$ that are emitted globally each year. Since these mechanisms usually do not cover all domestic emissions, the effective coverage is reduced to around 7% of global emissions. However, if domestic coverage was extended in developed countries and if emerging economies, including China (beyond its carbon market pilots), Brazil, Chile and others were to go ahead with their planned initiatives, effective coverage could put a price on almost half of global CO_2 emissions (World Bank, 2013).

Carbon taxes

There is now a growing body of experience in the implementation of carbon taxes, providing useful insights and lessons on their design and implementation. For example, carbon taxes should be introduced incrementally to allow households and businesses to adapt to rising energy prices. This could happen either by increasing the tax rate over time or by expanding the coverage. For example, in British Columbia, the carbon tax was initially set at CAD 10 per tonne CO_2 but increased over a 4-year time-period to CAD 30 per tonne CO_2. The annual increases of CAD 5 per tonne CO_2 were announced well in advance. The Swedish Carbon Tax, introduced in 1991, was initially set at USD 133 per tonne CO_2 and has since increased to over USD 160 per tonne CO_2. In response to competitiveness concerns, however, some sectors face a lower tax rate. The Finnish carbon tax initially covered only heat and electricity production but was later expanded to cover transportation and heating fuels, while in Denmark, the number of exemptions was gradually reduced (although some exemptions still remain).

The use of tax revenues can also determine how carbon taxes are perceived by the public. In principle, there are three options: governments can use carbon tax revenues to reduce their debt, to reduce other taxes (e.g. income and business taxes), or to

Box 3 | **Defining carbon taxes and emissions trading systems**

Emissions trading systems are managed by a governing jurisdiction that sets a limit or a cap on the total level of covered greenhouse gas emissions, including CO_2. The allowances to emit are either auctioned or allocated for free to liable entities (emission sources or others), which must redeem allowances for every emitted tonne of CO_2, with the possibility to trade unused allowances. The emission cap is set by the sum of distributed or auctioned allowance. As liable entities consider the cost of their emissions within their production processes and the possibility to buy or sell allowances, a market for CO_2 emerges, setting a price on CO_2 that acts as a reduction incentive for all liable entities.

Carbon taxes refer to taxes that are directly linked to the level of CO_2 emissions, often expressed as a value per tonne CO_2 equivalent (per tCO_2e). While carbon taxes provide certainty with respect to the marginal cost faced by emitters per tCO_2e, they do not guarantee the resulting level of maximum emissions, which is the strength of emissions trading systems. However, putting a price on the volume of emissions creates a strong incentive for polluters and resource users to become less reliant on fossil-fuel energy sources and helps to promote innovation in a similar (but not identical) manner as trading systems.

The two policy options have different targets and different distributional impacts. For administrative and practical reasons, they also tend to apply to different sectors: emissions trading systems usually target large, stationary energy-intensive activities; carbon taxes are applied to more diffuse sources of CO_2 such as the road transport, residential and commercial sectors. In theory, however, both instruments could apply to all emitting sectors.

Box 4 | **Promoting innovation through carbon pricing**

Policy mechanisms that put an explicit price on the emission of CO_2 and other greenhouse gases can be effective in promoting innovation in energy-efficient technologies. For example, an OECD study found that UK firms subjected to the full Climate Change Levy on fossil fuels and electricity were more likely to innovate (and register patents) than firms subjected to a reduced rate of the Levy. Carbon taxes and emissions trading systems give innovators the flexibility to identify approaches to reducing emissions that fall within their financial and operational constraints. In theory, explicit carbon pricing mechanisms initially induce increased investment in efficiency-enhancing technologies and innovations in production processes that lower the use of fossil-fuel inputs. This reduces the cost difference between conventional, carbon-intensive technologies and low-carbon alternatives. In the longer-term, a switch from operating mechanisms that are fossil-fuel intensive towards low-carbon technologies can be observed.

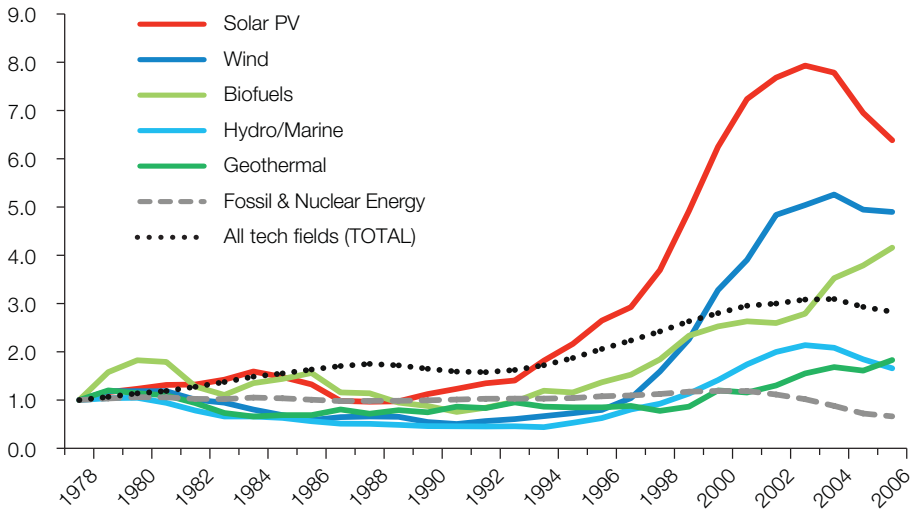
In practice investments in low-carbon technologies generally only occur when the innovator is directly exposed to the tax. As a result, explicit carbon pricing mechanisms could be complemented by policy instruments that target specific sectors or types of technologies as with energy efficiency standards. Manufacturers of electrical appliances and equipment may not choose to make investments that improve the energy efficiency of their products since the carbon price signal that the end-users observe is not strong enough for them to demand such changes. In this case, energy standards can guide production and consumption decisions towards increased efficiency.

Box 4 continued...

Many OECD countries have in recent years promoted increased investment in low emission technologies. Patent analysis shows that this has resulted in a significant increase in the rate of innovation of such technology, in particular wind power, solar power, biofuels, geothermal and hydro. Over the same period, patent activity for other fossil and nuclear technologies fell, even in comparison with the rate of patenting in general and for other energy technologies.

Growth rate of climate change mitigation patenting

(Count of claimed priorities (CP) worldwide, 3-year moving average, indexed on 1978=1.0)



Targeted support for investments in renewable energy has been justified by the relative immaturity of these technologies. Further, such technologies may warrant government support given their public good characteristic and the fact that such investments often are considered too risky, uncertain or long-term to be undertaken by the private sector alone. However, determining when and how the government should intervene inevitably results in having to "pick winners" amongst a portfolio of technologies or approaches. Finally, recent work suggests that relying on carbon pricing alone to trigger low-carbon technical innovation may be more costly than applying a lower carbon price complemented by targeted support for research and development.

Sources: OECD (2010a), ***Taxation, Innovation and the Environment***, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264087637-en; OECD (2012e), "Energy and Climate Policy: Bending the Technological Trajectory", ***OECD Studies on Environmental Innovation***, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264174573-en; Haščič, I. et al (2010), "Climate Policy and Technological Innovation and Transfer: An Overview of Trends and Recent Empirical Results", ***OECD Environment Working Papers***, No. 30, OECD Publishing, Paris, http://dx.doi.org/10.1787/5km33bnggcd0-en; Acemoglu, D. et al. (2012), "The Environment and Directed Technical Change", ***American Economic Review***, Vol. 102/1, pp. 131-66.

increase expenditures (e.g. for social programmes). In practice, most governments tend to recycle the revenue from carbon taxes back to consumers through reductions in income taxes, especially for low-income households most affected by the carbon taxes, or to increase the budget allocation for social services. This approach can make the tax, and subsequent tax increases, more socially acceptable. Tax revenues are in some cases used to finance the development of clean technologies and occasionally returned to companies that may be adversely affected by the tax.

Box 5 | **The Irish Carbon Tax**

Ireland introduced a carbon tax in 2010. The tax was an outcome of a number of factors, including the EU's commitment to reduce the emission of greenhouse gases. Although Ireland was allowed a seemingly generous target of +13% above its 1990 emissions following the EU burden-sharing agreement under the Kyoto Protocol, it was clear from the outset that it would be difficult to meet the target. When the Green Party in 2007 formed a coalition with Fianna Fáil, climate change was one of its three pillars in the joint Programme for Government. The Programme aimed to reduce greenhouse gas emissions by 3% over its term through the phase-in of appropriate fiscal instruments. This motivation was matched by a financial need by the government for additional sources of revenue in the face of a severe financial crisis.

The carbon tax was introduced at a rate of EUR 15 per tonne CO_2. Agreement on the tax rate was made possible by limiting the tax to those sectors outside of the EU ETS, and excluding most emissions from farming. Instead, the tax applies to petrol, heavy oil, auto-diesel, kerosene, liquid petroleum gas (LPG), fuel oil, natural gas, coal and peat, as well as aviation gasoline. Since its introduction, there have been phased increases of the tax to EUR 20 per tonne CO_2 on different fuels. In 2012, carbon tax revenues accounted for just under 1% of total tax revenues.

The carbon tax resulted in a significant increase in the price of peat and coal for heating, traditionally used by lower-income households. In response, the government increased its fuel-related assistance programmes. This included an increase in the national Fuel Allowance Scheme from EUR 82 million to EUR 250 million between 2005 and 2011. However, in an attempt to limit emissions, the duration of the scheme was cut from 32 to 26 weeks in 2013. The government also introduced a National Retrofit programme in 2010, targeting 1 million residential, public and commercial buildings. The programme also includes an Energy Efficiency Fund to roll-out discounted energy services to the public. Of the EUR 115 million spent on retrofitting to date, 75% has been earmarked for the domestic sector, 40% of which is allocated to address energy poverty measures.

Despite the additional cost the carbon tax imposed on households, opposition to the carbon tax was limited. In the context of a serious budgetary crisis, it was viewed as a choice between an increase in corporate taxes or the new carbon tax. There might also have been greater opposition if the tax had included some of the larger emitters in the industrial and farming sectors – the former were already covered by the EU ETS, however.

Source: Convery, F. J., L. Dunne and D. Joyce (forthcoming), "Ireland's carbon Tax and the Fiscal Crisis", ***OECD Environment Working Papers and Reports Series***, OECD Publishing, Paris.

Carbon taxes can also contribute to a reduction in other environmental externalities, such as those associated with the combustion of fossil fuels. In the transportation sector, this includes a reduction of local air pollutants through lower gasoline and diesel use as a result of more energy-efficient cars and changed driving practices, as well as reduced traffic congestion. These benefits, and the cost savings from energy-efficiency, can help to offset the social costs incurred by a carbon tax.

Emission trading systems

With the 1997 Kyoto Protocol, the majority of developed countries agreed to legally binding targets between 2008 and 2012 for their emissions of six[1] major greenhouse gases, including CO_2. Three emissions trading mechanisms were established to assist countries in meeting these goals: Emissions Trading, the Clean Development Mechanism (CDM), and Joint Implementation (JI). The introduction of tradable emission quotas helped to stimulate the development and implementation of a number of national, sub-national and regional emissions trading systems. The systems vary greatly in terms of their coverage and size (in tCO_2e per year), whether they are mandatory or voluntary, and in their scope (direct emission sources only or including energy users). The systems also differ in terms of their compliance provisions and the time period over which the emission targets are set (Ellis and Tirpak, 2006). These differences are briefly summarised in Box 6.

Following domestic systems in Denmark and the UK, the EU Emissions Trading System (EU ETS) was introduced in 2005 and it remains the largest mechanism in terms of coverage of traded volumes. Its experience has illustrated the importance of carefully defining the different design features. After an initial phase of relatively high allowance prices, the EU ETS has been characterised by low and in some cases volatile prices. This can in part be attributed to an overly generous allocation of allowances to certain industrial activities, the use of complementary measures promoting renewable electricity and enhanced energy efficiency. It also reflects the impact of the economic recession on industrial activity, and in turn electricity demand.

Similarly, the New Zealand Emissions Trading Scheme (NZ ETS) has also experienced volatile prices. The NZ ETS has a relatively broad coverage (scheduled to expand to all sectors and gases under the Kyoto Protocol by 2015), with the unstable price being linked to the generous allocation of free allowances to vulnerable sectors. An additional factor has been the ability of entities to use traded offsets (e.g. Certified

1. Carbon dioxide (CO_2), methane (CH4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF6).

Box 6 | **Key design features of emission trading systems**

Four elements define the nature and overall form of an emissions trading mechanism:

Emission caps and crediting baselines/thresholds: The emission cap reflects the emissions reduction objective of the system. To be effective in reducing emission levels, the total supply of allowances must be lower than the level of emissions expected under "business as usual" conditions. Over-allocation can result in low or zero allowance prices, which weakens the incentive for innovation and investment in clean technologies. Emissions allowances can be set using a relative metric such as tonne of CO_2 equivalent per unit of output to reduce the risk of over-allocation. This approach recognises that the demand for emission allowances decreases in times of economic recession. Baselines and thresholds describe what would have happened in the absence of the mechanism and sometimes include an additionality test to demonstrate that the emissions reductions would not have happened in the absence of the mechanism.

Coverage of emissions sources: Coverage determines which entities are subject to the mechanism: sectors, gases and installation size. The coverage is often dependent on the country's or the region's emission profile. Coverage can be politically motivated to protect certain sectors (e.g. due to their exposure to international competition), and exemptions may be made if other policies and measures already in place cover certain sectors or gases.

Allocation: There are three main modes of allocating allowances: i) competitive auctioning; ii) free allocation proportionate to sources' past emission levels; and iii) free allocation subjected to regular updates based on activity levels. Full auctioning is the most economically efficient approach as it generates budget revenues that can, for example, be used to offset other distortionary taxes and assist with transitional costs. However, some level of free allocation is common practice when trading systems have been introduced. This is generally done to lower the direct financial cost and alleviate concerns about international competitiveness. Within the same system, more than one allocation mechanism can be applied, sometimes differentiated across sectors.

Banking and borrowing (also known as "when" flexibility): Emitters covered by the system can be allowed to use allowances today for compliance in a future period (a measure known as "banking"), or, less commonly, to use allowances from a future period for compliance today ("borrowing"). While this reduces the flexibility that governing jurisdictions have to adjust the overall emission cap in response to external factors, it enables entities with long time-horizons to plan ahead and manage cost.

Sources: Prag, A., G. Briner and C. Hood (2012), "Making Markets: Unpacking Design and Governance of Carbon Market Mechanisms", ***OECD/IEA Climate Change Expert Group Papers***, No. 2012/03, OECD Publishing, Paris, http://dx.doi.org/10.1787/5k43nhks65xs-en.; Baron, R. and S. Bygrave (2002), ***Towards International Emissions Trading: Design Implications for Linkages***, OECD/IEA Publishing, Paris, available at: www.oecd.org/environment/cc/2766158.pdf.

Emission Reductions, Emission Reduction Units and Removal Units) to cover their emissions (World Bank, 2013).

These experiences raise the issue of how to determine the appropriate coverage and targeting of emissions trading systems. They also highlight the need of jurisdictions to ensure that design mechanisms in their own systems keep prices under control and that key design features can be revised at regular intervals in order to preserve the incentives of producers and consumers to reduce emission levels.

Notable developments that may benefit from these experiences is the development of a Chinese emissions trading system by 2015. To inform this process, seven carbon market pilots in two provinces and five cities were launched in 2013. Among these pilots, the city of Shenzhen launched its system in July 2013. Its goal is to reduce the emission intensity of the provincial economy by 21% below 2010 levels, with a total emission cap of 32 million tCO_2e. The system covers all companies with emissions over 20 000 tCO_2e in 26 sectors, including electricity and natural gas, water supply and industrial manufacturing. However, coverage of the Shenzhen pilot is limited and only covers around 40% of total emissions.

Price stabilisation mechanisms include price ceilings and price floors. Price ceilings can be introduced when there are concerns that carbon prices may be too high and affect competitiveness and household disposable income. A variant of a price ceiling was introduced in the Regional Greenhouse Gas Initiative (RGGI). The RGGI was the first market-based regulatory mechanism in the US to cap and reduce CO_2 emissions from the power sector in nine states[2]. The RGGI includes an offset allowance that serves as a flexibility mechanism for regulated facilities, equivalent to 3.3% of their compliance obligation. However, if the emissions allowance price reaches USD 7, a trigger mechanism increases the percentage of allowed offsets to 5% and to 19% if the price reaches USD 10 (World Bank, 2013).

Price floors can prevent the price from falling below a certain point in an effort to ensure a strong and certain signal to emitters, as well as current and potential investors in low-carbon technologies. In April 2013, the UK introduced a carbon price floor set at GBP 16 per tonne of CO_2. The price floor is set to gradually increase to GBP 30 per tonne by 2020 and to GBP 70 per tonne in 2030 (HR Revenue & Customs, 2013). A risk, however, is that the price imposed on UK companies will be significantly higher than that faced by their competitors in mainland Europe that only face the price under the EU ETS. Since emissions from companies both in the UK and in

2. Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont

mainland Europe fall under the EU ETS, the floor price will not affect the total level of emissions but instead result in a shift in relative costs, along with changes in other relative cost decisions. However, if UK companies lose their market share to companies in other countries outside the EU, this results in what is referred to as

Box 7 | **The EU Emissions Trading System (EU ETS)**

The EU ETS is the largest greenhouse gas emission trading scheme and is central to the EU's approach to meet the region's emission target specified in the Kyoto Protocol. It is compulsory for the EU's 28 member countries, in addition to Iceland, Lichtenstein and Norway that joined voluntarily the EU ETS in 2008. The EU ETS was launched in 2005 and is now in its third phase. Phase I (2005-2007) was a test phase that allowed for experiences to be developed, and banking was not allowed into Phase II. In Phase II (2008-2012), each EU member state had its own national emissions target defined by the EU burden-sharing agreement, which, together with the emission inventories from the first phase, guided allocation to the entities covered by the EU ETS. In Phase III (2013-2020), a single EU-wide emissions target was introduced for the trading system. Emission allowances are annually decreased by 1.74% to achieve a 21% reduction of greenhouse gas emission in 2020 compared to 2005 emissions.

The EU ETS covers around 45% of EU's total greenhouse gas emissions, focusing on three types of gases i) CO_2 from power plants, energy-intensive sectors and commercial airlines; ii) nitrous oxide (N_2O) from the production of certain acids; and iii) perfluorocarbons (PFCs) from aluminium production. The aviation sector is covered by the EU ETS but its active participation has been deferred to allow for an international agreement on aviation emissions. Participation in the EU ETS is mandatory for the emission of gases falling into one of the three categories, subject to minimum size thresholds. Sectors already covered by other domestic policies that reduce emissions by an equivalent amount can in theory be exempted from the EU ETS, although this option has not been used in practice.

In Phase I, individual emission caps for each of the member states were outlined in the countries' National Allocation Plans that together resulted in the EU-wide cap. Although the European Commission reduced the caps in 15 member states by an estimated 290 million tonnes of CO_2, with the objective of enforcing scarcity, allocated allowances exceeded emissions in the first year by at least 3%. As a result of this and of the impossibility of banking allowances, the price of allowances crashed to less than EUR 1 per tonne CO_2 in 2007. Responding to this mismatch, the Commission lowered the cap by 9.5% in Phase II. In Phase III, at least 50% of allowances were auctioned, compared to free allowances in Phases I and II. The percentage of auctioned allowances will gradually increase to reach 100% in 2027.

The rapid growth of renewable electricity generation, combined with lower electricity demand, lower industrial output following the recession, and enhanced energy efficiency, have resulted in reduced demand for allowances which, when coupled with relatively modest reductions in the cap, have led to very low allowance prices. In the absence of a further reduction in the cap, these prices may provide only a limited incentive for companies to undertake longer term investments to reduce emissions.

Source: Brunner, S. et al. (2009), ***Emissions Trading Systems: An Overview***, Potsdam Institute for Climate Impact Research, Potsdam.

carbon leakage where emissions reductions in one place result in higher emissions elsewhere. To the extent that the floor price was a response to severely depressed prices in the EU ETS, the best long-run solution would be renewed attention to the level of the cap governing the EU ETS.

Furthermore, due to loopholes in emissions trading coverage, technology-specific subsidies may in some cases need to be considered, while technology standards may be a useful complement to emissions trading schemes in order to help drive technological change. However, the costs and benefits of introducing complementary policies must be carefully examined and should only be introduced when they lower the net cost of reducing emissions for society.

The emergence of different standards, governance processes and scales has not prevented emissions trading systems from starting to link up both horizontally (e.g. between geographically distinct systems) and vertically (e.g. between overlapping mechanisms in the same geographic area with different levels of governance). An example of the latter is the Climate Change Agreement trading scheme in the UK that has operated alongside the EU ETS but covers a different set of entities and has different objectives. There can either be a one-way link between systems, whereby allowances in one are recognised and can be used in another, but not *vice versa*, or a two-way link where the allowances are interchangeable (Prag et al., 2012). One-way links are considered less risky than two-way links and may act as a stepping stone for the latter.

The Western Climate Initiative links five North American states (British Columbia, California, Manitoba, Ontario and Québec) with the objective of reducing emissions by 15% below the 2005 baseline by 2020. The target reflects the sum of existing goals of the individual partners and each participating jurisdiction is responsible for enacting appropriate regulations. In 2012, the EU and Australia announced plans for a one-way link to be established between their emissions trading systems on 1 July 2014, with the possibility of establishing a two-way link by 2018[3]. Such a two-way link would require that the systems become harmonised, making it difficult to introduce further adjustments. Figure 1 summarises examples of direct and indirect linking that already exist or are planned (Grubb, 2012).

3. In September 2013, the incoming Australian government indicated that it would be abolishing the Australian carbon pricing mechanism.

Table 1 | **Price information on selected emissions trading schemes**

Emission trading Scheme	Price stabilisation mechanism	Price per tCO_2e *Original currency*	*USD*
Australian Carbon Pricing Mechanism[2]	*Fixed price* from 2012 to 2015: AUD 23 in 2012, will increase by 2.5% plus inflation annually in the fixed price period. *Fixed price ceiling* for the first three years of the flexible period: price will be set in 2014 at AUD 20 above the expected price of EUAs for 2015–2016, rising by 5% plus inflation annually.	AUD 23	USD 24
European Union Emissions Trading System	*No explicit mechanism.* Some provisions in the event of excessive (upward) price fluctuations.	N/A	N/A
California's Cap-and-Trade Program	*Auction reserve price*[3] USD 10 in 2012, increasing by 5% . per year plus inflation. *Price containment reserve*: allowances from this reserve will be offered at auctions four times per year, at three price levels: USD 40, USD 45 and USD 50 for 2012, increasing annually by 5% plus inflation.	USD 14	USD 14
Chinese Carbon Market Pilots (in two provinces and five cities)	*No explicit mechanism.*	N/A	N/A
Japan City Level Cap-and-Trade Schemes (Tokyo, Saitama, Kyoto)	*No explicit mechanism.*	N/A	N/A
Kazakhstan's Emissions Trading Scheme	*No explicit mechanism.*	N/A	N/A
New Zealand Emissions Trading Scheme	*Fixed price ceiling*: NZD 25. In practice: due to the temporary rule that non-forestry participation can surrender one allowance for two tonnes of emissions, this means a price ceiling of NZD 12.5.	NZD 1	USD 0.85

Emission trading Scheme	Price stabilisation mechanism	Price per tCO_2e[1] *Original currency*	*USD*
Regional Greenhouse Gas Initiative	*Currently: offset trigger mechanism* (% of allowed offset increases to 5% of obligation if auction allowance prices reach USD 7 and to10% if prices reach USD 10). Proposed change (following review of scheme): removal of the offset trigger mechanism and creation of a cost containment reserve (CCR), consisting of a fixed quantity of allowances, in addition to the cap, only available for sale if allowance prices exceed USD 4 in 2014, USD 6 in 2015, USD 8 in 2016, and USD 10 in 2017, rising by 2.5%, to account for inflation, each year thereafter.	USD 2	USD 2
Québec Cap-and-Trade System	*Auction reserve price*: CAD 10 in 2012, increasing by 5%/y plus inflation. *Price containment reserve*: allowances from this reserve will be offered at auction four times a year, at three price levels: CAD 40, CAD 45, and CAD 50 for 2012, increasing annually by 5% plus inflation.	N/A	N/A
Swiss Emissions Trading Scheme	*No explicit mechanism.*	SFr.18	USD 19

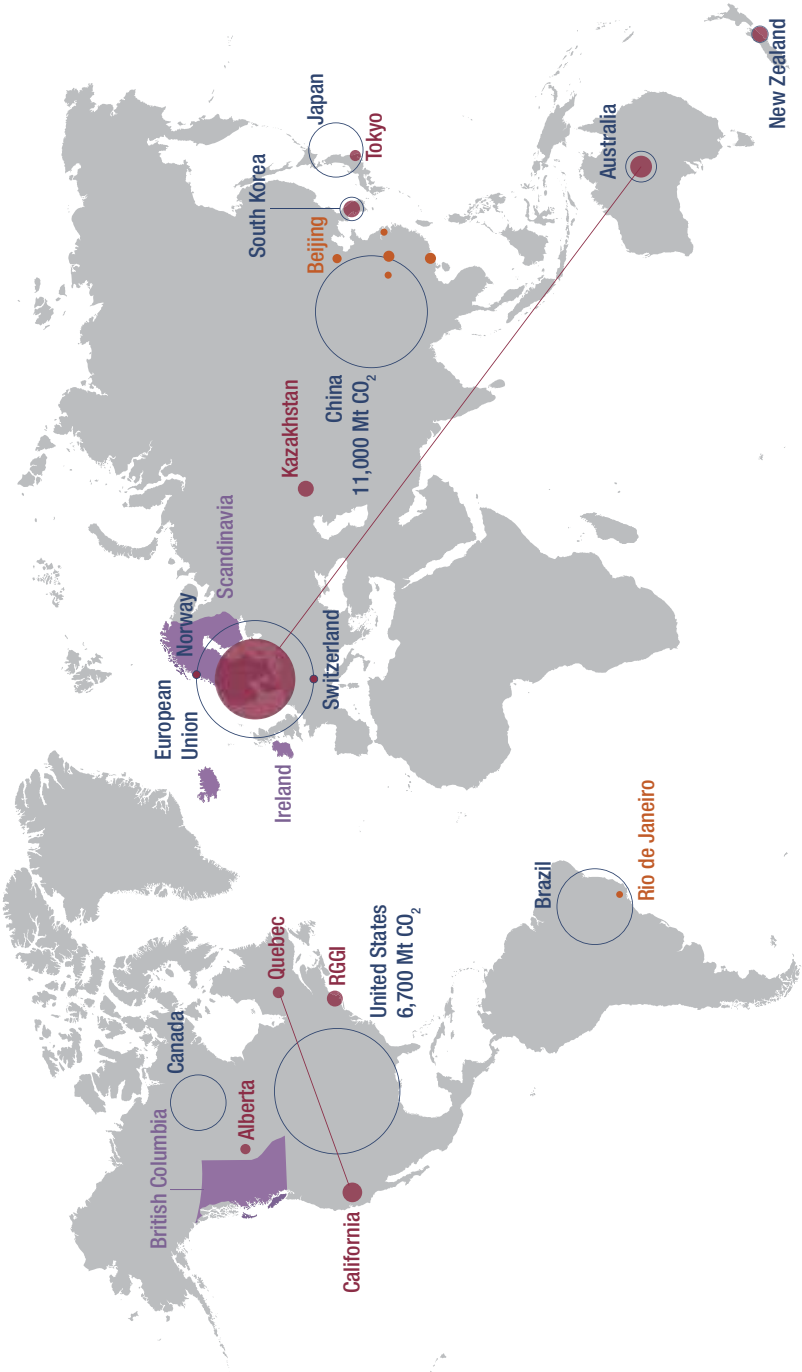
Note 1: Prices as of May 2013.

Note 2: The Australian Carbon Pricing Mechanism is due to be abolished following the change of government in September 2013.

Note 3: The auction reserve price refers to the minimum price that allowances can be sold for at an auction.

Source: Based on World Bank (2013), ***Mapping Carbon Pricing Initiatives: Developments and Prospects 2013***, Carbon Finance at the World Bank, Washington DC.

Figure 1 | **Some existing and planned carbon market mechanisms**



○ Emissions (2010) ● Operating trading systems ● Legislated trading systems (by 2015) ● Carbon tax
Mt CO_2 megatonnes of carbon dioxide equivalent (including déforestation). Circle sizes are approximately proportional to greenhouse gas emissions.

Source: Grubb, M. (2012), Emissions trading: Cap and trade finds new energy, ***Nature***, No. 491, http://dx.doi.org/10.1038/491666a., based on Prag, A., G. Briner and C. Hood (2012), "Making Markets: Unpacking Design and Governance of Carbon Market Mechanisms", ***OECD/IEA Climate Change Expert Group Papers***, No. 2012/03, OECD Publishing, Paris, http://dx.doi.org/10.1787/5k43nhks65xs-en.

4. Implicit carbon pricing: Energy taxes and regulatory standards

In addition to policy instruments that put an explicit price on CO_2 emissions, a number of other policy instruments implicitly price CO_2. The most prominent of these are taxes on energy products that are based on the volume or the energy content of fuels rather than their CO_2 emissions. Standards and regulations that govern the energy use of equipment or processes comprise another set of policy instruments that put an implicit price on carbon. Compliance with such standards and regulations results in consumers and producers indirectly paying a price for reducing emissions. Each of these will be discussed below.

Taxes on energy

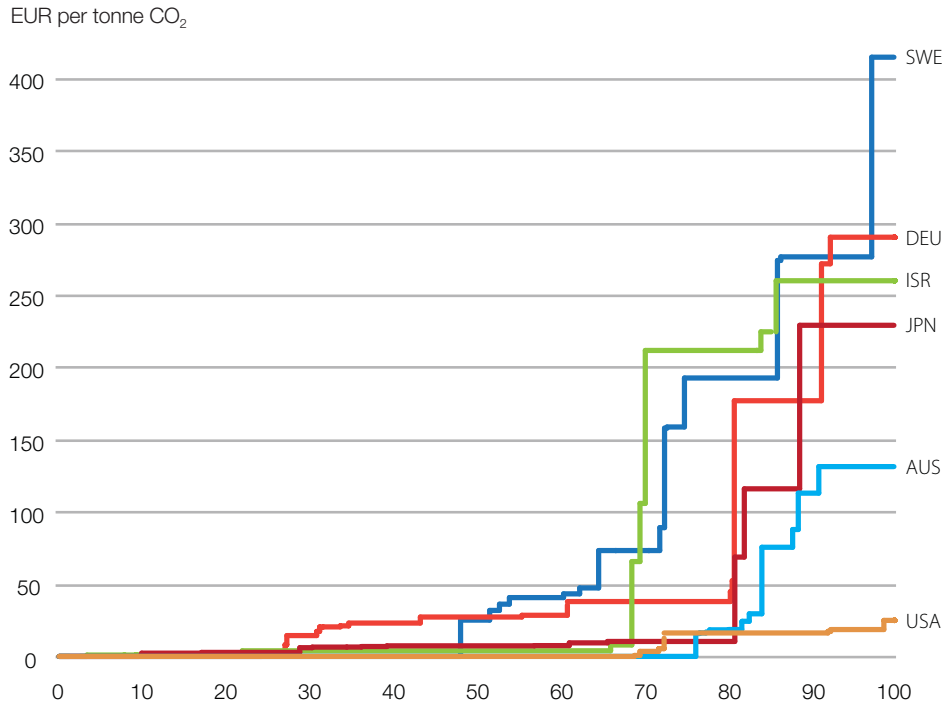
Energy taxes are levied on a wide range of energy forms, not just on fossil fuels, and can be a powerful tool to influence energy use patterns. Across the OECD, there are marked differences in the application of energy taxes in terms of i) the range of energy products taxed, ii) the tax rate levels and rebates, and iii) tax expenditures as reported by governments and rebates on energy use. These taxes are in many cases levied for purposes that have nothing to do with pricing carbon but they nonetheless significantly affect the relative price of different fossil fuels.

An OECD study has examined the effective tax rates on carbon in the energy sector (OECD, 2013a). In this study, tax rates, which are usually set in monetary units per physical quantity of fuel (e.g. litres, kilograms, kilowatt hours) are re-calculated as effective tax rates per gigajoule of energy or per tonne CO_2 emissions. The energy content provides a neutral basis for comparing tax rates on products that are otherwise expressed in diverse physical quantities, while fuel taxes based on carbon content can provide an effective means of internalising the social cost of CO_2 emissions.

Across the OECD, the effective tax rates on carbon range from around EUR 3 per tonne CO_2 in Mexico to EUR 107 per tonne CO_2 in Switzerland (OECD 2013a). A simple average for all OECD countries is EUR 52 per tonne CO_2 while the weighted average is EUR 27, as the large energy consuming economies in the OECD have lower energy tax rates (e.g. the United States, Japan and Canada). Figure 2 illustrates the different effective tax rates on a carbon emissions basis across selected OECD countries, using the estimated effective tax rates. The effective tax rates are arranged from the lowest to the highest tax rates. As can be seen, effectively 70-80% of fossil fuels in most countries are not taxed at all or at a very low rate.

There are also considerable differences in effective tax rates within countries and across categories of energy uses, here categorised as: transport, heating and process use, and electricity generation. In OECD countries, relatively high effective taxes are applied to the transport category compared to heating and process use and the electricity generation categories. This may be explained by the fact that taxes in the transport category often are aimed at addressing a broad range of externalities (e.g. congestion, traffic accidents and noise), rather than greenhouse gases specifically. Fuel consumption is used as a proxy for addressing these externalities. Road fuel taxes are also often used to fund road construction and maintenance.

Figure 2 | **Effective tax rates on a carbon-emission basis in selected countries**



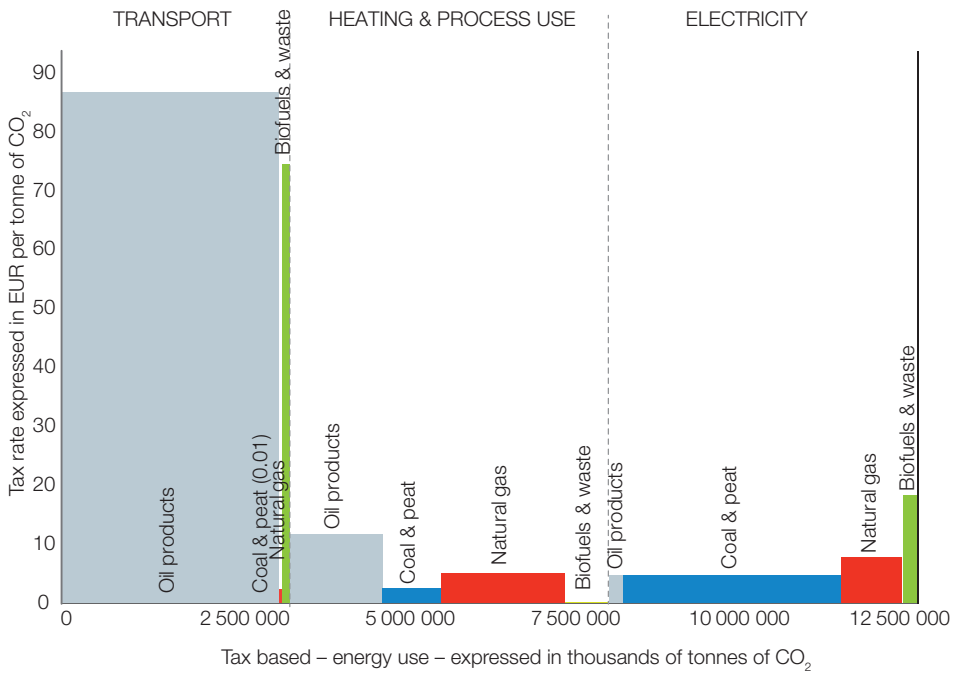
Note: The horizontal axis shows the proportion of all energy use in each country (measured in tonnes of CO_2), with the corresponding effective tax rate on carbon from energy taxes on the vertical axis. The 80% mark, for example, shows the rate at which the 80th percentile of the base is taxed, while the country profile for Germany illustrates that about 10% of its energy is taxed at an implicit carbon tax rate of EUR 290 per tonne CO_2.

Source: OECD (2013a), ***Taxing Energy Use: A Graphical Analysis***, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264183933-en.

In the case of heating and process use, tax rates are lower than taxes on transport fuels across OECD countries. Within this category, many countries apply lower effective taxes on energy products used for industrial or energy transformation than on residential and commercial energy, perhaps indicating a desire not to undermine industrial competitiveness. In other countries, rates on residential and commercial energy are lower, implying that the government is protecting households from high energy costs. In either case, exemptions from an energy tax represent a distortion that affects the level of emissions in the exempted sectors. A more effective approach, from an environmental and economic perspective, is to preserve the tax signal through fuel taxes and to address secondary impacts by other means that do not affect the price signal (e.g. cash transfers to industry or low-income families).

Electricity is a secondary energy product generated from primary energy sources like natural gas, coal, nuclear, hydro, wind and other new renewables. As a result, the estimates of effective tax rates here account for the fuel used to generate the electricity, including the

Figure 3 | **Taxation of energy in the OECD area on a carbon content basis**



Source: OECD (2013a), ***Taxing Energy Use: A Graphical Analysis***, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264183933-en.

energy lost in converting fossil energy into electricity. At the national level, taxes on electricity may be levied directly on the fuels used to generate electricity or indirectly, through taxes on the consumption of electricity. Seven OECD countries levy taxes on both the consumption and production of electricity, while five do not tax electricity at all.

In addition to the variation across the categories, the different levels of effective tax rates on fuels within each category are also noteworthy. For example, despite the important role of coal in electricity generation in the OECD area (illustrated by the width of the bar

Box 8 | **Effective tax rates on energy: Gasoline vs. diesel (road use)**

An example of price signals variation can be found by looking at the tax rates applied to transport fuels. By comparing the first and the second rows in the table below, it is clear that road fuels are taxed more than fuel used for other modes of transport when converted into EUR per tonne CO_2. The relatively high taxes levied on road fuels reflect the revenues needed to fund road infrastructure development and maintenance or to internalise specific social costs such as congestion, accidents and noise. In some cases, they may also be at levels that could reflect the costs of air pollution of greenhouse gas emissions associated with road transport.

OECD simple average effective tax rates on CO_2 from transport fuels, by fuel type and use

EUR per tonne of CO_2

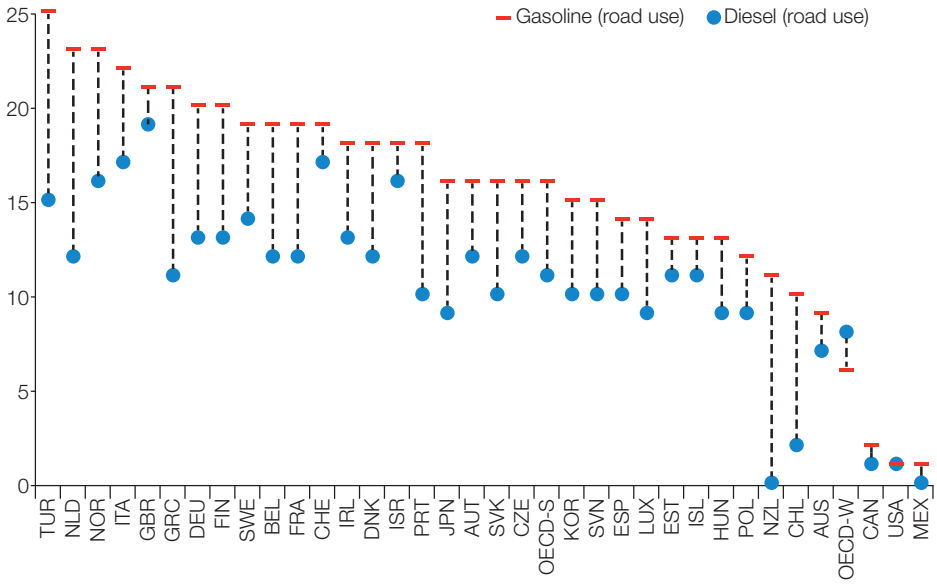
		Gasoline	Diesel	LPG	Aviation fuels	Biofuels	Natural gas	All fuels
	% of base	52%	36%	1%	6%	3%	1%	100%
Road use	90%	224	142	54	0	71	12	170
Non-road use	10%	15	60	4	23	0	5	40
Total transport use	100%	223	137	56	23	71	11	161

The effective tax rates also vary across the different fuel types, a striking example being the difference between the effective tax rates on road gasoline and diesel. The effective tax rate on diesel as a simple average for all OECD countries is 32% lower than that on gasoline in energy terms. Across the OECD area, only the US has a higher tax for diesel than gasoline on a per unit of energy basis, although the rates of tax on both diesel and gasoline in the US are very low relative to other OECD countries.

Box 8 continued...

Effective tax rates on energy: Gasoline vs diesel (road use)

Tax rate (EUR per GJ)



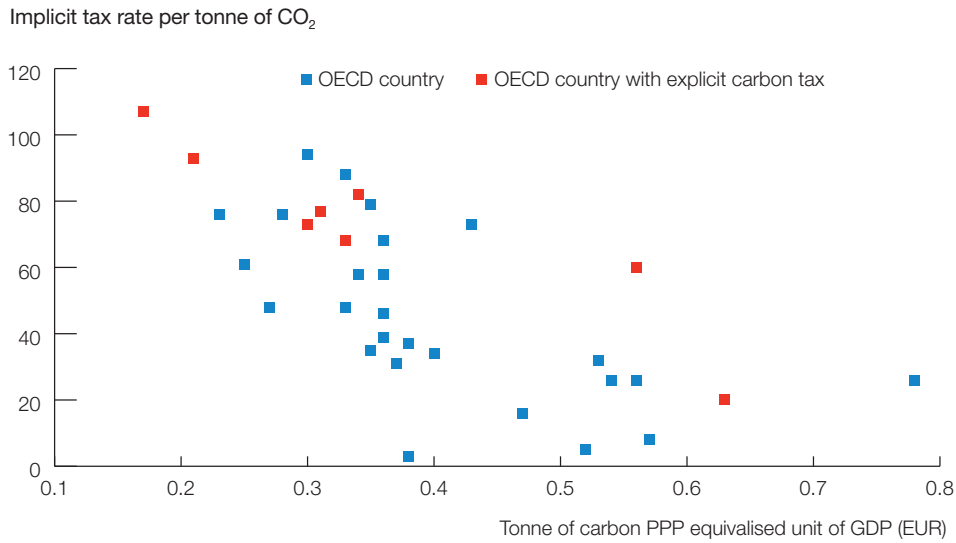
Although a litre of diesel has around 10% more combustion energy than gasoline, it produces roughly 18% more CO_2 emissions (in addition to higher emissions of local air pollutants). Therefore, in order to apply fuel taxes that are equal on a carbon basis, diesel taxes should be 18% higher than gasoline taxes on a per litre basis.

Source: OECD (2013a), Taxing Energy Use: ***A Graphical Analysis***, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264183933-en.

in the Figure 3), it is on average taxed less than most other fuel types used to generate electricity (illustrated by the height of the bar) despite being one of the most polluting fossil fuels per unit of energy (in terms of greenhouse gas emissions and other air pollutants). Similarly, in the transport and the heating and process categories, oil products (predominately gasoline and diesel) tend to be taxed significantly higher and more frequently than other energy products, such as natural gas and coal. Despite the relatively higher tax rates on gasoline and diesel, price signals vary considerably between the two, as illustrated in Box 8. These uneven price signals suggest that some cost-effective opportunities to reduce carbon emissions are foregone: a single effective carbon tax rate would avoid the current sectoral and fuel distortions that are encouraging higher consumption of the more polluting fuels relative to the cleaner alternatives.

Not surprisingly, the presence of energy taxes does seem to affect energy consumption behaviour. Countries with higher average effective tax rates on CO_2 tend to have lower carbon emissions per unit GDP. While this does not necessarily imply causation, it does suggest that there is a linkage. At the micro and sectoral level, there is evidence of relatively high price elasticities. For example, strong increases in market prices for petrol in OECD countries between 1994 and 2008 contributed to a significantly lower consumption of petrol per unit GDP, which decreased by almost 30% over the period (IEA, n.a). This reflects enhanced efficiency of car fleets driven at least in part by higher road fuel taxes.

Figure 4 | **Average effective tax rates on CO_2 and carbon efficiency in OECD countries**



Note: OECD calculations. Tax rates are as of 1 April 2012 (except 1 July 2012 for Australia); energy use data for 2009 is from IEA (2010). Figures for Canada and USA include only federal taxes.

Source: OECD (2013a), ***Taxing Energy Use: A Graphical Analysis***, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264183933-en.

The role of regulatory standards

The implementation of explicit and implicit carbon pricing instruments does not always ensure that the potential reductions in CO_2 emissions are achieved. This is for example the case in contexts where price signals from market-based instruments do not reach individuals or small producers. Alternatively, it is not always possible to identify components of the production or consumption process that are closely linked to emissions levels and can

therefore be effectively targeted. In such cases, complementary regulatory measures (e.g. fuel, vehicle and building efficiency standards) may be required.

Regulatory standards focusing on performance (i.e. in terms of reducing emissions) allow flexibility in how producers and consumers achieve the reductions, and thus tend to be less costly in terms of compliance compared with regulations mandating the use of specific technologies and processes. If regulatory standards are carefully designed to address market failures while avoiding costly overlaps with market-based instruments already in place, they can serve to accelerate the uptake of energy-efficient technologies and reduce emission levels.

A potential disadvantage of standards is that they tend to be most appropriate when targeting new technologies, infrastructure development or sources of emissions. For example, it can be difficult and very costly to retrofit appliances and other equipment to increase their energy efficiency, whereas standards for new equipment can be easier and less costly to implement. The impact of such standards will therefore depend on the rate of turnover of the relevant capital stock. Further, if the standard results in new appliances being markedly more expensive, it creates an incentive to delay the replacement of existing stock and can delay the achievement of the intended emissions reductions (Peace and Stavins, 2010).

When new standards require immediate compliance, they may be introduced before the owners have earned the returns expected when making the initial investment. This can result in significant potential losses and what is referred to as stranded capital, where an asset becomes financially unprofitable due to changes in market or regulatory conditions (OECD, 2012b). To reduce the risk of stranded capital, new technologies could be designed to increase the flexibility of future assets so that they are better suited to operate under different regulatory conditions. For example, in the context of energy generation, this could include the ability of operators to switch to lower-emitting fuels or to introduce end-of-pipe clean-up technologies. (OECD, 2012b).

Finally, the potential role of carbon capture and storage (CCS) as a transformational technology needs to be considered. CCS is a family of technologies and techniques that enable the capture of CO_2 emissions to be stored underground, e.g. in depleted oil and gas fields, or in geological formations. However, current capacity is limited. It is estimated that if all currently planned CCS capacity were to be constructed, only 90 million tonnes of CO_2 would be captured per year. This is equivalent to less than 1% of CO_2 emissions in the power sector in 2012 (IEA, 2013). In order to scale-up coverage, policy action will be required to address existing market barriers. CCS is a high-cost abatement option that will not be economically viable as long as there is no commercial market for captured CO_2. A proper price on carbon could help to create a market for CCS and provide the necessary incentives for the private sector to make the initial investments. Until credible and coherent policies are in place for pricing carbon, strong government support for CCS will be needed.

5. Comparing explicit and implicit carbon pricing policies

The wide range of policy instruments that explicitly or implicitly contribute to carbon pricing all impose a price on carbon. What is the effective carbon price of these policies and how do they compare with each other? This has been the subject of recent OECD research that estimates the net costs that society is bearing to achieve current levels of abatement via different policy instruments (OECD, forthcoming). The study gives estimates of the amount of greenhouse gas abatement each policy instrument contributes to; the costs to society of achieving this abatement; and, hence, the costs to society per tCO_2e abated. Any revenue raised by pricing policies is assumed to be put to good use by the government and not counted as a cost. The estimated effective carbon prices are based on a partial equilibrium, comparative static approach that compares a snapshot of the current situation with the policy in place with a scenario of no policy. The research draws on the experience of 15 OECD and emerging economies[4] in five sectors: i) electricity generation; ii) road transport; iii) pulp and paper; iv) cement; and v) households. The findings from the electricity and road transport sectors will be discussed below.

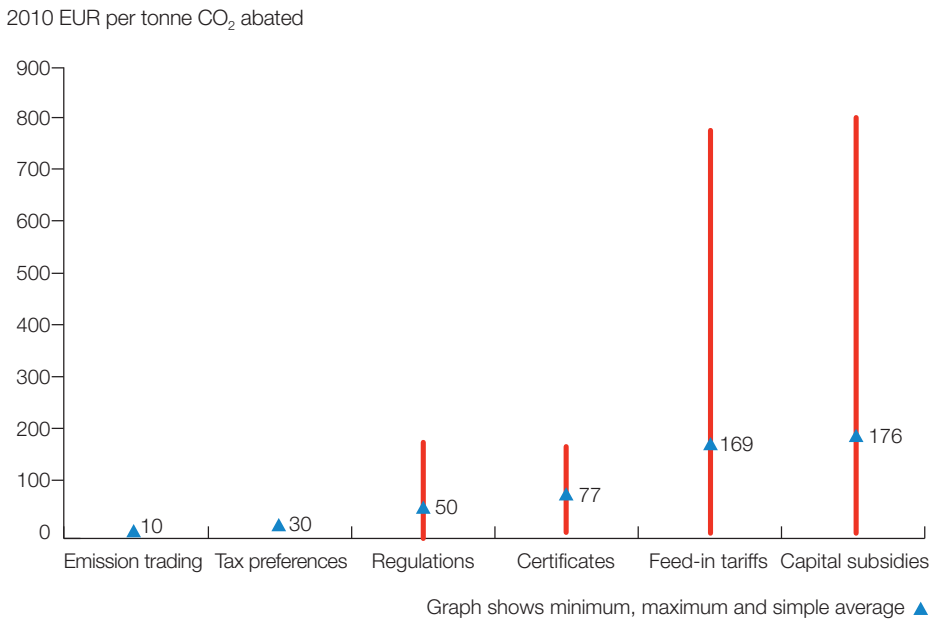
Electricity generation

Numerous policy instruments that explicitly or implicitly contribute to carbon pricing are used in the countries examined in the study (OECD, forthcoming). In the electricity sector, for example, policy instruments include feed-in tariffs for renewable energy generation, emissions trading systems, renewable energy certificates and renewable portfolio standards. Most of the countries examined use more than one policy instrument to pursue CO_2 reductions. In almost all the countries surveyed, the study identified an effective carbon price of at least EUR 25 per tonne CO_2 generated by one or more policy instrument. The key conclusion is that most of the countries reviewed provide relatively significant incentives to reduce some emissions from power generation, whether through explicit or implicit carbon pricing. However, this effective carbon price may only apply to a small share of the emissions in the sector. Moreover, a high implicit carbon price is not necessarily indicative of sound policy as it could merely stem from a policy that is not cost-effective.

Across the countries, there are also large differences in the effective carbon prices in the electricity sector depending on the type of pricing mechanisms used. As illustrated in Figure 5, the lowest costs per tonne CO_2 abated are associated with emissions trading systems, with

4. Australia, Brazil, Chile, China, Denmark, Estonia, France, Germany, Japan, Korea, New Zealand, South Africa, Spain, UK, US

Figure 5 | **Estimated effective carbon prices in the electricity sector, by instrument category**



Source: OECD (forthcoming), ***Effective Carbon Prices***, OECD Publishing, Paris.

an estimated effective carbon price of EUR 10 per tonne CO_2. In comparison, the estimated carbon price when using feed-in tariffs and capital subsidies is on average EUR 169 per tonne CO_2 and 176 per tonne CO_2 respectively, with high estimates in individual countries of up to almost EUR 800 per tonne CO_2. Despite the relatively higher costs of these policy instruments, it is worth noting that capital subsidies were in place in 13 of the 15 countries examined in 2010 and feed-in tariffs in 11 countries. In comparison, the more cost-effective emissions trading systems and carbon taxes had been introduced in just over half of the countries by 2010. This suggests that a similar level of CO_2 abatement could be achieved at lower cost, or a larger amount of abatement at the same cost, if more reliance was placed on cheaper policy instruments (i.e. the more cost-effective market-based instruments).

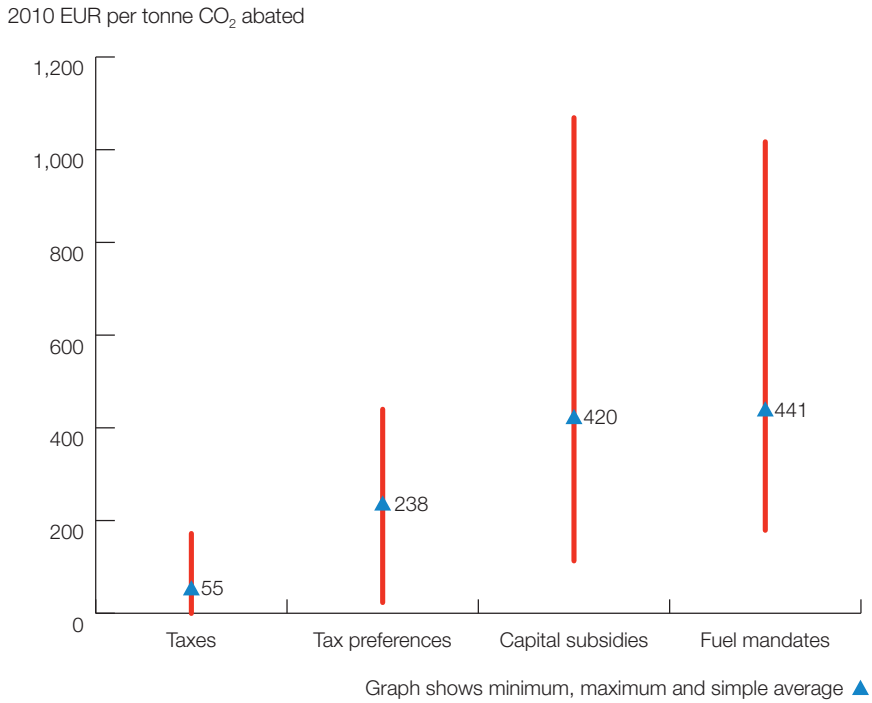
However, support programmes for renewable energy generation are often developed and implemented with more than just immediate CO_2 abatement in mind. These programmes are also often the result of regional or industrial policy, including efforts to scale up the development and implementation of renewables in an attempt to bring down the cost of these technologies to a level that is competitive with fossil fuel power and thus to enable

their wider deployment. Such cost reductions may make it easier to place more emphasis in the future on reducing emissions caps or increasing carbon taxes. In this way, there is a direct linkage between the operation of price and non-price-based instruments. The efficacy of such programmes is open to question and they should, like all public spending programmes, be subject to a cost benefit test prior to implementation and regular reviews. Support for renewables should be well targeted and time-bound, but at the same time it is important to ensure there are clear indications early on regarding when or under what conditions the support might be reduced or phased-out, in order to minimise investor uncertainty.

Road transport

A similar picture as that described for the electricity generation sector can be found for the road transport sector, where market-based instruments are found to be the most cost-effective policy measures. Figure 6 shows that the cost per tonne CO_2 abated is

Figure 6 | **Estimated effective carbon prices in the road transport sector, by instrument category**



Source: OECD (forthcoming), ***Effective Carbon Prices***, OECD Publishing, Paris.

Box 9 | **Feed-in tariffs in Germany**

In Germany, greenhouse gas emissions declined by 10% between 2000 and 2010, bringing emission levels to 24% below the Kyoto Protocol base year level. Around 40% of these reductions took place between 2008 and 2010, in part due to the economic recession. A reform of the country's energy taxes introduced in 1998 and the introduction of market-based instruments have also played an important role. Further, central to Germany's success in achieving its climate and energy goals is the increased use of renewable energy sources and enhanced energy efficiency. The 2010 *Energiewende* (Energy Concept) sets a target of 35% of gross electricity consumption coming from renewable energy in 2020, 50% in 2030, and 80% in 2050.

To achieve emission reduction goals, feed-in tariffs for electricity generation from renewable sources have been implemented. The feed-in tariffs vary depending on the capacity of the installations and the type of source. They also decline on an annual basis to reflect cost decreases in the sector as a result of technological development and economies of scale as renewables become more prominent in the energy mix. Additional measures introduced to promote the development of renewable energy include capital grants and low-interest loans, reduced tax rates for renewable-generated electricity and heat, tax exemptions and quotas for biofuels, and financial incentives for the use of renewables in buildings.

In 2010, the percentage of renewable electricity generation was 17%, up from 7% in 2000. In 2009, savings of 52 million tonnes CO_2 equivalent were attributed to the tariff system, and investments in renewable energy continued to increase throughout the recession, while investments in other sectors declined. Despite these apparent benefits, the feed-in tariffs have resulted in the implicit cost of abatement rising well above the CO_2 allowance price under the EU ETS, ranging from EUR 65 per tonne CO_2 for hydropower to EUR 655 per tonne CO_2 for solar. This additional cost is borne by end-use consumers. Between 2000 and 2010, the cost by residential electricity consumers increased from EUR 0.2 per kilowatt hour (kWh) to EUR 2.3 per kWh, accounting for about 10% of the total price. The cost to society of this policy is estimated to be around 0.25% of GDP. Furthermore, feed-in tariffs in large economies like Germany can lower the allowances prices of the EU ETS resulting in increased emissions elsewhere in the system. The EU ETS incorporated the possible unintended impacts of the development of renewables in EU countries when setting the cap in Phase III.

Despite the additional cost of abatement for local consumers, the German feed-in tariffs have managed to bring renewables technologies closer to grid parity by driving technological innovation and by increasing the diffusion faster than would otherwise have been the case. To the extent that the feed-in tariffs have contributed to speeding up the rate of decline in the production and deployment costs of new renewable sources of energy, they have helped to provide a technological platform that can support further reductions in the EU ETS cap.

Source: OECD (2012c), ***OECD Environmental Performance Reviews: Germany 2012***, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264169302-en.

considerably lower for fuel taxes than for any other type of policy instrument in the sector. In comparison, capital subsidies (for biofuels and electrical vehicles) and fuel mandates result in substantially higher effective carbon prices. However, as mentioned earlier, this is in part because reductions in carbon emission are not the primary objective of some of these policies. In the road transport category the primary objective is often to raise revenues, particularly for road construction and maintenance. Despite this caveat, Figure 6 suggests that fuel taxes provide a relatively cost-effective instrument for CO_2 abatement compared to other policy solutions.

The examples from the electricity generation and road transport sectors illustrate that the cost-effectiveness of reducing emissions varies greatly depending on the instrument used. More specifically, they have shown that some policy instruments applied in these sectors are simply not effective, when measured in terms of CO_2 abatement, as illustrated by the very high costs per tonne CO_2 abated. Some governments have chosen to implement certain policy instruments in the belief that they will be instrumental in driving innovation and ensuring the uptake of energy efficient alternatives. However, they may not be aware of the relatively high costs per tCO_2e abatement that characterise such policies.

6. Interactions between policy instruments

The broad range of sources and sectors that emit greenhouse gases means that no single policy instrument is likely to be able to achieve the required emissions reductions at a reasonable cost (OECD, 2009b). While market-based carbon pricing should be at the heart of action to reduce greenhouse gas emissions, governments will need to draw on a broader policy mix in order to address remaining market failures and achieve other environmental, economic and social objectives. For example, explicit pricing mechanisms can be complemented by research and technology support policies to address knowledge and diffusion failures of specific emission-reduction technologies, energy labelling to reduce information barriers, energy efficiency building codes to address split incentives between landlords and tenants, and active competition and regulations to limit market power.

Overlaps in policy instruments, however, can result in increased administrative costs and may reduce the flexibility to producers and consumers in their emission reduction efforts. It is therefore important to understand the potential interactions and overlaps of different instruments and to ensure the cost-effectiveness of such a policy package as a whole. This will require a good understanding of the comparative advantage of the individual policy instruments in addressing specific market imperfections.

For example, efforts to increase the deployment of renewable energy following the EU Renewable Energy Directive have lowered the carbon price in the EU ETS, although at a higher near-term cost of avoided CO_2 given the additional administrative cost and the loss of flexibility. Such policy overlaps should be considered by policymakers as they set the CO_2 cap, the renewable energy objectives and estimate the associated costs, in static and dynamic terms. The fact that complementary policies may trigger CO_2 price volatility should also be taken into account, as such volatility places an unnecessary burden on sources under emissions trading systems.

7. Reforming subsidies to fossil fuels

Explicit and implicit carbon pricing policy measures do not operate in a vacuum. OECD work shows the wide range of budgetary transfers and tax expenditures in place that encourage the production and use of fossil fuels. As a result, governments often have a policy package that explicitly and implicitly puts a price on carbon on the one hand, while pursuing mechanisms that subsidise fossil fuel production and use on the other. Such a policy arrangement is not mutually supportive and can significantly undermine the effectiveness of overall climate policies. This argues strongly in favour of removing fossil-fuel subsidies, which would also have the benefit of reducing public spending and increasing tax revenues. Over time, such reforms contribute to a shift away from fossil-fuel intensive activities and towards low-carbon technologies.

Across the OECD, a significant portion of support for fossil fuels is provided through reductions in, or exemptions from, energy taxes. The OECD (2013b) has identified over 550 individual support mechanisms that directly or indirectly encourage the production or consumption of fossil fuels across OECD countries. Producer support mechanisms include i) government intervention in market mechanisms to alter costs or prices, ii) transfers of funds to producers, iii) reduction, rebate or removal of certain taxes, and iv) the government assuming part of the production risk. Examples of consumption support

Box 10 | **Recent political commitments to phase out fossil-fuel subsidies**

OECD 2009 Declaration on Green Growth: Encourage domestic policy reform, with the aim of avoiding or removing environmentally harmful policies that might thwart green growth, such as subsidies to fossil fuel consumption or production that increase greenhouse gas emissions.

G20 2009 Leaders' Statement: To phase out and rationalise over the medium term inefficient fossil-fuel subsidies while providing targeted support for the poorest. Inefficient fossil-fuel subsidies encourage wasteful consumption, reduce our energy security, impede investment in clean energy sources and undermine efforts to deal with the threat of climate change.

Asia-Pacific Economic Co-operation: To rationalise and phase out over the medium term fossil-fuel subsidies that encourage wasteful consumption, while recognising the importance of providing those in need with essential energy services.

Rio+20: Countries reaffirm the commitments they have made to phase out harmful and inefficient fossil-fuel subsidies that encourage wasteful consumption and undermine sustainable development.

include direct transfers, tax relief, and rebates on energy products. Three country examples of consumption and production support mechanisms are summarised in Box 11.

The overall value of the support mechanisms identified in the OECD inventory is estimated between USD 55 and USD 90 billion a year for the period 2005-11. Petroleum products (i.e. crude oil and its derivative products) have generally been the primary beneficiaries of these measures accounting for about two-thirds of the total in absolute terms. This reflects the importance of oil in the OECD's total primary energy supply and

Box 11 | **Country examples of production and consumption support mechanisms**

Mexico: Consumption support in Mexico is provided through a floating excise tax on transport fuels. The tax rate is designed to respond to changes in international benchmark prices, so that when international prices increase, the tax rates for diesel and gasoline decrease, and even become negative (i.e. a subsidy) when oil prices are particularly high. For example, when the cost of crude oil in 2008 averaged USD 100 per barrel, the total value of consumer support amounted to MXN 223 billion (USD 20 billion) or around 1.8% of GDP. In response to the government's strategy to cut greenhouse gases by 50% by 2050 compared to the 2000 baseline, efforts are underway to better target energy subsidies and bring prices in line with costs. A new cash-transfer scheme was introduced to help poor households cover their energy needs, which is considered less distortionary than the floating excise tax. The 2013 Fiscal Reform proposed by the Mexican President includes the phase-out of gasoline subsidies, and electricity subsidies are being examined closely through the Energy Reform proposals.

Poland: In Poland the coal industry receives the majority of the government support available to the energy sector. Over the period 1999 to 2011, that support exceeded PLN 25 billion (USD 7 billion). During the communist era, the coal industry benefitted from various social benefits for coal miners and the regulation of coal prices. During the economic transition in the 1990s, the coal sector was gradually restructured through a series of capacity-adjustment programmes that brought about the closure of unprofitable mines and reduced the level of employment in the coal sector. These programmes, however, failed to bring about an effective restructuring of the sector. Since 2011, in line with EU Council regulations, government support has been limited to the closure of mines, the treatment of health damages sustained by miners, and environmental liabilities related to past mining.

Sweden: Producer support measures in Sweden are negligible since it only produces a small amount (about 1.2 million tonnes of coal equivalent) of peat for energy use; oil, natural-gas and coal are imported. Sweden, however, does provide consumer support through exemptions and reductions from energy- and CO_2-taxes for particular users and uses of fossil fuels. In 2011 this amounted to about SEK 19.1 billion (USD 2.9 billion). It is estimated that 69% of the tax exemptions were linked to the consumption of diesel that is taxed at a lower rate than gasoline for transport purposes. Plans are underway to review the support mechanisms in order to reduce government tax expenditures.

Source: OECD (2013c), ***An OECD-Wide Inventory of Support to Fossil-Fuel Production or Use***, OECD Publishing, Paris, available at: www.oecd.org/iea-oecd-ffss.

the relatively higher taxes that are generally levied on refined products. The 2008 peak in Figure 7 can in part be explained by transfers provided through Mexico's floating tax, as the international oil price reached a high of USD 140 per barrel.

Consumer measures accounted for two thirds of total support over the 2005-11 period (with a peak of 80% in 2011), though there remain considerable differences at the country level reflecting countries' resource endowments, tax rates and other factors. For example, producer support remains significant in countries that possess abundant fossil resources while several other OECD countries are large consumers of fossil fuels and do not produce any significant amounts of coal or hydrocarbons (e.g. France, Italy, Japan and Sweden). Overall, almost half of the measures listed in the OECD inventory directly target the end-use of fossil fuels while around a third benefit fossil-fuel extraction, with only a few supporting intermediate stages of the supply chain (i.e. transportation, refining and processing).

There are a number of rationales given for fossil-fuel subsidies. Out of the 550 support mechanisms identified, around a third are direct budgetary expenditures that can generally be categorised under three headings: i) support for energy purchases by low-income households; ii) government expenditure on research, development and demonstration projects; and iii) transfers to help redeploy resources in declining fossil-fuel industries (mostly coal). The remaining two thirds are tax expenditures that are estimated with reference to a benchmark tax level or system. Again, these can be categorised into three broad groups:

- **Tax expenditures relating to the final consumption of fossil fuels**. This category includes broad-based value-added taxes (VAT) on final consumption and excise taxes levied on specific goods. They can either be targeted at: i) specific groups or consumers that are taxed less on their fossil-fuel use in order to achieve social goals for low-income earners; ii) specific fossil fuels that are taxed less or exempted altogether even where they are intended for the same end purpose as other higher-taxed fuels (e.g. lower tax rate or exemption on diesel relative to gasoline); or iii) particular uses of fossil fuels (e.g. diesel used for transportation versus diesel used in primary industries). This last category is closely linked to the discussion above on the implicit carbon pricing of fossil fuels for transport, heating and process use, and electricity generation (section 4).

- **Tax expenditures relating to the use of fossil fuels as inputs to production**. Some government taxes such as VAT aim to tax only final consumption. Firms are therefore exempted from the VAT they pay on inputs (including energy and fossil fuels) in order to avoid discrimination across different production methods. Excise taxes, on the other hand, intentionally increase the price of the taxed item, either because they are deemed harmful to society or because they are an easy and relatively effective source

Figure 7 | **Support to fossil fuels in OECD countries by year and type of fuel**

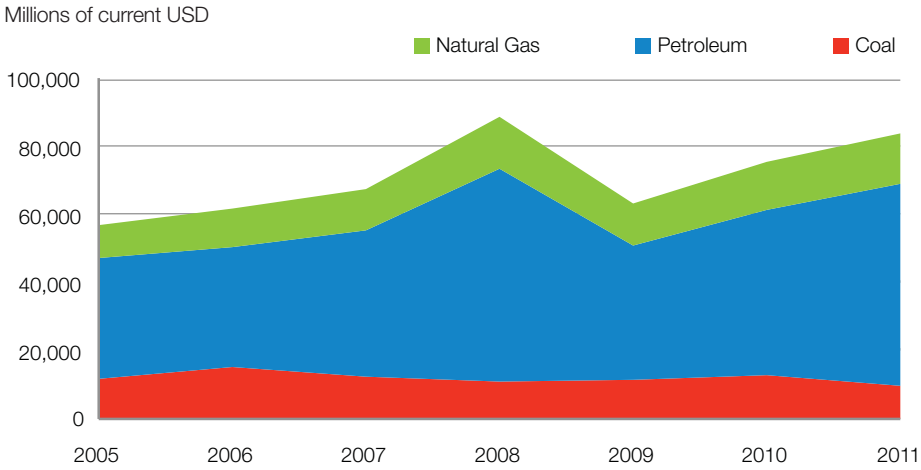
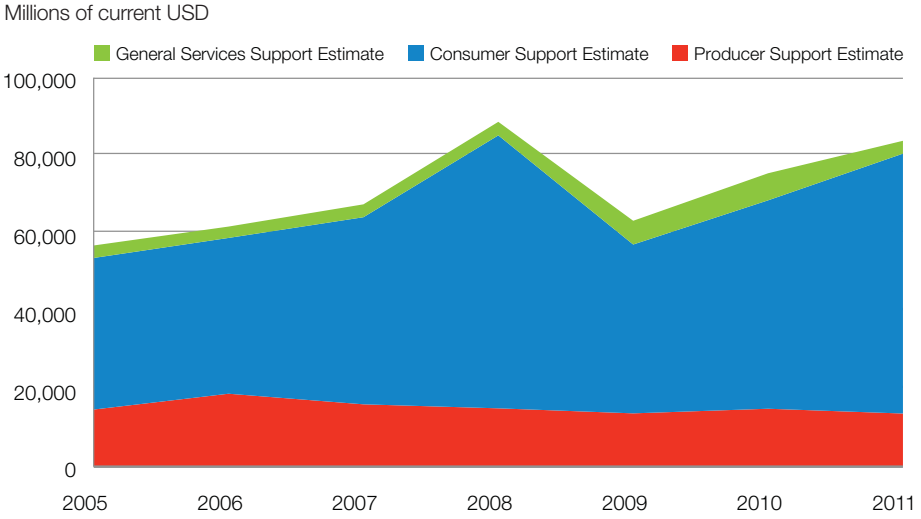


Figure 8 | **Support to fossil fuels in OECD countries by type of indicator**



Note: These figures are based on an arithmetic sum of the individual support measures identified for all 34 OECD member countries. It includes the value of tax relief measured under each jurisdiction's benchmark tax treatment. The estimates do not take into account interactions that may occur if multiple measures were to be removed at the same time.

Source: OECD (2013b), ***Inventory of Estimated Budgetary Support and Tax Expenditures for Fossil Fuels 2013***, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264187610-en.

of government revenue. In such cases, tax exemptions (e.g. for certain types of business or households) limit the effectiveness of the tax.

- **Tax expenditures relating to the production of fossil fuels.** Governments often charge fossil-fuel extraction companies a levy (e.g. royalties, resource taxes and direct state participation) that represents the "sale price" for publically-owned resources. At the same time, many fossil-fuel-producing countries also provide corporate tax expenditures that encourage the extraction or production of fossil fuels. Other, less visible, tax expenditures include provisions that accelerate the amortisation of capital equipment for tax purposes or special tax treatment benefitting particular types of income (e.g. royalties benefitting private resource owners and "passive losses"). The objective of these tax concessions is to lower production costs and encourage investments that in turn enhance economic output.

Despite the arguments in favour of reforming or eliminating special tax exemptions or outright fossil-fuel subsidies, it is in practice politically challenging to do so. This is in part due to the strong lobbying capacity of large companies benefitting from such exceptions, but also because of the potentially negative impacts reform can have on vulnerable households. While the evidence clearly shows that subsidies to fossil fuel consumption are generally poorly targeted, and thus the majority of the subsidy tends to accrue to high or middle income households, any potential impacts of reforms on poor households still need to be addressed. Experience from countries that have successfully reduced fossil fuel and electricity subsidies show four common strategies for success (IEA/OPEC/OECD/World Bank, 2011):

- Increase the availability and transparency of support data to facilitate an informed debate between parties in favour of and against such policies. Good data can also support peer review processes and encourage compliance with future subsidy reforms.

- Provide financial support to vulnerable groups during the transition period that is carefully targeted, temporary and transparent.

- Where possible, integrate taxation and fossil fuel reforms in broader structural reforms.

- Demonstrate the government's commitment to compensate vulnerable groups and to use freed-up public funds in a beneficial way. This can be achieved through broad communication strategies, appropriate timing of subsidy removal, and implementation of compensatory social policies.

8. Overcoming barriers to coherent carbon pricing

The most difficult barriers to the implementation of credible carbon pricing are the expected negative effects of the measure(s) on international competitiveness as well as on the disposable income of households. The design of explicit carbon pricing mechanisms often includes features that either allow for a phased introduction, or compensate affected parties for lost income and increased costs. Both these measures can be critical in improving the political and social support for explicit carbon pricing. In many cases, the design of the mechanisms also exempt the most vulnerable and vocal sectors. For example the agricultural and aviation sectors are exempt from the EU ETS. In addition, experience shows that outreach and communication strategies are critical for the successful introduction of carbon pricing mechanisms.

Distributional concerns

The introduction of a carbon price can have a regressive impact, as low-income households tend to spend a higher share of their income on energy bills and energy-intensive goods. In the end, however, the final distributional impact of carbon pricing depends on the government's allocation of the revenues raised or expenditures saved through the carbon pricing mechanisms. On a global scale, it is estimated that using carbon taxes and auctioned emissions allowances to meet the emission reduction targets that countries have already announced could raise up to USD 250 billion per year by 2020 (OECD, 2012a). A relatively small proportion of these revenues would be sufficient to address potential distributional impacts that may arise from the implementation of these measures. At the domestic level, governments have a number of policy mechanisms for recycling the revenues to affected households to choose from. Examples include the use of cash transfers, the reduction of income taxes, the distribution of tax credits, increased government support to social security provisions, and subsidised support to energy efficiency improvements and other public services.

Decisions on which approach to take should be based on a number of criteria, including cost-effectiveness, environmental efficiency and political feasibility. The example of Indonesia provides some useful lessons on government efforts to pave the way for reforms in energy pricing, which could equally apply during the introduction of a carbon price. Independent of the approach taken, it is widely agreed that any redistributive measures should be addressed through policies outside of the pricing mechanism.

Box 12 | **Social policies to complement the reform of fossil-fuel subsidies in Indonesia**

Indonesia has a history of providing subsidies to the national petroleum producer, to the petroleum-dependent electricity sector, and to consumers of petroleum products (e.g., gasoline, diesel and kerosene) as well as undertaking subsidy reforms. Following a restructuring of the oil and electricity sectors, the government introduced between 2000 and 2008 a number of fuel subsidy reforms. The objectives of the reforms were to: relieve budgetary pressures; improve the efficiency of social welfare policies; increase energy security; and help mitigate climate change.

In order to reduce the opposition to the subsidy reform, and to limit the adverse economic and social impacts, the government introduced an unconditional cash transfer programme in 2005, called Bantuan Langung Tunai. The programme targeted over 19 million poor and near-poor households (around 19% of the population) and provided monthly payments of IDR 100 000 (around USD 10) between October 2005 and September 2006. The cash transfer programme was accompanied by other social security measures such as: the distribution of vouchers that entitled recipients to free health care in local public health clinics; government grants to primary and secondary schools on the basis that their school fees were reduced by an equivalent amount; and support to rehabilitate infrastructure in almost 2 000 low-income and remote villages.

The cost of the cash transfer programme is estimated to have been around one quarter of the government expenditures saved from the subsidy reform. Independent estimates had projected that the reform would increase the poverty rate by more than 5%. Instead, the poverty rate decreased by just over 1% over the same period. While electricity subsidies for large industrial consumers were removed in 2008, a government proposal to further reduce the fossil-fuel and electricity subsidies and to reduce the volume of subsidised fuel faced fierce opposition and had to be rescheduled. Despite the reform efforts, Indonesia is still among the ten non-OECD countries providing the most generous energy subsidies in the world (OECD, 2010c).

Sources: Beaton, C. and L. Lontoh (2010), ***Lessons Learned from Indonesia's Attempts to Reform Fossil-Fuel Subsidies***, International Institute for Sustainable Development (IISD), Manitoba; OECD (2012d), ***OECD Economic Surveys: Indonesia 2012***, OECD Publishing, Paris, http://dx.doi.org/10.1787/eco_surveys-idn-2012-en; OECD (2010c), ***OECD Economic Surveys: Indonesia 2010***, OECD Publishing, Paris. http://dx.doi.10.1787/eco_surveys-idn-2010-en.

Competitiveness concerns

In the absence of a global emissions trading system, there is a risk that companies subjected to carbon pricing are at a competitive disadvantage to companies that do not face such costs. This may result in industries that are subject to a climate policy moving their production to non-complying countries, reducing the employment opportunities and the economic output within the acting country. Alternatively, they may lose market shares against competitors that do not face a carbon price. This has been one of the principal hurdles to ambitious climate policy in many OECD countries.

Box 13 | **Addressing competitiveness and carbon leakage concerns**

OECD research has examined the macroeconomic, sectoral competitiveness and carbon leakage impacts associated with the mitigation scenarios introduced in the *OECD Environmental Outlook to 2050*, and the possible role of BCAs and direct and indirect linking of carbon markets as response measures to address observed impacts. Four key messages emerge from this analysis:

- In the scenario of a global approach to mitigation, macroeconomic and sectoral impacts are largest when carbon markets are not linked and the stringency of mitigation action varies substantially across countries.

- In the case of multiple carbon markets that do not include all countries, sectors or gases and that are not linked, competitiveness impacts are mostly concentrated in emission-intensive, trade-exposed (EIT) sectors (e.g. chemicals, non-ferrous metals, fabricated metal products, iron and steel, pulp and paper, and non-metallic mineral products) in acting countries. This results in an increase in the production and export of EIT goods in non-acting countries, while fossil fuel exporting countries (acting and non-acting) are negatively affected by the lower global demand for energy. However, the emission reductions in acting countries may be offset by increased emissions in non-acting countries, reducing the overall effectiveness of the policy.

- In the case of carbon markets that do not include all sectors, higher production costs for sectors covered by the emissions cap result in a shift in demand towards sectors not affected by the cap. This causes a sectoral shift in emissions referred to as domestic carbon leakage. While this domestic leakage is generally small it increases with the size and the number of excluded sectors. Further, when the cap is limited to CO_2 there is a decrease in other greenhouse gases since they are largely linked to the same economic activities. However, if only CO_2 is covered, the price on CO_2 is relatively high since a number of cost-effective mitigation measures that may be found in reducing other gases are missed.

- BCAs and direct or indirect linking across carbon markets can, in theory, help address some of the competitiveness losses or carbon leakage. BCAs can help preserve the domestic macroeconomic and sectoral competitiveness of acting countries as they extend the burden of emission reductions to non-acting countries. However, this must be weighed against the practical limitations of BCAs. In the case of indirect linking (e.g. the Clean Development Mechanism), non-acting countries receive compensation for the reduced emissions, since acting countries compensate non-acting countries for the emissions reductions achieved in their countries. This is considered to be a more equitable policy approach in terms of reducing the global welfare and EIT sectoral output losses. Linking may also contribute to relatively lower carbon prices as they ensure that all least-cost measures are adopted.

Source: Lanzi, E., et al (2013), "Addressing Competitiveness and Carbon Leakage Concerns Arising from Multiple Carbon Markets: A Modelling Assessment", ***OECD Environment Working Papers, No.58***, OECD Publishing, Paris, http://dx.doi.org/10.1787/5k40ggjj7z8v-en.

Table 2 | **Impacts on energy-intensive industries from climate change mitigation policies**

MEASURES / PRINCIPLE	Full action/tax ("Reference Case")	**Measures to Address Competitiveness Impacts from Climate Policy:**	
		Free Allocation	
		Grandfathered free allocation	**Output-based revenue recycling or allocation**
Effectiveness in addressing competitiveness impacts	Likely to impact some energy-intensive sectors	**+/–** Profits maintained, but market share impacts remain	**+** Incentivises production
Economic efficiency	Maximises economic efficiency	**+/–** Efficiency of policy maintained, reduces fiscal revenues	**–** Production and emissions levels distorted and fiscal revenues reduced
Incentives for greenhouse gas mitigation and innovation	Full abatement incentives	**No change**	**–** Abatement from production reductions eliminated
International political economy	Mixed effect on developing country GDP and welfare	**No change**	**No change**
Domestic political implications	Generally negative due to political power of energy-intensive industries	**+** Reduces industry concerns over profits	**+** Can allow for more ambitious policy
Implementability	Similar for all participating sectors	**No change**	**–** Requires common output metrics and competitive domestic market

Change from reference case: "no change", "+" indicating improvement of criterion from reference case "-" indicating reduction, and "+/-" indicating uncertain effect

Border Carbon Adjustments		Other
Import only	**With export rebates**	**Industry exemption**
+/– Output further reduced; domestic market share may not change	**+/–** Preserves export market share but reduces output due to higher carbon prices	**+** Though indirect costs still remain
– Barriers on imports increase costs	**–** Barriers on imports increase costs	Some cost-effective abatement not implemented
No change	**–** Export exemption decreases abatement	Very few incentives
+/– Reduces developing country GDP/welfare further with uncertain effects on climate action		**No change**
+/– Intermediate goods are more costly for all; some industries may perceive market share benefits from international competitors facing similar carbon costs		**+** Fewer stakeholders
– Analyses of embedded carbon can be costly		**+** Fewer participating sectors

Source: OECD (2010b), ***Addressing International Competitiveness in a World of Non-Uniform Carbon Pricing: Lessons from a decade of OECD analysis***, available at http://www.oecd.org/environment/cc/46533174.pdf.

The asymmetry of climate policy implementation can result in what is known as carbon leakage, where emissions in non-acting countries increase as a result of climate policies in acting countries. While modelling estimates abound, leakage has not been estimated empirically. In principle, it should depend on the number and size of countries and sectors covered by the pricing policy, as well as on transport costs, and the ability to pass the additional cost through to final consumers.

A common approach seen in a number of explicit carbon pricing instruments to address competitiveness concerns is to initially allocate emission allowances free of charge to selected energy-intensive sectors that are competing in the global market, such as the cement, steel, and the paper and pulp sectors. This means that such sectors do not face the direct cost of procuring auctioned emission allowances while still facing the opportunity costs of emitting carbon, requiring them to participate in the market, and therefore encouraging least-cost emission reductions. Another approach is to exempt selected sectors altogether from the emissions trading systems. Examples from current systems include the agriculture sector, aviation, and waste. By restricting the coverage of emissions trading systems, such exemptions reduce their effectiveness.

Another approach that has been proposed is the introduction of border carbon adjustments (BCAs), i.e. a tax imposed on imported goods or a rebate for the export of goods from the country imposing the carbon tax. If introduced, such a tax would aim to reflect the carbon price the exporter would pay for emitting CO_2 during the production process, if it were subject to the climate policy applied by the importing country. OECD analysis drawing on general equilibrium models suggests that such BCAs may only be effective in reducing carbon leakage if the number of countries with explicit carbon pricing instruments is small (Burniaux et al., 2010). Due to technical issues around the design of BCAs (e.g. product coverage, carbon accounting for different products and possible country exemptions), and concerns over compatibility with WTO regulations and potential trade tensions, co-ordinated global action on climate policy remains, if possible, the preferred solution.

Whatever the measures relied on to address competitiveness concerns, they should be carefully targeted and temporary in nature, with a clear exit strategy in place. Otherwise, it can be politically difficult to remove such measures later. If the rate of development and implementation of new emission trading systems and carbon taxes continues, it is possible that the competitiveness question may become less of a concern as the number of countries engaged in these schemes increases.

The communication of change

The potential costs and human impacts of climate change make it essential that economies move towards zero-carbon emissions in the second half of the century. However, like all major structural shifts, this transition will not be painless and governments have a responsibility to manage the transition as best they can, to minimise the impacts on workers and low-income households and to communicate the broader benefits of the reforms.

The introduction of carbon pricing mechanisms that may increase the cost of living or companies' production costs are often likely to face some political and social opposition. Even if these mechanisms cost society less per tonne of CO_2 abated than most regulations or other policy measures, the transparency of an explicit price makes them particularly vulnerable to opposition. Consumers and producers are often more willing to accept higher implicit prices of regulations rather than lower explicit prices of taxes, because the costs of regulation are often far less visible than an explicit tax. Governments can help to mitigate resistance to more explicit pricing mechanisms through complementary or flanking policies that can help to create the political momentum to enable the policy to be implemented.

An important element of the government's role in mitigating opposition is to ensure that the rationale for the pricing mechanism is clearly communicated along with practical advice on how to minimise any negative impacts. In addition to stakeholder consultations, this requires targeted advice to business and local communities on how they can enhance their energy efficiency and reduce their reliance on carbon intensive goods and services. Failure to incorporate this in the policy development strategy from the outset risks jeopardising public acceptance and support and creates distrust about the real objective of the new carbon tax (is it about raising revenues or about reducing emissions?). The communication of the carbon tax in British Columbia (summarised in Box 14) is often referred to as an example of good practice.

Box 14 | **The importance of communicating change: British Columbia's carbon tax**

British Columbia introduced its carbon tax on 1 July 2008. It is structured around five core principles: i) revenue neutrality by lowering income and business taxes; ii) phased implementation to allow individuals and business to adjust over a five-year period; iii) protection of low-income families through refundable tax credits; iv) broad coverage of all emissions from fossil fuel combustion in British Columbia; and v) coherence with other policy measures to avoid double taxation.

The carbon tax targets almost all fossil fuel emissions identified in Canada's National Inventory Report and it is estimated that the tax covers around 75% of the province's total emissions. Current exemptions include, for example, emissions from waste and agriculture and from the natural gas industry. The tax was initially introduced at a relatively low rate of CAD 10 per tCO_2e. Before the tax was introduced, it was announced that it would increase by CAD 5 per year over a four-year period. Since 2012, when the tax had reach CAD 30 per tonne CO_2, further increases have not been made and the government announced in 2013 that no additional increases are for the time being planned.

The carbon tax is revenue-neutral, meaning that all revenues are returned to the public in terms of income tax cuts and rebates. To ensure that this does in fact happen, the government present every year a plan to the Legislature that clearly outlines how the revenue will be returned to taxpayers. This transparent approach has ensured widespread support from the public. This is for example demonstrated by the fact that the Liberal Party that introduced the tax in 2008 has since been re-elected twice.

Although the carbon tax is still fairly new, an initial assessment indicates that the tax has reduced the per capita emission of greenhouse gases in British Columbia by almost 9% more than in the rest of the country. In real terms this translates to a 4.5% reduction in greenhouse gases between 2007 and 2010 despite a population growth of more than 5%. Finally, the tax has not weakened the province's economy: the unemployment rate is slightly below the national average while growth is just above average.

A Climate Action Secretariat was established in 2007 to co-ordinate climate change action by the the different ministries in British Columbia and other public sector organisations. In 2008 its three-year budget was CAD 46 million. An additional CAD 62 million was made available for contingency funding for additional new initiatives. From the core funding, the emphasis on outreach, education and communication is clear. Out of the CAD 46 million, CAD 12 million were earmarked for outreach and consultation across different levels of government and other stakeholders. This entails the establishment of a Citizen's Conservation Council responsible for climate change education and outreach. An additional CAD 15 million were assigned to communication and education of British Columbians about the choices they can make to reduce greenhouse gas emissions.

Sources: British Columbia Ministry of Environment (2012), ***Making progress on B.C.'s Climate Action Plan***, Province of British Columbia, British Colombia; British Columbia Ministry of Finance (2008), ***Budget and Fiscal Plan 2008/09 – 2010/11***, National Library of Canada Cataloguing in Publication Data, British Columbia; Sustainable Prosperity (2012), ***British Columbia's Carbon Tax Shift: The First Four Years***, University of Ottowa, Ottowa.

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BETTER POLICIES FOR BETTER LIVES

OECD ENVIRONMENT POLICY PAPER, NO. 1 OCTOBER 2013

Climate and carbon
Aligning prices and policies

The international community has agreed to limit the average global temperature increase to no more than 2ºC above pre-industrial levels. This will require a gradual phase-out of fossil fuel emissions by the second half of this century. This report brings together lessons learned from OECD analysis on carbon pricing and climate policies. It recommends that governments ensure coherent policies surrounding the gradual phase-out of fossil fuel emissions and consistent signals to consumers, producers and investors alike. A key component of this approach is putting an explicit price on every tonne of CO_2 emitted. Explicit pricing instruments, however, may not cover all sources of emissions and will often need to be complemented by other policies that effectively put an implicit price on emissions. But the policies must be mutually supportive and as cost-effective as possible, both on their own and as a package. In addition, tax exemptions and fossil-fuel subsidies that undermine the transition towards zero carbon solutions must be reformed. Finally, the report highlights the issues of competitiveness, distributional impacts and communication as key elements in implementing climate policy reform.

Climat et carbone
rapprochement de la politique et des prix

La communauté internationale s'est accordée sur la nécessité de maintenir l'augmentation de la température moyenne de la planète en deçà de 2º C par rapport au niveau de l'ère préindustrielle. Cela nécessitera une élimination progressive des émissions liées aux combustibles fossiles durant la seconde moitié de ce siècle. Ce rapport rassemble les enseignements tirés de l'analyse de l'OCDE sur la tarification du carbone et les politiques en matière de changement climatique. Il recommande aux gouvernements de s'assurer de la cohérence à la fois des politiques visant à la suppression progressive des émissions liées aux combustibles fossiles, et des signaux envoyés aux consommateurs, producteurs et investisseurs. Un élément clé de cette approche consiste à établir de façon explicite un prix pour chaque tonne de CO_2 émise. Toutes les sources d'émissions ne peuvent cependant pas se prêter à une telle approche et il sera nécessaire de faire appel à d'autres mesures établissant un prix du carbone de manière implicite. Les politiques mises en place doivent se soutenir mutuellement et offrir un bon rapport coût/efficacité, à la fois individuellement et collectivement. De plus, il est nécessaire de réformer les exemptions fiscales et les subventions aux combustibles fossiles qui compromettent la transition vers des solutions décarbonées. Enfin, le rapport souligne le rôle clé des questions de compétitivité, des effets redistributifs, ainsi que l'importance de la communication pour mettre en œuvre la réforme des politiques en matière de changement climatique.

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