19 Taxing carbon: Current state of play and prospects for future developments

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Pricing carbon is emerging as an essential element for achieving global mitigation targets, providing a necessary signal for investments in low-carbon and resilient growth. Depending on each country's different circumstances and development priorities, various instruments (such as domestic emissions trading schemes or carbon taxes) can be used to price carbon and efficiently and reduce emissions in a cost-effective manner.

In 2015, about 40 national and over 20 sub-national jurisdictions are putting a price on carbon, representing almost a quarter of global GHG emissions, with the value of existing carbon taxes around the world being estimated at US$14 billion. Despite successful experiences and lessons that have been generated over the years of carbon tax implementation, the challenges that countries face when designing and implementing carbon taxes are not to be underestimated.

That said, the progress countries have shown so far is indisputable. With a uniform global carbon price being difficult to envisage in the near future, these on-the-ground efforts to use market forces to curb emissions are critical for any global mitigation efforts, potentially paving the way for the emergence of an international coordination mechanism for carbon pricing.

1 The findings, interpretations and conclusions expressed herein are those of the authors and do not necessarily reflect the view of the World Bank Group, the Partnership for Market Readiness or the governments they represent. The World Bank does not guarantee the accuracy of the data included in this work. The boundaries, colors, denominations, and other information shown on any map in this work do not imply any judgement on the part of The World Bank concerning the legal status of any territory or the endorsement or acceptance of such boundaries.

1 National context: A key driver behind countries' choice of carbon-pricing instruments

1.1 A wide variety of carbon-pricing instruments

Closing the gap between the 2°C target and our current climate trajectory requires a set of pragmatic policy and competitiveness solutions that support national development goals, while lowering carbon emissions. With the 2015 deadline for a global climate deal drawing nearer, policymakers around the world have been increasingly looking at carbon pricing to meet the challenge of achieving global mitigation targets, while providing a necessary signal for investments in low-carbon and resilient growth.

1.2 National political economy matters

Depending on their different circumstances and development priorities, countries opt for various instruments to price carbon efficiently and reduce emissions cost effectively. Considerations behind countries' choices of a carbon-pricing instrument can be of a political, economic, institutional, or social nature, to name a few. In some cases, it is easier to introduce one instrument as opposed to another. Moreover, specific design features can reduce opposition to the instrument of choice without jeopardising environmental effectiveness.

South Africa is a case in point. With a majority of the country's GHG emissions coming from the energy sector and the oligopolistic nature of the energy market which is dominated by a few companies, a carbon tax was an evident choice. Simply put, the lack of energy industry players would likely reduce the efficiency gains that would normally result from an emissions trading scheme (ETS). Moreover, several studies modelling the broad macroeconomic impact of a carbon tax for South Africa have indicated that the tax could be an important instrument for achieving the country's mitigation objectives at a reasonable cost to the economy, especially if coupled with one or more revenue recycling options (World Bank 2015).

China, on the other hand, has opted for a market-based instrument. With the support of the World Bank's Partnership for Market Readiness (PMR), the national government is intensifying its preparation for the design of a national ETS, which is expected to be

launched in 2017. The ETS will cover major industry and power sectors, which are the major drivers for GHG emissions. A national ETS is expected to play a critical role in using market means to reduce emissions at scale but in a cost effective way.

1.3 Carbon tax versus ETS: Not so different?

While the choice between an ETS and carbon tax is mainly driven by political economy considerations, the similarities between the two approaches are greater than the differences. Moreover, the design details are more important than the choice of instrument itself. For instance, many emissions trading schemes demonstrate a trend of including 'hybrid' elements, such as price floors or market stability reserves. To this end, the UK's carbon price floor (CPF) is in fact a tax on fossil fuels used to generate electricity. Some tax schemes also include similar 'hybrid' elements, such as carbon offset schemes. South Africa is again a good example of such an approach, currently exploring how offsets could complement its carbon tax and serve as a flexibility mechanism that would enable industry to deliver least-cost mitigation and therefore lower its tax liability. In order to ensure the effective implementation of both a carbon tax and a complementary offset mechanism – and ultimately facilitate transition towards a low-carbon economy – design features need to be well thought through. In the case of South Africa, the carbon offset eligibility criteria include South African-based credits only.

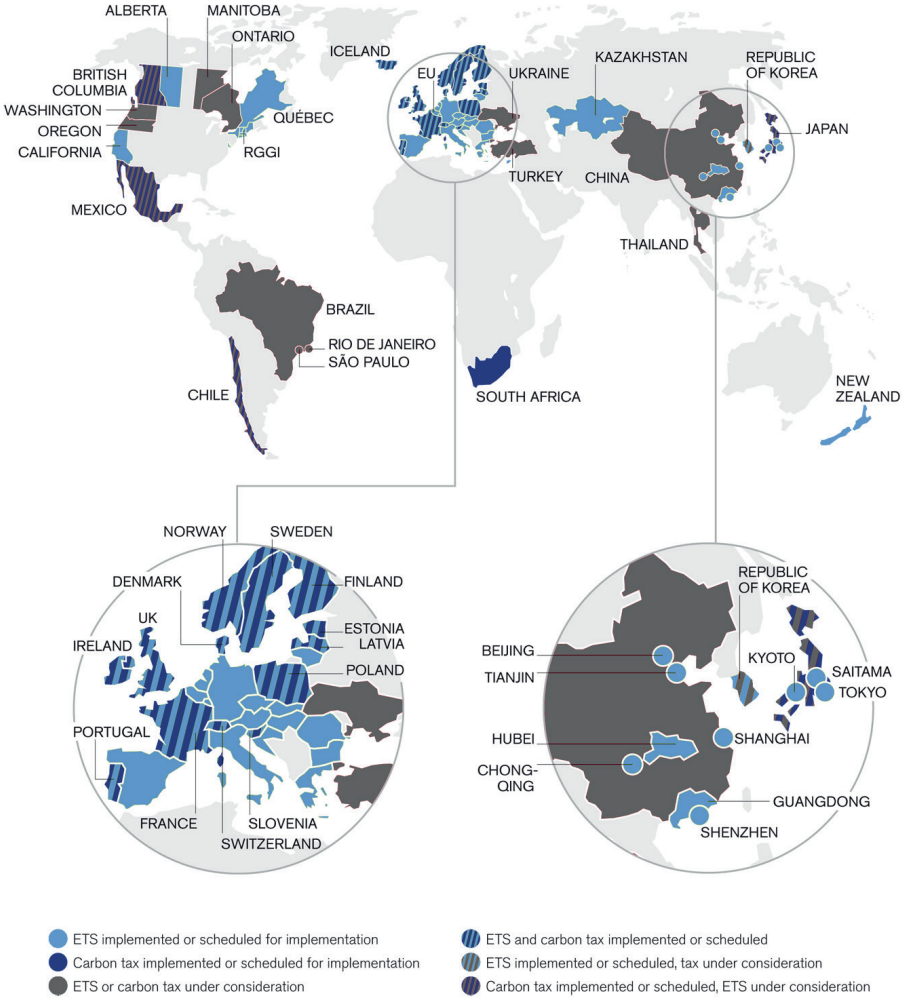
2 Carbon tax around the world: Overview and recent developments

2.1 Carbon tax at a glance

A carbon tax refers to a tax directly linked to the level of CO_2 emissions, often expressed as a value per tonne CO_2 equivalent (per tCO_2e). Carbon taxes provide certainty in regard to the marginal cost faced by emitters per tCO_2e, but do not guarantee a maximum level of emission reductions, unlike an ETS.[2]

2 Based on OECD (2013).

Figure 1 Summary map of existing, emerging, and potential regional, national and subnational carbon pricing



Source: World Bank (2015b).

Carbon taxes can be implemented as 'upstream taxes' (on the carbon content of fuels), 'downstream' taxes (on emitters), or some combination of the two. In all cases, the main policy issues concern determining the tax base, the tax rate, the use of revenues, compensation mechanisms for industries and households, if any, and coordination and interaction with other policies.

2.2 Overview of existing and emerging carbon taxes

Today, about 40 national and over 20 sub-national jurisdictions, representing almost a quarter of global GHG emissions, are putting a price on carbon (see Figure 1 and the Appendix) (World Bank 2015b). These carbon-pricing instruments cover about half of the emissions in these jurisdictions, which translates into approximately 7 $GtCO_2e$, or about 12% of annual global GHG emissions (World Bank 2015b). The value of global ETSs as of 1 April 2015 is about US$34 billion, while the existing carbon taxes around the world are estimated to be valued at $14 billion (World Bank 2015b).

2.3 Carbon tax experience in developed countries and jurisdictions

Carbon taxes were first adopted in Europe in the early 1990s and were often introduced alongside another carbon-pricing instrument, such as an energy tax (see also the contribution by Sterner and Köhlin to this book). While the experience with direct carbon tax implementation is relatively new, a number of important lessons can be drawn, as illustrated by the examples of Norway, Sweden, and British Columbia.

Norway introduced its carbon tax in 1991, which covers all consumption of mineral oil, gasoline and natural gas. It is, therefore, estimated that approximately 50% of the country's total GHG emissions are covered by the carbon tax. Emissions not covered by the carbon tax are included in Norway's emissions trading scheme (ETS), which was linked to the European ETS in 2008. Depending on the fuel type and usage, the tax rate varies between 25–419 krone/tCO_2 (US$4–69/$tCO_2$) (Kossoy et al 2014).

Sweden introduced its carbon tax in 1991, mainly as part of the energy sector reform. The major sectors included in Sweden's carbon tax system are natural gas, gasoline, coal, light and heavy fuel oil, liquefied petroleum gas (LPG), and home heating oil. While households and services are fully covered by the carbon tax, non-ETS industry and agriculture are partially exempted. Over the years carbon tax exemptions have increased for installations under the EU ETS, as opposed to directly providing exemptions to all GHG emissions covered under the EU ETS. The tax rate is 1,076 krone/tCO2 (US$168/$tCO_2$), as of January 2014 (Kossoy et al 2014).

British Columbia introduced a carbon tax in 2008, applicable to the purchase or use of fuels within the province. The main objective of the tax is to encourage low-carbon development without increasing the overall tax burden. For this reason, British Columbia's carbon tax is revenue neutral, which means that all the funds generated by the tax are returned to the citizens through reductions in other taxes, such as in personal and corporate income tax and tax credits. After seven years of implementation, British Columbia's carbon tax has been generally supported by the public, and has achieved significant environmental impacts without compromising economic development (Kossoy et al 2014). For instance, from 2008 to 2011, British Columbia reduced its GHG emissions per capita from sources subject to the carbon tax by a total of 10%, while the rest of Canada only reduced their emissions from the same source types by 1% over the same period (Elgie and McClay 2013).

2.4 Carbon taxes in emerging economies

Emerging economies are taking action, too. Recent noteworthy developments include passage of carbon tax legislation in Chile in 2014, further refinements to the design of a carbon tax in South Africa, and implementation of a carbon tax in Mexico.

Chile, as part of a major tax reform, is introducing a carbon tax that will regulate CO_2 emissions, as well as local pollutants, produced by fixed sources used for thermal power generation. The carbon tax is expected to enter into force in 2017 and is envisioned to be designed as a tax on emissions from boilers and turbines with a thermal input equal or greater than 50MW (Kossoy et al. 2014). With an additional analysis to examine the impact of proposed carbon tax in the works, initial assessments suggest that approximately 50% of energy in the country will be taxed. While further analytical work is needed, it is clear that carbon tax design and implementation will carry a number of challenges – including technological changes in the energy sector and the implications on international competitiveness, to name a few.

South Africa is working on a carbon tax scheme, which could be launched in 2016 if the Parliament adopts the legislation. The proposed rate is set at RND120 (US$11.20) per tonne of CO_2e, with a yearly increase of 10% until 2019/2020. However, the 'effective' rate is much lower – between US$1 and US$4 due to a relatively high

tax threshold and 'exemptions' (World Bank 2015a). The tax is envisioned to be a fuel input tax, based on the carbon content of the fuel used, and will cover all stationary direct GHG emissions from both fuel combustion and non-energy industrial process emissions, amounting to approximately 80% of the total GHG emissions. The carbon tax and accompanying tax incentives, such as an energy-efficiency tax incentive, are expected to provide appropriate price signals to help shift the economy towards a low-carbon and sustainable growth path. A complementary offset scheme is also proposed, though its parameters have yet to be finalised. The offset scheme aims to provide flexibility to taxpayers, leading to a lowering of their tax liability, as well as to incentivise mitigation in sectors not directly covered by the tax (World Bank 2015a).

Mexico's carbon tax on fossil fuel import and sales by manufacturers, producers and importers, which came into effect in 2014, covers approximately 40% of the country's total GHG emissions. Depending on the type of fuel, the tax rate is \$10–50 pesos/tCO_2 (US\$1–4/tCO_2). Mexico's carbon tax is not a tax on the carbon content of fuels, but rather on the additional amount of emissions that would be generated if fossil fuels were used instead of natural gas. Therefore, natural gas is not subject to the carbon tax. The tax also allows for the use of offsets. Companies may choose to comply with their commitments by buying offset credits from domestic Clean Development Mechanism (CDM) projects – equivalent to the market value of the credits at the time of paying the tax – therefore promoting the growth of mitigation projects in Mexico and the creation of a domestic carbon market (World Bank 2015a).

3 Carbon tax design and implementation: Key lessons

3.1 The case for a carbon tax

While a carbon tax (unlike the ETS) does not guarantee the maximum level of emission reductions, this economic instrument can be used to achieve a cost-effective reduction in emissions.

First, since a carbon tax puts a price on each tonne of GHG emitted, it sends a price signal that gradually causes a market response across the entire economy, creating a

strong incentive for emitters to shift to less GHG-intensive ways of production and ultimately resulting in reduced emissions.

Second, a carbon tax can also raise substantial amounts of government revenue, which can be recycled towards low-carbon development investments, reductions in other taxes, or funding of other government programmes and policies. Chile is a case in point – its carbon tax is expected to increase revenues for funding the national education reform.

Moreover, carbon taxes can further improve national welfare through various co-benefits, such as improvements in health or a reduction in local pollution.

Last but not least, by reducing GHG emissions that are driving global warming, national carbon taxes also have global benefits.

3.2 Common challenges to carbon tax implementation

Despite these advantages, the many challenges that countries face when designing and implementing a carbon tax are not to be underestimated.

First, it is often argued that carbon taxes tend to have a disproportionate impact on low-income households. In reality, there are different mechanisms and policies that are targeted at protecting low-income individuals and families, and the experience of British Columbia's carbon tax attests to this. Its revenue recycling mechanism, which includes various tax cuts and credits for low-income households to offset their carbon tax liabilities, is a good example how this challenge could be overcome (see also the contribution by Sterner and Köhlin in this book).

Second, many political challenges could arise from issues around carbon leakage, i.e. if the introduction of a carbon tax in one jurisdiction leads to a relocation of economic activity to jurisdictions where carbon taxes are not in place – a matter of concern especially for industrial competitiveness (see the contribution by Fischer in this book.). Despite the importance that these issues have been given in policy debates around the world, a number of approaches can help mitigate the risks of carbon leakage – ranging from measures that are integrated into the design of a carbon tax, such as tax exemptions and credits, to those that exist alongside a carbon tax, such as financial and institutional

support for emission reductions investments, energy efficiency improvements, and so on.

Moreover, careful management and coordination of a carbon tax with other existing or planned policies is critical in order to avoid overlapping and uncoordinated efforts. Good practice demonstrates that, when designing a carbon tax, countries typically look across the entire portfolio of policy measures that put a price on carbon and assess their cost-effectiveness, as well as consistency with other climate policies. Engaging in policy-mapping exercises in this regard ensures that new policies align with the existing ones and contribute to countries' overall efforts to achieve medium- and long-term mitigation objectives.

Finally, countries often face significant practical challenges during carbon tax implementation (in particular, 'downstream' taxes) in regard to data on current and projected emissions, technical infrastructure for monitoring reporting and verification (MRV) of emissions (see also the contribution by Weiner to this book) or legal rules and procedures for implementation, to name a few. What is important to stress is that improving carbon-pricing readiness in terms of technical and institutional capacity sets a foundation for the implementation of a forthcoming carbon-pricing instrument. Regardless of whether a country ultimately implements a carbon-pricing instrument, building and improving such readiness is a no-regrets measure, which has cross-cutting benefits that support domestic climate change policies and low emissions development.

4 Looking ahead: Options for global carbon pricing

4.1 Carbon tax: A domestic policy with a global reach

As noted in the case of countries and jurisdictions with long-standing experience of carbon tax implementation, a carbon tax promises a number of national co-benefits – from encouraging low-carbon alternatives and shifts in technology to raising revenues and ultimately leading to a socially efficient outcome. Additional to these benefits, of course, is a contribution to global efforts to curb emissions.

Despite facing many challenges when designing and implementing carbon taxes and other carbon-pricing instruments, the progress that countries have made so far is indisputable. These on-the-ground efforts to use market forces to curb emissions will be critical for any global mitigation efforts.

4.2 Coordinated efforts are key to achieving global mitigation targets

Paris is hardly an end goal, but it is surely an important milestone. For the global climate regime to be successful, the Paris agreement must reinforce our collective ambition and provide a clear pathway to net zero GHG emissions before the end of the century. Equally important for the agreement will be to draw on individual country contributions and include comparable mitigation targets from major economies. Since it is difficult to envisage a globally uniformed carbon price in the near future, an international coordination mechanism may be necessary to enhance a dialogue across different jurisdictions, to promote transparency in the process of price setting, as well to overcome some of the perpetual challenges – such as issues around carbon leakage – that countries face when putting a price on carbon.

That being said, it is encouraging to see that a number of bottom-up initiatives for fostering the international cooperation on carbon pricing have already taken root. For example, the World Bank's Partnership for Market Readiness (PMR),[3] established in 2011, brings together the world's major economies that are pursuing various carbon pricing instruments, including those that are preparing to implement a carbon tax. As an illustration, the PMR supports efforts by Chile and South Africa to design and implement their respective carbon taxes, including looking at the issues around the use of offset mechanisms, exploring interactions between the carbon tax and other existing polices and measures, building technical foundations for the tax implementation, and so on.

Through the PMR platform and other relevant initiatives on the subject matter, policymakers share valuable knowledge on technical and policy challenges faced during

3 PMR Participants are: Brazil, Chile, China, Colombia, Costa Rica, India, Indonesia, Jordan, Mexico, Morocco, Peru, South Africa, Thailand, Turkey, Tunisia, Ukraine, Vietnam, Kazakhstan, Australia, Denmark, the European Commission, Finland, Germany, Japan, the Netherlands, Norway, Spain, Sweden, Switzerland, the UK and the US. For more information about the PMR and its participants, see https://www.thepmr.org

the design and implementation of carbon tax and other carbon-pricing instruments. By facilitating efforts to establish common standards for GHG mitigation and supporting pricing schemes to become more open and transparent, it is not inconceivable that the international coordination mechanism on carbon pricing could emerge from such bottom-up initiatives, ultimately helping us get on a path to zero net emissions before the end of the century.

References

Elgie, S. and McClay, J. (2013), *BC's Carbon Tax Shift after Five Years: Results. An Environmental (and Economic) Success Story*, Ottawa: Sustainable Prosperity.

Fischer, C. (2015), "Options for avoiding carbon leakage", Chapter 21 in this book.

Kossoy, A., K. Oppermann, A. Platonova-Oquab, S. Suphachalasai, N. Höhne et al. (2014), *State and Trends of Carbon Pricing 2014*, Washington, DC: World Bank.

OECD (2013), "Climate and Carbon: Aligning Prices and Policies", OECD Environment Policy Papers No. 1 Paris.

Stavins, R. (2015) "Linkage of regional, national and sub-national policies in a future International climate agreement", Chapter 20 in this book.

Sterner, T. and G. Köhlin (2015), "Pricing carbon: The challenges", Chapter 18 in this book.

World Bank (2015a), "South Africa Market Readiness Proposal (MRP)", Partnership for Market Readiness, Washington, DC.

World Bank (2015b), *Carbon Pricing Watch 2015*, Washington, DC (available at https://openknowledge.worldbank.org/handle/10986/21986).

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Appendix: Overview of carbon taxes around the world

	Country/ jurisdiction	Type	Year adopted	Overview/coverage	Tax rate
1	British Columbia	Sub-national	2008	The carbon tax applies to the purchase or use of fuels within the province. The carbon tax is revenue neutral; all funds generated by the tax are returned to citizens through reductions in other taxes.	CA$30 per tCO_2e (2012)
2	Chile	National	2014	Chile's carbon tax is part of legislation enacted in 2014. The carbon tax is expected to enter into force in 2017 (currently it is being debated in the Senate) and is envisioned to be designed as a tax on emissions from boilers and turbines with a thermal input equal or greater than 50 thermal megawatts (MWt).	US$5 per tCO_2e (2018)
3	Costa Rica	National	1997	In 1997, Costa Rica enacted a tax on carbon pollution, set at 3.5% of the market value of fossil fuels. The revenue generated by the tax goes toward the Payment for Environmental Services (PES) programme, which offers incentives to property owners to practice sustainable development and forest conservation.	3.5% tax on hydrocarbon fossil fuels
4	Denmark	National	1992	The Danish carbon tax covers all consumption of fossil fuels (natural gas, oil, and coal), with partial exemption and refund provisions for sectors covered by the EU ETS, energy-intensive processes, exported goods, fuels in refineries and many transport-related activities. Fuels used for electricity production are also not taxed by the carbon tax, but instead a tax on electricity production applies.	US$31 per tCO_2e (2014)
5	Finland	National	1990	While originally based only on carbon content, Finland's carbon tax was subsequently changed to a combination carbon/energy tax. It initially covered only heat and electricity production but was later expanded to cover transportation and heating fuels.	€35 per tCO_2e (2013)
6	France	National	2014	In December 2013 the French parliament approved a domestic consumption tax on energy products based on the content of CO_2 on fossil fuel consumption not covered by the EU ETS. A carbon tax was introduced from 1 April 2014 on the use of gas, heavy fuel oil, and coal, increasing to €14.5/tCO_2 in 2015 and €22/tCO_2 in 2016. From 2015 onwards the carbon tax will be extended to transport fuels and heating oil.	€7 per tCO_2e (2014)

	Country/ jurisdiction	Type	Year adopted	Overview/coverage	Tax rate
7	Iceland	National	2010	All importers and importers of liquid fossil fuels (gas and diesel oils, petrol, aircraft and jet fuels and fuel oils) are liable for the carbon tax regardless of whether it is for retail or personal use. A carbon tax for liquid fossil fuels is paid to the treasury, with (since 2011) the rates reflecting a carbon price equivalent to 75% of the current price in the EU ETS scheme.	US$10 per tCO_2e (2014)
8	Ireland	National	2010	The carbon tax is limited to those sectors outside of the EU ETS, as well as 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.	€20 per tCO_2e (2013)
9	Japan	National	2012	Japan's Tax for Climate Change Mitigation covers the use of all fossil fuels such as oil, natural gas, and coal, depending on their CO_2emissions. In particular, by using a CO_2 emission factor for each sector, the tax rate per unit quantity is set so that each tax burden is equal to US$2/$tCO_2$ (as of April 2014).	US$2 per tCO_2e (2014)
10	Mexico	National	2012	Mexico's carbon tax covers fossil fuel sales and imports by manufacturers, producers, and importers. It is not a tax on the full carbon content of fuels, but rather on the additional amount of emissions that would be generated if the fossil fuel were used instead of natural gas. Natural gas therefore is not subject to the carbon tax, though it could be in the future. The tax rate is capped at 3% of the sales price of the fuel. Companies liable to pay the tax may choose to pay the carbon tax with credits from CDM projects developed in Mexico, equivalent to the value of the credits at the time of paying the tax.	10-50 pesos per tCO_2e (2014)* * Depending on fuel type
11	Norway	National	1991	About 55% of Norway's CO2 emissions are effectively taxed. Emissions not covered by a carbon tax are included in the country's ETS, which was linked to the European ETS in 2008.	US$4-69 per tCO_2e (2014)* *Depending on fossil fuel type and usage

	Country/ jurisdiction	Type	Year adopted	Overview/coverage	Tax rate
12	South Africa	National	2016	South Africa plans to introduce a carbon tax at RND120 per tonne of CO_2e, with annual increases starting in January 2016. The tax is envisioned to be a fuel input tax based on the carbon content of the fuel and cover all stationary direct GHG emissions from both fuel combustion and non-energy industrial process emissions, amounting to approximately 80% of the total GHG emissions.	RND120/tCO_2e (Proposed tax rate for 2016)* *Tax is proposed to increase by 10% per year until end-2019
13	Sweden	National	1991	Sweden's carbon tax was predominantly introduced as part of energy sector reform, with the major taxed sectors including natural gas, gasoline, coal, light and heavy fuel oil, liquefied petroleum gas (LPG), and home heating oil. Over the years, carbon tax exemptions have increased for installations under the EU ETS, with the most recent increase in exemption starting from 2014 for district heating plants participating in the EU ETS.	US$168 per tCO_2e (2014)
14	Switzerland	National	2008	Switzerland's carbon tax covers all fossil fuels, unless they are used for energy. Swiss companies can be exempt from the tax if they participate in the country's ETS.	US$68 per tCO_2e (2014)
15	United Kingdom	National	2013	The UK's carbon price floor (CPF) is a tax on fossil fuels used to generate electricity. It came into effect in April 2013 and changed the previously existing Climate Change Levy (CCL) regime, by applying carbon price support (CPS) rates of CCL to gas, solid fuels, and liquefied petroleum gas (LPG) used in electricity generation.	US$15.75 per tCO_2e (2014)

Source: http://www.worldbank.org/content/dam/Worldbank/document/SDN/background-note_carbon-tax.pdf.