Cap and Trade

Carbon Emissions Trading Explained

Carbon Cap Management LLP
Capping and Reducing Emissions

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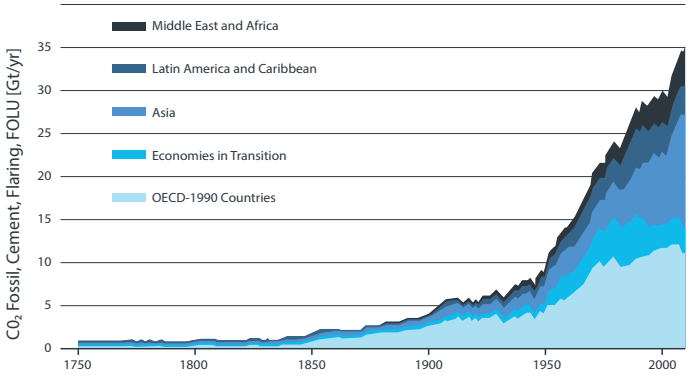
Increasing Awareness

Climate change is one of mankind's greatest challenges and Carbon Cap is a company dedicated to raising awareness about climate change and providing solutions directly associated with the capping and reduction of carbon emissions. Related to this is our goal to provide high quality educational materials to individuals and companies on climate change and emissions reduction strategies. This document outlines the benefits of carbon emissions trading systems as one of the most important solutions to support the reduction of the emissions in line with global mitigation targets such as those agreed under the Paris Agreement.

Putting a Price on Carbon

Carbon emissions are an example of what economists term a market failure as they give rise to the unpriced negative externality of climate change. Activities that generate carbon emissions provide benefits (goods and services) to humans, but they also come with costs in terms of the damages caused by temperature rises and climate change. These costs of climate change are distributed across all humanity, however carbon emissions themselves are traditionally unpriced. As such, emitting companies do not factor in the external societal cost of their carbon emissions into their production costs which results in an overproduction of carbon emissions. This market failure can be seen in practice, as emissions have grown exponentially since the industrial revolution (figure below).

Figure 1: Annual Release of CO2 into the Atmosphere (IPCC, 2021)



Source: IPCC Sixth Assessment Report (AR6) 2021.

To correct this market failure, we need to put a price on carbon emissions that reflects the costs of climate change imposed on the planet and the people who live on it. It is generally accepted that one of the most efficient ways to correct a market failure is to place a price on the externality that reflects its true cost. Explicitly pricing the externality causes firms or individuals to internalize its costs when making production and consumption decisions. Pricing carbon has proven an effective, flexible and low-cost approach to reducing emissions, through incentivising consumers and producers to shift away from high-emissions processes and products to low carbon alternatives (CPLC, 2017).

*CPLC, 2017: High-Level Commission on Carbon Prices, 2017. Report of the High-Level Commission on Carbon Prices. Washington, DC: World Bank.

Normally, carbon emissions are expressed in tonnes of carbon dioxide-equivalent (tCO2e) released into the atmosphere and the amount of carbon released for a given activity is referred to as its carbon footprint. Some examples of the average carbon footprint emitted from typical activities are:

- A passenger's flight from London to New York: 2 tCO_2e
- The average annual emissions for an adult in Europe: 10-20 tCO_2e

For companies, the cost of reducing one additional tonne of carbon emissions is known as the marginal abatement cost (MAC) and this can differ across sectors and firms, depending on production processes and technologies available. Marginal abatement cost curves (MACCs) aggregate a firm's MACs and provide an indication of what volume of emissions reductions can be expected at different carbon price levels. Table 1 indicates carbon prices estimated to stimulate emissions reductions sufficient to meet the Paris Agreement targets in 2020 and 2030 across various regions.

Carbon Price Forecasts in 2030

	2030
OECD Carbon Rates 2021 Report	$135
IEA Net Zero by 2050	$130
Bank of England	$150
UK REA Bioenergy Strategy	$125

Source: OECD Carbon Rates 2021 Report, IEA Net Xero by 2050 A Roadmap for the Global Energy Sector, Bank of England & UK REA Bioenergy Strategy, Brown, A. 2019.

As carbon pricing continues to grow, it is important that its benefits are understood. Carbon pricing has allowed economies to decouple emissions from economic growth, reducing previous concerns that environmental policies hinder economic prosperity. For example, over time carbon emissions have declined while GDP has increased across the EU Emissions Trading System (EU ETS), Regional Greenhouse Gas Initiative (RGGI), and the California cap and trade (see table below), illustrating that ETSs are compatible with economic growth. For RGGI in particular, over the first four years of operation emissions declined almost three times faster while the economy grew more than two times faster in RGGI-states compared to non-RGGI states. Carbon pricing may also generate positive competitiveness impacts by stimulating Investment and development into more competitive, innovative low-carbon technologies. These effects have also been predicted in economic theory such as the Porter Hypothesis which suggests that well-designed environmental policy can yield innovation benefits that increase profits, offsetting the cost of regulation and improving competitiveness.

Emissions reductions and GDP growth in three carbon markets

Jurisdiction	Emissions reduction	Real GDP growth
RGGI	25% (2009-16)	12% (2009-16)*
California	10% (2012-17)	21% (2012-17)
EU ETS	29% (2005-18)	8% (2005-18)

Sources: Eurostat (2021); European Environment Agency (2021); RGGI Inc (2021) & US Bureau of Economic Analysis (2021); California Air Resources Board (2020)

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Tax or Cap and Trade?

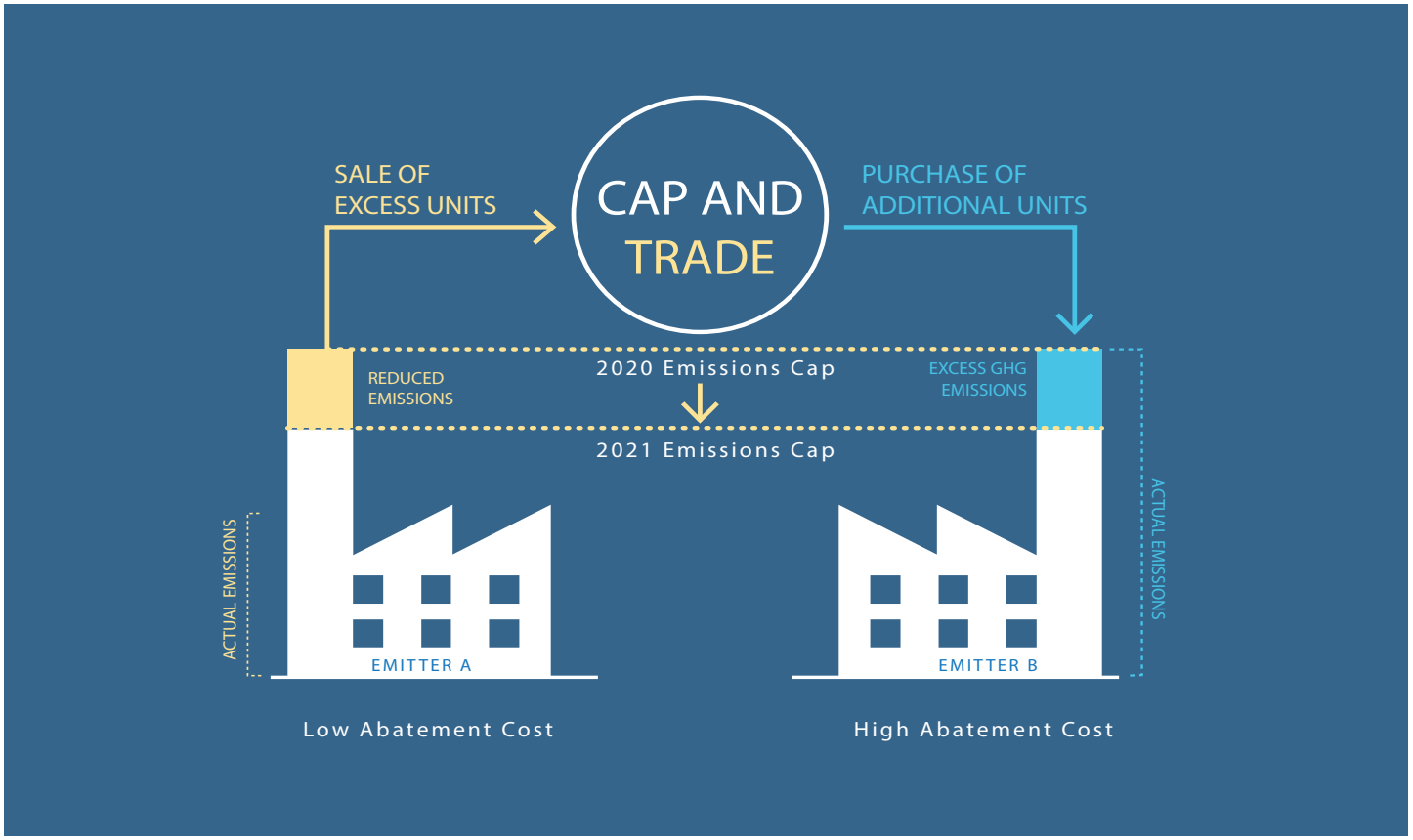
As the need to price carbon to reflect its true cost to society is generally accepted by economists (CPLC 2017), the decision becomes how to price carbon. There are two ways to implement a price on carbon; a carbon tax; or a cap and trade system. Both policies can achieve the goal of pricing carbon to provide a financial incentive to reduce emissions, and both policies have been implemented around the world, sometimes together.

Under ideal conditions, taxes and cap-and-trade would result in the same cost and quantity of emissions abatement. However, reality implies an inevitable degree of uncertainty, such as on the benefits and costs of abatement. As carbon taxes provide cost certainty but no environmental certainty, it is possible for emissions to continue to rise. However, ETS provide certainty as to the final volume of abatement achieved, but have less certain costs, as the market determines allowance prices. Additionally, through allowance trading and banking ETSs also provide least-cost abatement and temporal flexibility.

A carbon tax can be imposed on the production, distribution or use of fossil fuels (i.e. coal, oil, and gas) and provides price certainty without providing certainty regarding the total amount of abatement that can be expected. A government sets a price per tonne of carbon which translates into a tax on the carbon content of fossil fuels.

The goal is to set the tax at a level that creates a disincentive to use fuels and processes that generate carbon emissions means and facilitates a switch to low-carbon technology such as wind or solar power.

Cap and trade systems, often referred to as emissions trading systems (ETS), provide environmental certainty, least-cost abatement and provide firms temporal flexibility. ETS set emissions caps that decline annually to meet a climate policy target over time. This market-based solution provides environmental certainty in terms of the amount of emissions produced, whilst allowing the market to set the price. Carbon allowances equal to the emissions cap are then either allocated or auctioned to emitting entities who may then trade these allowances between them. Allowance trading is a key benefit of ETS as it incentivises least-cost abatement, as firms with a low abatement cost will abate and sell their allowances to firms with a higher abatement cost (as shown in diagram below). ETSs also provide entities temporal flexibility by often allowing firms to "bank" allowances, holding them for use in the future compliance years. Non-compliant entities receive penalties. For example, non-compliance in the EU market costs €100/tCO_2 (adjusted by EU inflation from 2013 onwards) in addition to having to surrender shortfall allowances the following year. This mechanism to cap and trade greenhouse gas emissions is now one of the most preferred policy instruments in the world.



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How Cap and Trade Works

Politically, cap and trade systems are often more favourably received among citizens than a carbon tax. A tax requires firms to reduce emissions on the government's terms and can be perceived as a tool for government revenue generation. However, a cap and trade system provides entities flexibility through allowance trading and banking . In a cap and trade system, the market determines the price of allowances and this allows further flexibility as it means prices are counter-cyclical and adjust to economic and political factors. For example, in economic downturn, output and emissions decline, this reduces demand for allowances and hence lowers the allowance price which reduces the total economic costs of the policy.

Cap and trade systems have also been launched by subnational jurisdictions within North America, as United States (US) states and Canadian provinces have taken control of reducing their emissions. The oldest system is RGGI which covers 9 states on the east coast of the US and the second is the Western Climate Initiative (WCI) consisting of California and the province of Quebec in Canada. Recent policy announcements suggest that other US states are also considering Introducing cap and trade systems which could join either RGGI, WCI or remain standalone. Pennsylvania has plans to design a cap and trade system compatible with RGGI, New Jersey will join RGGI In 2020, Virginia, Washington and Oregon continue to pursue plans to develop cap and trade systems. Meanwhile, the Transportation and Climate Initiative (TCI) is an organisation comprised of 12 Northeast and Mid-Atlantic states and the District of Columbia that aims to introduce a regional transport sector cap and trade scheme.

Similarly, many other countries have either launched emissions trading systems or are planning to launch them shortly. The EU ETS is currently the world's largest compliance cap and trade system, South Korea has implemented a cap and trade system since 2015, New Zealand's cap and trade system began in 2008, Kazakhstan restarted their cap and trade, and the Swiss cap and trade system will link with the EU ETS in 2020. Countries with upcoming cap and trade systems include China, Mexico, Colombia, Chile, Turkey, and Ukraine.

An illustrative example of how ETS results in emissions reduction

If a power generator is regulated under an ETS, it will need to demonstrate compliance with the rules of the system at the end of each compliance period, typically annually. The company will be audited by an approved third party company who will verify the total emissions they have generated. This audit report is then submitted to the national emissions registry office and the government then audits a number of these reports to confirm they are correct. The company will be required to deliver carbon allowances to the regulator equal to the amount of carbon emitted (tCO2e) in the compliance period. The company will typically receive or purchase carbon allowances that they can use for compliance. Failure to comply incurs costly penalties and the entire system is tightly monitored and regulated.

If the power generator needs to generate additional electricity in the short run, they may have to decide between using coal or natural gas. Since the generating electricity using the fossil fuels will generate carbon emissions, the company will need to factor the price of carbon allowances into its decision. As such, while coal prices might be lower than natural gas prices, the addition of a carbon price may incentivise the generator to use natural gas rather than coal, as natural gas has around half the carbon intensity as coal. This Is known as fuel-switching and it is a central power sector mitigation measure. However, the company will only implement a mitigation measure if its marginal abatement cost (MAC) is less than the carbon price. The key determinant of how much physical abatement takes place is therefore dependent upon two main factors: the physical cost of abatement and the price of a carbon allowance. This illustrates how carbon pricing creates a financial incentive that favours low carbon solutions.

In the longer term, if the company were to replace their fossil-fuel based electricity production capacity with renewable electricity production, this would result in the company generating the same amount of electricity with lower emissions. This would mean the company either has to purchase fewer allowances on the market or it could sell surplus allowances into the market.

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Cap and Trade Success Stories

One of the earliest success stories for cap and trade was a system implemented in the USA in 1990 to curb Sulphur Dioxide (SO2) emissions that were causing acid rain. Flue gas emissions from coal-fired power plants were the primary source of these emissions in the US. The Clean Air Act Amendments of 1990 aimed to slash annual SO2 emissions by 10 million tonnes out of the total 26 million tonnes that were being emitting by 3,200 coal plants. The Clean Air Act itself mandated an allowance trading system to accomplish this goal, in the process making it the world's first large scale pollutant cap and trade system. Through two phases, the government freely allocated emission allowances and then let firms decide how to trade them to meet the requirements under the new cap on emissions. Phase I lasted through 1995-1999 and required reductions from the 263 most-polluting coal plants. Phase II began in 2000 and placed an aggregate national emissions cap of 8.95 million tonnes per year on approximately 3,200 electric generating units.

Between 1990 and 2004, SO2 emissions from the power sector fell 36% even though total energy output from coal-fired power plants increased by 25% over the same period. By 2010 total emissions had fallen to only 5.1 million tons, a reduction of 81%.

The cap itself represented an approximately 50% reduction from 1980 levels. The actual cost of implementation of this very effective system was between 15%-90% lower than forecast and it also resulted in an explosion of innovation among the entities since it allowed them to find new ways of reducing their emissions. The scheme's success has led to Harvard University producing a full report highlighting the successes and lessons learned.

This "market based" approach of an ETS is perhaps its most valuable characteristic since it allows the "invisible hand" of the market to determine the price of carbon and the most cost-effective path to emissions reductions. This is one of the reasons why emissions trading is expanding around the world and is advocated by organizations such as the World Bank and the UN.

Carbon Cap's mission is to raise awareness about climate change and provide solutions directly related to the capping and reduction of carbon dioxide emissions.

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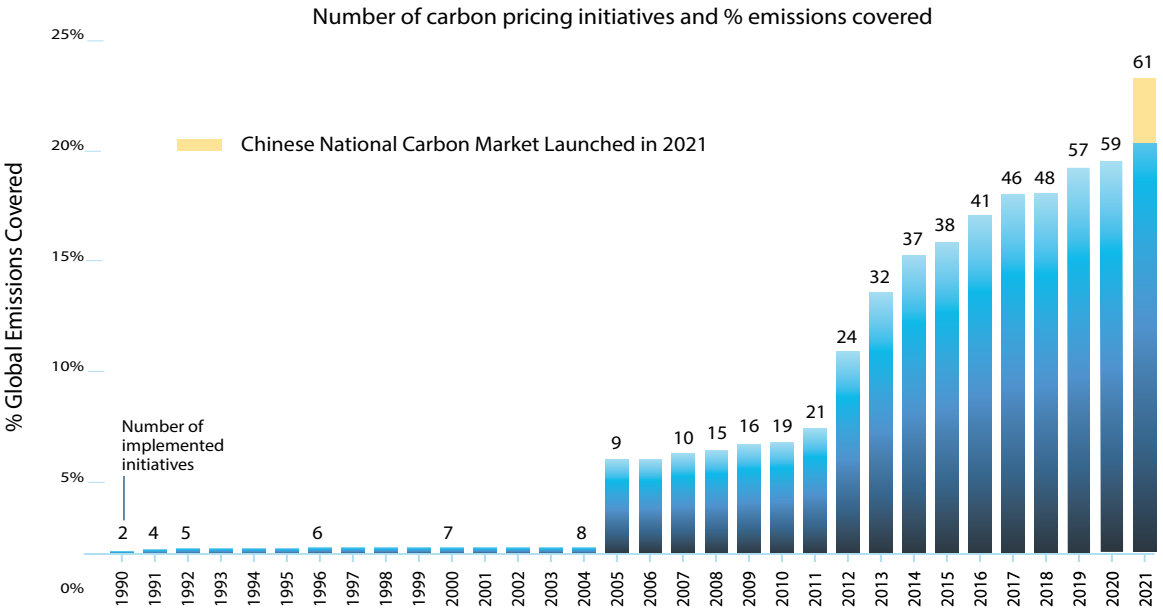

Source: State and Trends of Carbon Pricing, The word Bank, 2020