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Carbon pricing

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The role of a carbon price as a climate change policy instrument

wbcsd energy & climate

What is a carbon price?

In its scenario for a sustainable future, **Vision 2050**, WBCSD calls for a *"carbon price and increased use of other forms of true-value pricing"* as a deliverable necessary by 2020 in order to be able to achieve a vision of a world living well, and within its means, in 2050. We need a pricing for goods and services that includes their full cost and benefits – economic, social and environmental. In the case of a carbon price, this is a value that reflects the impact of CO_2 emissions from the product or service on the environment. This is often referred to as a "negative externality", although in practice it more typically reflects a prescribed limit on emissions, or a requirement to minimize emissions. This may not be the same as the true externality.

Establishing a carbon price is potentially one of the most powerful mechanisms available to reduce national greenhouse gas emissions. It is usually delivered through legislation, which imposes a cost, or places an opportunity value on the emission of greenhouse gases into the atmosphere. The goal of carbon pricing is to create a change in the economy, whereby the market begins to differentiate between goods and services on the basis of their carbon footprints.

A carbon price can be established explicitly, for example, through carbon taxes or emissions trading, or implicitly, through regulations, such as an emissions standard or a Best Available Control Technology (BACT) requirement. The choice of the specific policy tools depends on a country's national circumstances and on the characteristics of the affected economic sectors.

Establishing a carbon price is only one element of a much broader climate change policy framework. Comprehensive policy approaches also have to include other elements such as additional funding for research and development (R&D), fiscal support for early large scale demonstration of near-commercial technologies, or the removal of subsidies that support carbon intensive activities, such as fuel subsidies.

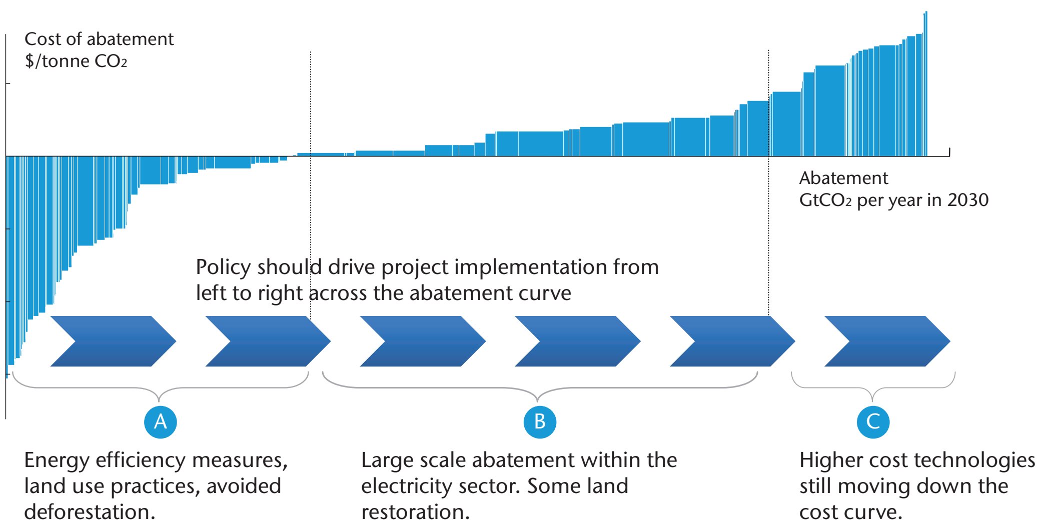
A successful policy framework will trigger the implementation of emission reduction projects and actions throughout the economy, with the lowest cost result being delivered by encouraging the most economically attractive projects to be developed first, and progressively moving from left to right across the abatement curve (see figure 1).

Over time, the various national policy approaches should complement each other, link or converge to create a global price on carbon.

Atmospheric carbon dioxide – a negative externality

Over the last 200 years, the CO_2 content of the atmosphere has risen from 285 ppm to some 390 ppm (or as much as 430-450 ppm CO_2 equivalent, if other greenhouse gases are included), as a result of human activity. The combustion of fossil fuels, deforestation, agricultural practices and emissions of particular gases by industry are the major contributors. This accumulation has enhanced the natural warming function of the atmosphere, resulting in a steady rise in global temperatures. Although the specific long-term impact of this warming remains uncertain, there is likely to be a cost imposed on future generations; for example, the need to adapt to a rising sea level is an already observable trend. This cost is not reflected today in the price we pay for goods and services that contribute to the level of CO_2 in the atmosphere. This is a failure of the market that is delivering these products.

Figure 1: Cost abatement curve



The economics of a carbon price

The goal of a carbon price is to create a change in the economy such that the market begins to differentiate between goods and services on the basis of their carbon footprint.

In its generic realization, the carbon price, initially experienced by the emitter or fuel provider (e.g. by paying a tax, purchasing allowances from the government or implementing a required project), is passed through to the consumers of the product. The result is a change in the relative cost of most goods and services based on their carbon footprint, and the emergence of a new cost ranking within the economy. This will influence the purchasing decisions of consumers.

Products with a high carbon footprint will be less competitive, either forcing their removal from the market, or driving manufacturers to invest in projects to lower the footprint. Any revenue raised by the government from carbon pricing, will be typically directed to the treasury as part of the overall national budget process. It should be used efficiently; for example, to offset any net change in costs to the consumer by reducing taxes.

A transparent pass-through of operating costs to the consumer is an important feature of any market. It allows the manufacturer to adjust the sales price to maintain profitability, as new costs enter a process, or existing costs change. An increase in the sales price could only occur to the extent that the market allows the change to take place, due to competition from manufacturers with a different cost structure that may limit the potential for cost pass-through. This gives rise to one of the principal challenges of introducing carbon pricing into an economy.

Carbon pricing is being introduced piecemeal throughout the world. Some manufacturers incur the cost of carbon, while others do not, although they may be competing in the same market. A manufacturer incurring the cost of carbon is penalized, as the market price is set by a lower cost provider without the carbon price. This can result in "carbon leakage", where a higher cost manufacturer struggles to compete, and market share is gained by a producer not subject to the carbon price. Consequently, the environmental integrity of the approach can be undermined and economic distortions introduced. A global carbon price is therefore important in order to gain a level playing field. Another challenge arises in heavily regulated markets where the producer may not be able to raise prices, and therefore cannot recover the carbon cost.

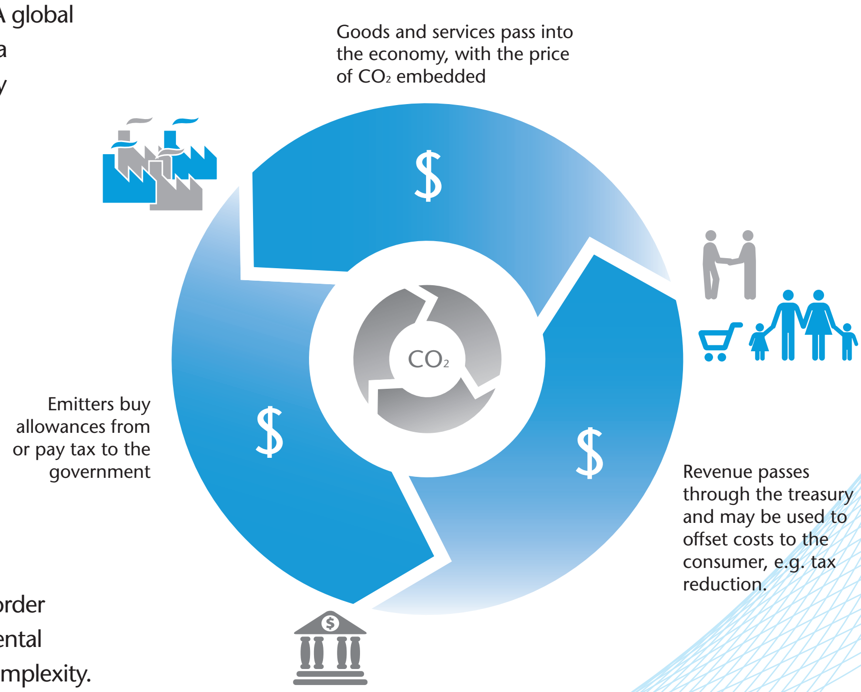
The design of a carbon pricing policy must recognize these issues. For example, if the policy involves the use of an emissions trading system, the free allocation of a portion of the allowances to certain sectors means that they do not incur the direct cost, but retain the opportunity cost of carbon in the free allowances. The environmental goal is retained, since a fixed number of allowances are in circulation.

An alternative is to correct any distortion through border tax adjustments, but these could result in environmental policy challenging trade policy, further increasing complexity.

The carbon footprint explained

The carbon footprint of a product is the net change in global carbon emissions as a result of the production and use of that product. Given that such a change is almost impossible to measure, the calculated carbon footprint is, at best, a proxy of actual emissions. The simplest approach is to add up the emissions from the various steps within the manufacturing process and final use; this does not, however, always give the complete answer. Secondary effects may need to be included, such as those associated with product substitution (e.g. the process produces a by-product which in turn changes another market), the impact of changes in land use, or a fuel switch to low carbon mixed grid electricity as a result of the demand for, and use of, the product (e.g. an electric car).

Figure 2: A new flow of capital in the economy



Implementing a direct carbon price in the economy

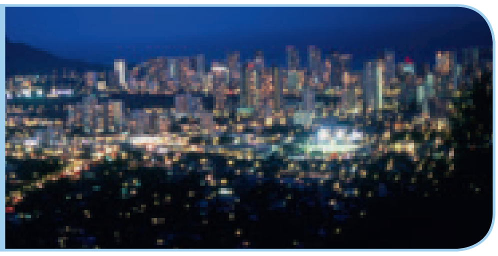
	Cap-and-trade system	Carbon tax
Description	The desired environmental outcome, expressed as a cap, for the sectors covered by the system, is translated into allowances. The only obligation on an emitter operating within the system is to surrender one allowance for each tonne of CO_2 emitted. Allowances are introduced into the economy by the government, with the total number created being limited to the desired outcome. The allowances are transferable through trade and have a value – the carbon price. An offset mechanism may apply.	The government imposes a fixed tax on CO_2 emissions at some point in the economy. This may be at the source of the emissions, or upstream of the actual emissions (e.g. at the point of sale from a coal mine). The level of tax is the carbon price. Like a cap-and-trade system, the carbon tax approach requires measurement, reporting and verification of CO_2 emissions across the sectors covered by the policy.
Operation	It delivers a specific environmental outcome through the overall cap, in theory at the lowest overall cost to the economy as participants progressively implement projects from left to right across the abatement curve (figure 1). Allowances are typically auctioned by the government into the market. Early on, as the economy begins adjusting to the carbon pricing mechanism, and sometimes to prevent carbon leakage, the government may allocate some, or all, as free allowances. The system relies on robust measurement, reporting and verification processes at each installation, causing administrative burden, and is more appropriate for large emissions sources.	A tax based approach is strongly favoured by many economists. It is a relatively simple approach to understand and implement, but requires significant analysis, with regards to the setting of the tax level, in order to achieve a specific environmental outcome. This can only come from a clear understanding of the abatement opportunities present in the economy. A disadvantage is that when providing exemptions to prevent carbon leakage, the sector does not perceive the price signal.
Current examples	• Power and industry sectors in the EU. • Power sector in the US north-east states. • New Zealand economy, but in stages. • In final development for California.	• British Columbia. • Norwegian offshore facilities.

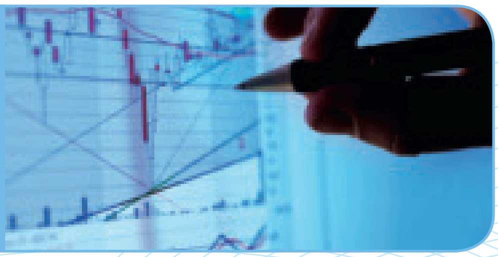
Implementing an indirect carbon price in the economy

	Alternative energy standards	Emissions performance standards
Description	A national or sector based standard is established by government dictating the percentage of sources of energy in the mix, as a means of reducing fossil fuel use. There is an implicit carbon price, but calculating this by basing it on substitution costs may result in an overestimation, as governments typically have other objectives as well (e.g. security of supply).	A sector or facility standard is established by government setting a limit on the emissions per unit of production; for example, grams CO_2 per kWh of electricity produced. The approach provides a clear implied carbon price, which can be calculated from the standard itself, in combination with market energy prices.
Operation	The approach requires a mechanism to translate the high level target into company or facility level compliance. It is usually supported by penalties, but may also include tradable compliance certificates.	It is in operation in both the EU and California in the vehicle fuel pool. Compliance is at supplier level and is supported with tradable certificates (see "Baseline-and-credit").
Current examples	• EU Renewable Energy Directive. • US Bio-energy mandates for transport.	• Proposed Canadian moratorium on new unabated coal fired power stations. • California Low Carbon Fuel Standard.

Baseline-and-credit approach	Project mechanism
The government establishes a baseline emission for each sector, typically on a CO_2/unit of production basis. This is also called an intensity based approach. The participants earn credits by exceeding the baseline, or surrender credits if they fall short. The credits are tradable and can be banked, as in the cap-and-trade approach. The approach could also be linked with an offset mechanism, as for cap-and-trade.	A project is developed and emissions are compared with a baseline, which may represent best available technology or typical practice for a particular country. For example, if coal is the usual fuel for similar projects, then this would be used to calculate the baseline. If the project emission reductions are better than the baseline, credits are issued. These credits are tradable, and may be bought directly by governments, or used as compliance instruments in cap-and-trade systems.
Baseline-and-credit requires accurate benchmarking across different sectors. Because of the trade of credits, benchmarks should also represent an equivalent effort when comparing sectors, i.e. y tonnes CO_2/t cement equivalent to x tonnes CO_2/t of steel. If not, sectoral economic distortion results. Importantly, the environmental outcome in terms of absolute emissions is uncertain, as it depends on the level of production. This approach does not generate additional revenues to the government because allowances are not sold.	Like the baseline-and-credit approach, a project mechanism requires a high level of oversight, including baseline determination and measurement, reporting and verification. The mechanism typically requires an assessment panel of some description, such as the Executive Board of the CDM. This may introduce a level of subjective decision-making into the process.
• No direct industrial application. It has been used in the UK prior to the development of the EU-ETS. • The Low Carbon Fuel Standard in California incorporates aspects of baseline-and-credit.	• The Clean Development Mechanism. • Various voluntary carbon reduction schemes (e.g. airline offset programs), use project mechanisms as a source of credits. • REDD+ payments for improved management of forests in developing countries, (e.g. Indonesia, Ghana).

Efficiency standards	Social commitments
Efficiency standards are set by government, often at a micro economic level, e.g. on energy consumption of equipment such as air-conditioning units, the CO_2 emissions per km on vehicles, or in the design of new buildings. The approach is performance based, and deriving an underlying carbon price can be complex, since it depends on the actual use of the product (e.g. hours of operation or mileage).	Many companies, and some national and global sectors, have pledged to reduce CO_2 emissions on a voluntary basis. Such a commitment introduces an implicit carbon price for the entity making the offer, though the calculation of the price may be very difficult to determine.
The approach may require considerable data collection, but can be tailored to a given sector. It promotes the importance of saving energy with business entities, and is used extensively in some countries.	This requires a high degree of voluntary reporting, and transparency of this reporting, so that observers can determine the effectiveness and value of the contribution.
• "Top-Runner Standard" in Japan. • Energy Saving Act of 1979 in Japan. • CO_2 regulations for cars in the EU.	• Shell target 1990-2010, Unilever target 2012. • Japanese industry implements the "Keidanren Voluntary Action Plan" in line with national Kyoto obligations.





What can a carbon price deliver?

An explicit carbon price operating in the economy directly influences the relative cost of most goods and services, as a function of their carbon footprint. This will have an impact and, over time, may result in product substitution, changes in the size of certain sectors, adjustments in production techniques and change the long-term investment path. Some examples are outlined below:

- Today, Australia exports iron ore to Asia where it is smelted with coal to produce wrought iron and finally **steel**. In future years, a carbon price operating within Asian and Australian economies could encourage the development of the necessary process for the production of the steel in Australia using natural gas, where that fuel is prevalent, rather than coal, as is the case in Asia today. The transfer of allowances from Asia to Australia, assuming linked carbon trading systems, would underpin any additional emissions in that country, but overall emissions between the two would be lower, thus making the project an attractive proposition.

- In the **building industry**, substitution of brick and block construction with timber framing may result from the lower CO_2 emissions of timber along its life cycle.

The complex interrelation of carbon pricing policies

Direct carbon pricing works better in well functioning markets where the administrative burden for implementing such a system is reasonably low, for example, large emitters in power generation and industry. In other sectors, because of the barriers to energy efficient solutions (lack of information, principal-agent or high upfront investment, to name a few), or that emission sources are small and dispersed, regulation is often the most appropriate solution. Regulatory measures inherently mean establishing an implicit carbon price. Using regulatory measures is becoming widespread and more common, particularly as policy makers face political pressure not to implement more financial or tax-based systems. An implicit carbon price may be delivered in many ways, but in some instances it can be difficult to determine the scale of its presence. For example:

- Carbon prices may result in a substitution of products in the **automotive industry**. The introduction of an implicit carbon price through strict CO_2 emission requirements for automobiles would increase focus on the weight of vehicles in a bid to improve vehicle efficiency. In addition, the relative cost of the materials used to produce vehicles would probably shift as a result of the difference in carbon emissions in the respective manufacturing phases, when direct pricing is applied for those sectors. Vehicle designers will need to balance these separate but linked changes, as they evaluate the possibilities for future models. This could include the substitution of aluminium in place of steel, the use of thinner steel panels following the development of advanced rolling & milling techniques, or the substitution of both steel and aluminium with carbon fiber panels.

- A renewable energy mandate, set for both energy security and carbon emission reasons, might lower the explicit carbon price set by an emissions trading scheme and put pressure on development of other low carbon technologies (e.g. nuclear or CCS). Determining the exact level of the carbon price operating in the sector then becomes somewhat subjective.

- In the EU, both a renewable energy mandate and a carbon standard operate in tandem in the transport fuel pool, which adds a layer of complexity to the calculation of the underlying carbon price. The choice of fuels to meet one objective can also affect performance against the second objective.

A regulatory approach to managing emissions may be a more expensive option for the economy as a whole. Regulations tend to focus on specific activities, and often dictate specific solutions that may not be the same as the next project choice on the abatement curve. This then raises the cost of emissions reduction, as higher cost projects are undertaken earlier than would otherwise be the case.

Regulatory approaches may interfere with direct pricing approaches. Similarly, purposed regulations that exist in the same sector as a cap-and-trade system will force down the prevailing carbon price and drive up the mitigation cost for the sector as a whole. This is because regulation forces the implementation of a project further along the abatement curve than the market would otherwise dictate. The resulting reduction in emissions takes some pressure out of the market, which in turn depresses the carbon price. An example of this is in the EU ETS, where the carbon price would probably be higher if the Renewable Energy Directive was not in place, forcing renewable energy projects to be implemented. However, such regulations are often in place for reasons other than just CO_2 abatement.

Why is a carbon price needed urgently?

In the wake of a deep recession, and in the midst of a tough political environment, governments without a comprehensive climate policy may look to a variety of proxy approaches in order to deliver emission reductions across the economy. These will certainly deliver some results, but matching the efficiency and order imposed by establishing a market-responsive approach will be difficult. It will also cost the economy more than is necessary, a difficult route to justify in the current global economic conditions.

Business requires clear signals towards a low carbon economy, and a level playing field across international markets. This can best be achieved through global and stable carbon prices. Proxy approaches create uncertainty, and may delay investments in low carbon alternatives. Determined support for global carbon pricing would be the most efficient way to curb global carbon emissions. Business is willing to take the challenge that this will involve, including deep changes in the current market structure and production methods. Although significant business opportunities exist on the path towards low carbon growth, the necessary investments require regulatory certainty.

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