International Energy Agency

Implementing Effective Emissions Trading Systems: Lessons from international experiences

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Abstract

Carbon pricing is a valuable instrument in the policy toolkit to promote clean energy transitions. By internalising the societal cost of greenhouse gas emissions, carbon pricing can stimulate investments in low-carbon technological innovations, foster multilateral co-operation and create synergies between energy and climate policies. Emissions trading systems offer one possible design for carbon pricing schemes. Where emissions are capped, trading systems create certainty about the allowed emissions trajectory, while allowing carbon prices to fluctuate. Emissions trading systems create incentives to reduce emissions where these are most cost-effective. Sub-national, national and supranational jurisdictions have shown increasing interest in emissions trading systems as a policy instrument to achieve climate change mitigation goals. By analysing international experiences, this report draws lessons for designing and implementing effective, efficient emissions trading systems. The report covers structures, policies and objectives across the energy sector, elaborating key lessons and questions especially for jurisdictions interested in developing new emissions trading systems. This report identifies key energy-related challenges drawn from "real world" experiences, opening the doors for a deeper examination of technical issues and lesson-sharing.

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Table of contents

Executive summary **6**

Introduction **12**

Carbon pricing initiatives around the world 13

Carbon pricing in the public policy and private sector landscape 15

How to read this report 16

Defining the role of an emissions trading system **18**

Primacy of trading systems in reducing emissions 19

Choosing the type of emissions cap 24

The long-term perspective: policy predictability 25

Key lessons 27

Guiding questions for policy makers 27

Managing interactions with wider energy transition policies **29**

Responsiveness of an emissions trading system helps manage policy interactions 30

Alignment of emissions trading systems with national mitigation strategies 35

Key lessons 37

Guiding questions for policy makers 38

Tailoring emissions trading system to power market structures **39**

Power market structure can affect emissions trading system effectiveness 39

Adapting the design of the emissions trading system to power market structures 40

Key lessons 46

Guiding questions for policy makers 46

Facilitating low-carbon transitions in industry through emissions trading systems **47**

Emissions trading systems and industry: Context and objectives 47

Competitiveness and carbon leakage concerns for industry 48

Key lessons 54

Guiding questions for policy makers 54

Conclusions **55**

Defining the role and function of emissions trading systems 55

Managing emissions trading system interactions with wider energy transitions policies 56

Tailoring emissions trading systems to power market structures 56

Facilitating low-carbon transitions in industry through emissions trading systems 56

Abbreviations and acronyms **58**

List of figures

Figure 1.1 Emissions trading systems (ETS) and hybrid ETS operational or scheduled for implementation, 2020, by emissions covered 14
Figure 2.1 Estimated cumulative emissions reductions due to carbon pricing in Canada compared with other federal policies 21
Figure 2.2 Estimated cumulative greenhouse gas reductions of California's cap-and-trade system compared with those of other state mitigation policies (2021-30) 23
Figure 5.1. Phasing down free allocation as transitional assistance over time in favour of allowance auctioning 53

List of tables

Table 1.1 Direct carbon pricing mechanisms 13

List of boxes

Box 3.1 Emissions trading system experiences in the face of unforeseen exogenous economic downturns 32

Executive summary

Carbon pricing is a valuable instrument in the policy toolkit to help accelerate clean energy transitions. By providing a clear signal that GHG emissions entail a cost to society, carbon pricing can stimulate investments in low-carbon technological innovations, foster multilateral co-operation and create synergies between energy and climate policies. Carbon pricing instruments comprise carbon taxes and emissions trading systems. Carbon taxes consist of direct taxation on emissions. Emissions trading systems are market-based instruments that create incentives to reduce emissions where these are most cost-effective. In most trading systems, the government sets an emissions cap in one or more sectors, and the entities that are covered are allowed to trade emissions permits.

Emissions trading systems expose emitters to the external costs of emissions in the most flexible and least costly way. The design of such a system needs to take into account local contexts and regulations, as well as interlinkages with other policy priorities in each jurisdiction. This report analyses real-world experiences of the design and implementation of trading systems in different jurisdictions around the world. The analysis considers the diversity and complexity of the interlinkages of energy policies, energy targets and energy system structures, and it identifies key issues and common challenges that jurisdictions face when considering the establishment of a new trading system. In addition, common challenges in trading system design and implementation for the power and industry sectors are analysed. Key lessons and guiding questions for policy makers are provided to help with developing and implementing emission trading systems.

Carbon pricing initiatives are spreading throughout the world. Over 60 countries, cities, states and provinces have implemented or are planning to implement carbon pricing schemes, with a fairly balanced distribution between emissions trading systems and carbon taxes. When the trading system in China's power sector starts operating, carbon pricing initiatives will cover 20% of global emissions. Jurisdictions in Asia and the Americas are now the driving forces for new carbon pricing initiatives.

Role of an emissions trading system

In defining the role of a trading system, policy makers could reflect on what the system is designed for and expected to do. For example, an emissions trading system could be intended to drive emissions reductions as its principal role, or provide a backstop for other policies. In practice the system may function somewhat differently than intended, such as a means to raise revenue for investing in further emissions reductions projects or in sectors other than those covered by the system. Throughout the process of defining the role of an emissions trading system, policy makers could also reflect on other expected outcomes of the system, such as changing business practices or shifting investment decisions.

Primacy of trading systems in reducing emissions

Jurisdictions have implemented emissions trading systems with varied ideas of the role they will play in reducing emissions reductions. In some cases, trading systems are seen as the principle means of achieving emissions reductions, in others as a backstop measure to ensure reductions in case other policies do not deliver. The effectiveness of an emissions trading system should be evaluated based on its objective. In the longer term, gradually increasing the stringency of a trading system's cap would contribute more to emissions reductions.

Choosing the type of emissions cap

Policy makers can set the cap of an emissions trading system in different ways, and this choice affects the predictability of emissions reductions. The most common ways to set a cap are through an absolute emissions reduction target (or "mass-based" cap) or an emissions target set relative to output ("intensity-based" target). Mass-based caps provide certainty on emissions reduction performance. Intensity-based targets can increase absolute emissions under certain conditions, but they allow more flexibility in adjusting to changes in economic conditions.

The long-term perspective: Policy predictability

When designing an emissions trading system, policy makers may want to consider what role the system would play in the jurisdiction's long-term strategy, as well as how to ensure long-term policy predictability for the emissions trading system. For the private sector, long-term policy predictability is important for guiding investment decisions as it enables management of carbon price expectations.

Guiding questions for policy makers on the role and function of a new emissions trading system

- What is the intended role of the emissions trading system?
- What is the emissions cap design most suited to the trading system's role and function?

- How could the emissions trading system evolve to expand greenhouse gas and sectoral coverage, and strengthen incentives and emission cap stringency?
- What role will the trading system play in the jurisdiction's long-term emissions reduction strategy?
- What is the best way to best ensure long-term policy predictability for the emissions trading system?

Managing interactions with wider energy transition policies

Carbon pricing policies are implemented alongside a wide mix of other policies that promote clean energy transitions, such as air pollution control, renewable energy deployment, energy conservation, economic restructuring, and energy sector and power market reforms. It is important to understand the interaction of an emissions trading system with these other policies because it can accelerate or hinder clean energy transitions.

Emissions trading systems can be responsive

Mechanisms that promote both flexibility and certainty of a carbon price are fundamental to ensure that emissions trading systems can respond to unexpected or unintended impacts of domestic companion policies and other external factors, such as an economic crisis. Experiences from emissions trading system responses to the 2008 global financial crisis can enable us to understand market dynamics in the face of unexpected exogenous economic downturns. They can also help us to cope better with new crises, such as the global economic crisis induced by the Covid-19 pandemic in 2020. Policy makers can rely on several mechanisms to enhance the flexibility and certainty of the carbon price in an emissions trading system, which were not used during the 2008 crisis. Automatic triggers for such mechanisms further enhance predictability and minimise the need for discretion by policy makers.

Aligning emissions trading systems with national mitigation objectives

An emissions trading system is generally embedded within higher-level greenhouse gas mitigation objectives, including those expressed within each country's nationally determined contribution (NDC) to the Paris Agreement on climate change and long-term mitigation strategies. Some jurisdictions have worked to align the emissions reductions trajectory and cap of their emissions trading system with these mitigation objectives, though in different ways. Setting the emissions trading systems cap with a top-down approach can help better align the trading system with the national mitigation objectives.

Guiding questions for policy makers on the interactions of emissions trading systems and other policies:

- How will the emissions trading system interact with other domestic companion policies?
- What mechanisms can be used to promote emissions trading system flexibility and certainty over time?
- What is the best way to align the emissions trading system with national mitigation objectives?

Tailoring emissions trading systems to power market structures

As a major source of emissions in most jurisdictions, the power sector is included in virtually all operating emissions trading systems around the world, as well as in jurisdictions that are developing or considering developing such systems. In theory, the cost of an emissions trading system allowances creates various levels of incentives for the power sector to reduce emissions, for example by investing in less carbon-intensive power supply, reducing electricity demand or changing the merit order of electricity dispatch in favour of low-carbon power supply.

In practice, however, power markets are often fully or partially regulated, and some power market structures can weaken the carbon pricing signal, reducing the emissions trading system's effectiveness. This raises questions about the compatibility of trading systems with energy market regulation constraints. It is essential for the design of an emissions trading system to match local circumstances to generate the most effective carbon price signals.

Adapting the design of emissions trading systems to power market structures

Several methods can be used to better reflect the system's carbon price signal while taking into consideration existing power market regulations. These methods include consignment auctions, covering indirect emissions, consumption charges, climate-oriented dispatch rules, carbon investment boards and pricing committees. Further research and experience will improve understanding of the effectiveness of these options.

Guiding questions for policy makers on emissions trading systems and the power sector

- How can the emissions trading system design align with the local power market structure?
- How can the carbon price be reflected in the capacity expansion planning, power plant dispatch decisions and end-use prices?
- In markets where electricity supply is liberalised but heat supply remains regulated, how should the carbon pricing be allocated to the electricity and heat output of co-generation plants?

Facilitating low-carbon transitions in industry through emissions trading systems

How the industrial sector is included in an emissions trading systems needs careful consideration. Policy makers should estimate the potential greenhouse gas mitigation potential available in industry and more generally reflect on the role of industry as a functional sector for the wider decarbonisation of the economy. At the same time, it is important to estimate the potential economic impact that an emissions trading system would have on the various players in the industrial sector.

Competitiveness and carbon leakage concerns for industry

Introducing an emissions trading system in the industrial sector could in theory affect economic competitiveness, leading for example to lower investments in industry and job losses. It could also affect the economic competitiveness of internationally traded goods. Industrial production (and associated pollution) might also move to jurisdictions with less stringent environmental controls or emissions reductions requirements, a phenomenon known as "carbon leakage". All current emissions trading systems address these concerns by including features aimed at reducing the extra costs imposed on some industries.

It is therefore important to have a transparent means of identifying industries with the highest risks of carbon leakage and competitiveness concerns, estimating the associated costs. Free allocation of allowances has been widely used by various emissions trading systems as a way to address competitiveness and carbon leakage concerns for the industrial sector. There exist different design methodologies to allow free allocation of allowances, which require varying degrees of inputs. The choice of the allocation method is important, as this would determine the amount of allowances that the industrial facility would receive and would impact its emissions trading system obligations. Gradually phasing down free allocation in favour of auctioning can help correct potential market distributional distortions, generate revenue, and increase the mitigation effectiveness of trading systems.

Guiding questions for policy makers on emissions trading systems and industry

- How can competitiveness concerns and the risks of carbon leakage be accurately identified for different industries?
- How can allocation decisions balance near-term competitiveness concerns with ensuring cost efficiency and distributional equity over time?
- In which industries are there sufficient data to develop benchmarks?

Introduction

Carbon pricing is a valuable instrument in the policy toolkit to promote clean energy transitions, characterised by its versatility and flexibility. The design and application of carbon pricing mechanisms very much depends on local circumstances. Carbon pricing internalises societal costs of greenhouse gas emissions. If the carbon price is well reflected in relevant prices of goods and services, it can influence decisions in the short term (e.g. consumer behaviour, dispatch of cleaner power plants), medium term (e.g. decommissioning of high-carbon assets) and long term (e.g. investment in long-lived infrastructure). Confidence in rising future carbon prices can also be a strong driver for investment in clean energy technology research, development and deployment. A well-designed carbon price, therefore, operates through means that are difficult to replicate by any other single policy tool.

Carbon pricing systems are increasingly attractive for subnational, national and supranational jurisdictions as they do not dictate by how much *individual* entities reduce emissions; instead, they send economic signals to let emitters decide whether to change their business logic towards reducing emissions or continue emitting and pay the price. Carbon pricing can stimulate technological and market innovation. It can also be a significant source of public revenues. These could be used to fund or finance climate activities or supportive measures that can offset the cost burden on the most vulnerable consumers and firms. In addition, effective carbon pricing can transform private-sector business models by creating an incentive to integrate the price of carbon in operations and strategic decisions. The carbon price becomes a tool to identify potential risks and opportunities stemming from concerted policy action to mitigate climate change.

Carbon pricing instruments comprise carbon taxes and emissions trading systems. When optimally defined, both approaches have the same objective and impact.[1] More recently, hybrid systems with elements of carbon taxes and emissions trading have emerged as ways of best meeting national circumstances.

[1] Goulder L. and A. Schein (2013), Carbon Taxes versus Cap and Trade: A Critical Review.

Table 1.1 Direct carbon pricing mechanisms

Instrument	Functioning	Features
Carbon taxes	Direct taxation on emissions, e.g. a direct carbon dioxide (CO_2) tax; input or output charges	• Creates a predictable carbon price • Difficult to estimate *ex-ante* the amount of emissions that will be reduced
Emissions trading systems	Market-based instruments that create incentives to reduce emissions where these are most cost-effective, allowing the market to find the cheapest way to meet the overall target	• Carbon price fluctuates • Allows control of the amount of emissions in absolute or intensity terms, and hence can provide certainty on an agreed-upon emissions reductions trajectory.

This paper focuses on emissions trading systems, which are market-based instruments that create incentives to reduce emissions where these are most cost-effective, allowing the market to find the cheapest way to meet the overall target. Policy makers can set a cap for an emissions trading system that would determine the maximum amount of greenhouse gases that can be emitted in the sectors covered by the trading system. The cap can be set in different ways, such as an absolute emissions reduction target (also called a "mass-based" cap) or a relative emissions reduction target (often called a "rate-based" or "intensity-based" cap; see section "Defining the role of an emissions trading system").

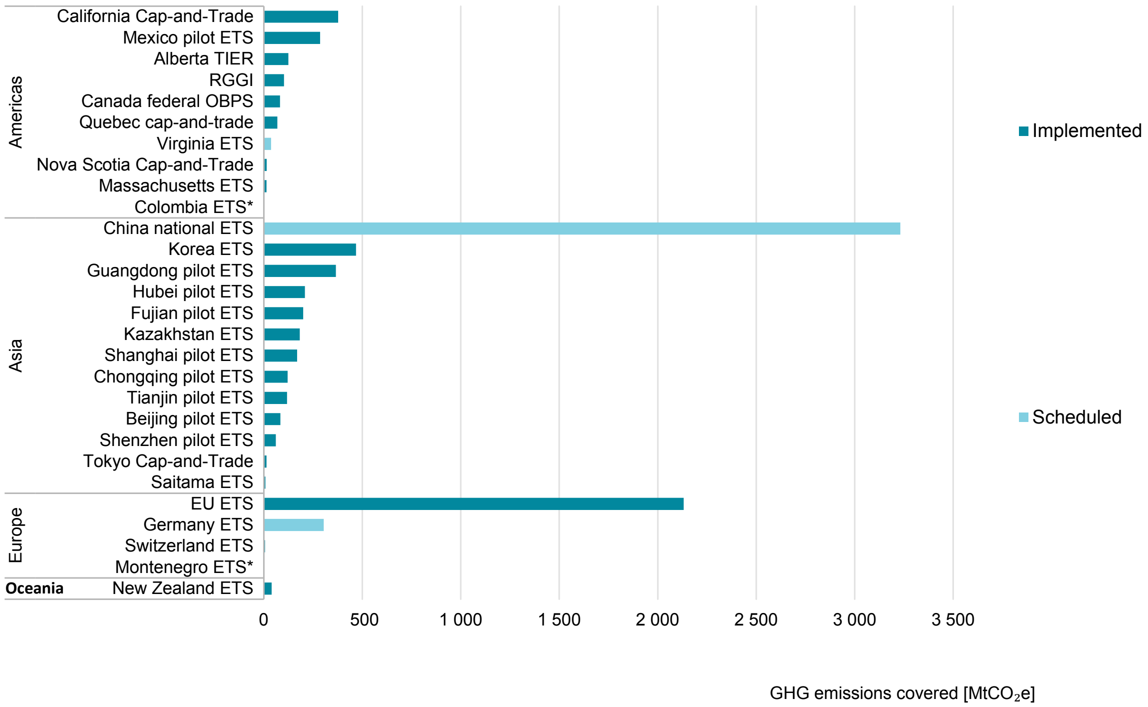
Carbon pricing initiatives around the world

As of April 2020, there were 61 carbon pricing initiatives around the world already implemented or planned for implementation, including 31 ETS and 30 carbon tax initiatives. Carbon prices vary widely from scheme to scheme, from less than USD 1 per tonne of CO_2 equivalent (tCO_2-eq) to USD 127/tCO_2-eq (Sweden Carbon Tax). Carbon prices have increased in some regions in recent years, but only 5% of current carbon prices around the world are at levels consistent with emissions pathways that fulfil the Paris Agreement targets and less than 4% are at levels consistent with the emissions pathways of the IEA Sustainable Development Scenario.

Jurisdictions in Asia and the Americas are now the driving forces for the development of new carbon pricing initiatives. Eight new operational initiatives have been launched in the Americas in the past three years: carbon taxes or hybrid systems for

Alberta, Chile, Colombia, Argentina and Canada at the federal level, and emissions trading systems in Mexico, Massachusetts and Washington State. In Asia, carbon pricing initiatives have been implemented or are scheduled for implementation in China, Indonesia, Japan, Kazakhstan, Korea, Philippines, Thailand, Singapore and Viet Nam, alongside various subnational jurisdictions. Implementing a carbon price initiative in these regions requires innovation in policy design because their economies are growing and restructuring rapidly, creating significant challenges for determining the emissions cap and price stabilisation (in the case of an emissions trading system) or the optimal price level (for a carbon tax).

Figure 1.1 Emissions trading systems (ETS) and hybrid ETS operational or scheduled for implementation, 2020, by emissions covered



* Emissions trading systems scheduled for implementation but estimates of covered emissions unavailable.

Notes: RGGI = Regional Greenhouse Gas Initiative (United States). TIER = Technology Innovation and Emissions Reduction Regulation. OBPS = Output-Based Pricing System (Canada).

Source: World Bank data.

As of April 2020, there were 23 emissions trading systems covering around 9% of global emissions:

- One supranational system: the European Union Emissions Trading System (EU ETS).
- Five national systems: in Kazakhstan, Korea, Mexico, New Zealand and Switzerland.

- Ten systems at regional, provincial or state level: in Alberta, California, Fujian, Guangdong, Hubei, Massachusetts, Nova Scotia, Quebec, the Regional Greenhouse Gas Initiative (RGGI) in the United States and the federal Output-Based Pricing System (OBPS) applied to certain provinces and territories in Canada.
- Seven systems at city level: in Beijing, Chongqing, Saitama, Shanghai, Shenzhen, Tianjin and Tokyo.

In addition, new emissions trading systems are being planned or considered by many jurisdictions around the world. Among these, the national emissions trading system of the People's Republic of China (hereafter "China"), announced at the end of 2017, aims to start operation in 2020, becoming the world's largest carbon market. However, the Covid-19 outbreak may delay the launch of China's emissions trading system and affect other carbon pricing systems. A national emissions trading system will be launched in Germany in 2021, complementing the EU ETS and covering heating and transport fuels.

Carbon pricing in the public policy and private sector landscape

Carbon pricing instruments are often implemented within complex energy and climate policy landscapes that serve many policy objectives. If well designed and implemented, carbon pricing can bring environmental and social benefits and help governments and enterprises to find cost-effective emissions reduction methods. A price on carbon can affect operation costs, encourage stakeholders to lower emissions and spur technological innovation. In addition to reducing emissions, carbon pricing instruments can facilitate the achievement of complementary energy and environmental goals, such as conserving energy and reducing air pollution. For example, the emissions trading system pilot in Beijing and the carbon tax in Chile are also significantly reducing local air pollution.

Cross-border policy co-operation to implement or harmonise carbon pricing instruments in different jurisdictions is also possible. The EU ETS is the largest international regional carbon pricing initiative. It has gradually extended its geographic coverage over the years and currently operates in 31 countries. The European Commission promotes international co-operation beyond the boundaries of the EU ETS to link systems and build capacity. A linking agreement between the EU and Swiss emissions trading systems has been finalised. The European

Commission has also established strong bilateral co-operation programmes with China and Korea on designing and implementing emissions trading systems.

In the United States, RGGI is the largest regional emissions trading system, operating in ten states. California, Québec and Ontario[2] established the first North American regional emissions trading system through the Western Climate Initiative. The multilateral process undertaken within the United Nations Framework Convention on Climate Change (UNFCCC) negotiations has provided considerable incentives for international carbon market development, initially through the Kyoto Protocol flexible mechanisms and more recently through Article 6 of the Paris Agreement, which is still under negotiation. Collaborative research on emissions trading systems as well as initiatives to link systems among government, the private sector and civil society are likely to increase.

The implementation of emissions trading systems in certain jurisdictions may also have supported the application of internal carbon pricing for corporate investment decisions. The private sector is increasingly using carbon pricing as an indicator to quantify the financial implications relating to energy transition risks, as part of their climate risk management strategies. In particular, the Task Force on Climate-related Financial Disclosures (TCFD) recommends that organisations provide their internal carbon prices as part of the metrics used to assess climate-related risks and opportunities, in line with their strategy and risk management processes. Private companies, organisations and investors are also using internal carbon pricing more and more as a planning tool to help identify revenue opportunities and risks, as an incentive to reduce costs through energy efficiency, and as guidance for capital investment decisions. The level, distribution, variation and trends of internal carbon prices could become key drivers for companies to change development plans, investment philosophies and climate governance.

How to read this report

This report presents international experience in developing and implementing emissions trading systems, focusing on four key issues:

- Section 1 explains the importance of defining the role and function of an emissions trading system.

[2] On 3 July 2018, the government of Ontario ended its climate plan, including its cap-and-trade pollution pricing system. The province of Nova Scotia joined in 2018 but is not yet linked to the Québec and California market.

- Section 2 explores the interactions of emissions trading systems with wider energy transition policies and sets out strategies to manage these interactions.
- Section 3 outlines experiences on tailoring emissions trading systems to power market structures.
- Section 4 highlights the role of emissions trading systems in facilitating low-carbon transitions in industry.

Defining the role of an emissions trading system

A fundamental concept for policy makers in designing an emissions trading system is its role. The role concerns what the system is designed for and expected to do. For example, an emissions trading system could be intended to drive emissions reductions as its principal role, or provide a backstop for other policies. In practice the system may function somewhat differently than intended. For example, the system could end up functioning as a means to raise revenue for investing in further emissions reductions projects or in sectors other than those covered by the system. Defining the role offers a chance for policy makers to consider the expected outcomes of the system, such as changing business practices and shifting investment decisions.

In an ideal world, a carbon price would play the central – if not singular – role in driving cost-effective emissions reductions. However, in the real world the role of the carbon price is limited by three main factors. First, jurisdictions face constraints in implementing carbon prices at a level that would send a strong signal throughout the economy, including challenges associated with increasing final energy prices. Second, jurisdictions have multiple objectives that overlap and co-exist with emissions reductions within the energy transitions agenda, such as economic development (including growth of low-carbon sectors), energy access, air quality improvement, energy security and energy affordability. As a result of various constraints and objectives, governments develop packages of policies, of which carbon pricing may be only one (though important) element. A third limitation is that in the real world, market failures make it difficult for a carbon price signal to get through and play the role it is meant to.

In many jurisdictions, the role and function of the emissions trading system have also evolved. The function of a system can change as its design elements alter, such as changes in the cap stringency, carbon price levels, sectoral and gases coverage, and allowance allocation method.

For instance, in most trading systems a pilot phase generally precedes the actual trading of allowances. This helps to set up emissions measurement, reporting and verification systems, establish the allowances exchange platforms, simulate trading, and build capacity and buy-in of various stakeholders. Such a phase was used for example by the Korean emissions trading system: the explicit role of its first phase was to build knowledge and experience among stakeholders. In subsequent phases, its role focused on driving progressively more emissions reductions.

Primacy of trading systems in reducing emissions

Jurisdictions implementing an emissions trading system have done so with varied conceptions of the role it will play in reducing emissions. In some cases, the system is seen as the principle means of achieving emissions reductions. In others, it is a backstop measure to ensure reductions in case other policies do not deliver.

The role and function of the EU ETS: Is meeting the emissions cap sufficient?

The EU ETS, launched in 2005, was initially designed as a primary means of meeting the European Union's 2012 Kyoto Protocol target in a cost-efficient manner while minimising negative impacts on economic growth and employment. Subsequently, the European Union developed sequential emissions reductions targets for 2020 and 2030, with the trading system still intended to be a "cornerstone" for meeting these targets, as it covers approximately 45% of EU emissions. The EU ETS will also play a central role in the European Union's long-term mitigation goal of reaching climate-neutrality by 2050.

The EU ETS has achieved its stated goal of meeting targeted emissions levels, with a reduction in emissions from fuel combustion in the power sector playing the biggest role. However, evidence suggests it has not been the primary driver of emissions reductions in the sectors that it covers, due to the over-allocation of allowances and resulting weak price signal (i.e. low allowance prices). Nevertheless, the allowance costs have been high enough to favour coal-to-gas switching in the power sector before 2011 and since 2016. The low allowance prices were caused by several factors, such as the unexpected low demand for allowances from emissions reduced by energy efficiency and renewable energy policies, the 2008-09 economic recession, and the oversupply of certified emissions reduction credits from the Clean Development Mechanism allowed in the emissions trading system to meet the Kyoto Protocol targets. Recent reforms aimed to address some of these challenges, such as making certified emissions reduction credits ineligible for use for compliance in the EU-ETS (see section "Managing interactions with wider energy transition policies"). Towards 2030, renewable energy and energy efficiency policies in EU member states may continue to contribute greatly to meeting the 2030 target for reducing emissions in sectors covered by the EU ETS.

Overall, views differ on the ultimate success of the EU ETS, depending on how its role is considered. The system achieved the objective of reaching the level of emissions reductions fixed by its emission cap. However, it is difficult to directly attribute the emissions reductions to the EU ETS alone, as other policies in each sector covered by the system may have contributed. However, policy makers considered that just meeting the emissions cap was insufficient; recent revision and reform of the system reveals the view that its role should also be to drive more fundamental changes in the economy, through both a stronger carbon price signal and use of revenue. Low allowances prices meant a weak price signal has failed to drive significant technology innovations and deeper emissions reductions. This experience underscores the importance of defining the primary objective of an emissions trading system: to achieve an emissions reductions level, to create a carbon price signal, to drive structural changes in the economy, or a combination of these.

The Canadian perspective: Federal carbon pricing as a backstop for provincial carbon pricing

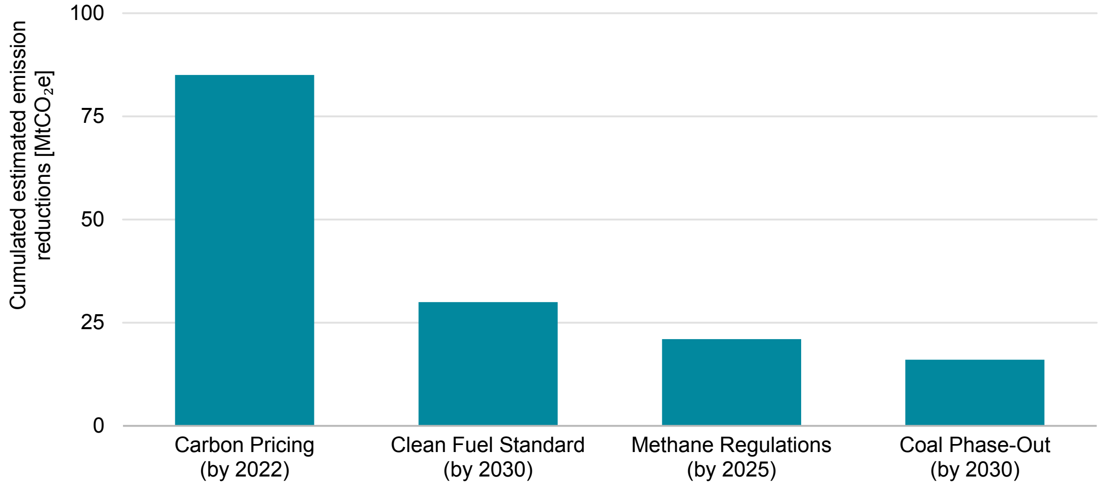
Canada is a large country, with regionally diverse energy resources and levels of economic development, which has implemented a national carbon pricing policy. Canada is a decentralised federation, where provinces and territories have a high level of autonomy and responsibility in policy decisions, including those in relation to environment and energy. These subnational policies have an impact on the federal government's ability to meet its national policy goals and commitments, including Canada's nationally determined contribution to the Paris Agreement.

In its Greenhouse Gas Pollution Pricing Act, Canada's federal government developed a backstop carbon pricing policy that prescribes a minimum carbon pricing benchmark (in terms of stringency and coverage), but allows subnational governments flexibility to determine the instrument (e.g. carbon tax or emissions trading system). Any jurisdiction not meeting the benchmark will follow the backstop policy, consisting of a carbon tax for the transportation and buildings sectors (referred to as the "fuel charge" component) and an output-based allocation system for electricity and industry. The backstop policy can also serve to supplement existing subnational policies that do not meet the benchmark.

The benchmark for subnational carbon pricing is defined as CAD 20/tCO_2-eq by 2019, rising to CAD 50/tCO_2-eq by 2022. In terms of coverage, the subnational carbon price has to cover all fuels with limited sectoral exemptions, such as on-farm fuel use. If the carbon price takes the form of an emissions trading system, it must define a cap at least as ambitious as Canada's 2030 nationally determined contribution target and define annual and declining caps to meet the emissions reductions equivalent of the carbon price determined through modelling.

The implementation of the policies of the federal Greenhouse Gas Pollution Pricing Act are estimated to reduce 80-90 $MtCO_2$-eq by 2022 across all jurisdictions. Notably, this estimate includes the impact of provincial carbon pricing policies that existed before implementation of the federal policy but that may be modified to meet the benchmark. While carbon pricing is a critical element of Canada's clean growth and climate plan, it is not designed to be the only policy measure in the plan to reduce greenhouse gas emissions, as this would require a very high carbon price. Complementary policies and measures, such as the Clean Fuel Standard, methane regulations and coal phase-out, are important to target emissions that are not covered by carbon pricing and can help make carbon pricing more effective.

Figure 2.1 Estimated cumulative emissions reductions due to carbon pricing in Canada compared with other federal policies



Source: Environment and Climate Change Canada.

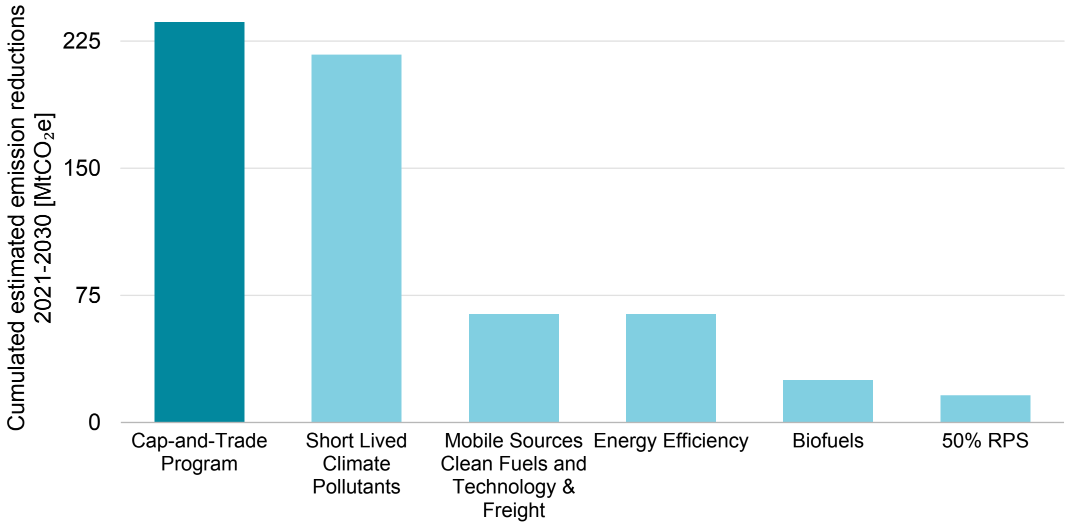
A key strength of this approach is that it ensures a minimum carbon price benchmark across the country, while allowing subnational governments to design and manage their own carbon pricing policies. However, the primacy of the implemented carbon pricing system for reducing emissions may vary from province to province. Some provinces have backed away from previous carbon pricing systems or have not implemented these. In such cases, the federal government has applied the backstop system in whole, or for some regions, only the fuel charge or industry component. This effect was difficult to anticipate *ex-ante* but has shown that the backstop system has worked to ensure the intended emissions reductions. As of mid-2020, the backstop federal "fuel charge" tax applies in Alberta, Manitoba (which has plans for its own system), New Brunswick, Nunavut, Ontario, Saskatchewan and Yukon. The component of the federal pricing policy for industry and electricity production applies as of mid-2020 in Alberta, Manitoba, Nunavut, Ontario, Prince Edward Island, Saskatchewan and Yukon. In Ontario, Alberta and New Brunswick, previous provincial governments had conceived carbon pricing policies, but subsequently elected provincial governments scrapped or refused to implement them.

The Canadian example reflects a trade-off between regional goals and economic efficiency at the national level, and shows how the role and function of carbon pricing systems can vary from jurisdiction to jurisdiction at the subnational level as well as from country to country. Since most provinces are encouraged to develop their own carbon pricing systems rather than have the federal backstop applied, they will have the flexibility to tailor their policy design to the intended role of their carbon pricing system or to adopt the federal systems if it suits them.

California's cap-and-trade: Backstop system alongside other mitigation policies

California's cap-and-trade system is intended as a backstop to other policies that are expected to deliver the bulk of emissions reductions towards the state's targets. The California Air Resources Board (CARB) estimates that in the period 2021-30 the cap-and-trade system and other key low-carbon policies can reduce emissions by 621 $MtCO_2$-eq. Of these, the cap-and-trade is expected to reduce 236 $MtCO_2$-eq and the other prescriptive mitigation policies the remaining 385 $MtCO_2$-eq. These other measures include the Renewables Portfolio Standard, energy efficiency measures, the Low Carbon Fuel Standard, vehicle emissions standards and measures to address short-lived climate pollutants.

Figure 2.2 Estimated cumulative greenhouse gas reductions of California's cap-and-trade system compared with those of other state mitigation policies (2021-30)



Note: RPS = Renewables Portfolio Standard.

Source: CARB.

However, these other mitigation policies could underperform relative to expectations. If this happens, the cap-and-trade system is designed as a backstop to ensure that the overall goal to reduce 621 $MtCO_2$-eq by 2030 is achieved, by filling the gap in the emissions reductions over and above what is achieved by the prescriptive measures. In light of this, a low initial carbon price in the cap-and-trade system was desirable from a political standpoint, to avoid political controversy and enhance the system's long-term durability.[1] Therefore, despite low allowance prices, the primary role of California's cap-and-trade system is to maintain covered emissions below a cap representing a known level of emissions reductions that can be counted upon, should other policies fail to deliver.

The emissions cap of California's system was set to decline by around 3% per year until 2020, then by 5% per year until 2030, and then until 2050 by a factor calculated by a formula set in the Cap-and-Trade Regulation.

The perspective of RGGI: delivering on policy goals other than reducing CO_2 emissions

RGGI was the first mandatory emissions trading system in the United States. As of April 2020, RGGI covers ten states in the Midwest and Northeastern United States:

[1] Bang, G., D. Victor, and S. Andresen (2017), California's Cap-and-Trade System: Diffusion and Lessons.

Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island and Vermont. The system's composition has evolved over time, with New Jersey withdrawing in 2011 and re-joining in 2020. Virginia is set to join by the end of 2020 and Pennsylvania by 2022.

RGGI's formal aim is to reduce CO_2 emissions from fossil fuel electric generating units. The initial 2009-13 cap was set above actual emissions, and despite downward revisions of the cap in 2014 by 45%, the system has had minimal impact as a direct driver of CO_2 emissions reductions. Other policy drivers and factors are likely to have had a greater impact. These include the introduction of state renewable portfolio standards, coal-to-gas switching due to market conditions, and overall declining electricity demand. The cap has not been significantly tightened up to this point, reflecting RGGI's role in supporting overall power decarbonisation alongside other policies. RGGI may have driven emissions reductions indirectly, through revenue reinvestment in energy efficiency, renewable energy and other low-carbon projects.[2] Evidence also suggests RGGI has influenced the revenues of power generators, favouring those using low-carbon sources. After 2020, the cap will decline linearly, resulting in a 30% reduction from 2020 to 2030.

Despite the limited CO_2 impact to date, RGGI has delivered on other important policy goals for the participating states, such as creating a stable source of revenue (through allowances auctions and price floors for allowances) and improving air quality. The economic gains resulting from reinvestment of auction revenues have been estimated at USD 1.4 billion between 2015 and 2017. The public health benefits of RGGI due to improved air quality were estimated at USD 5.7 billion between 2009 and 2014.

Choosing the type of emissions cap

Policy makers can set the cap of an emissions trading system in different ways, and this choice affects the predictability of emissions reductions. One way to set a cap is through an absolute emissions reduction target (also called "mass-based" target). This cap would fix a maximum amount of emissions in the emissions trading system expressed in absolute form (e.g. in tCO_2-eq); only one variable (the quantity of emissions reductions) is concerned. Mass-based caps provide certainty on the emissions reductions performance of an emissions trading system, and are applied

[2] Murray, B., P. Maniloff and E. Murray (2014), Why Have Greenhouse Emissions in RGGI States Declined? An Econometric Attribution to Economic, Energy Market, and Policy Factors.

in the majority of existing systems, including California, the European Union, Korea, RGGI and the Tokyo Metropolitan Government.

Another possibility is to set an intensity cap, or a relative emissions reduction target (often called a "rate-based", "output-based" or "intensity-based" target). This target is expressed in relative form, such as the emissions reductions per unit of output (e.g. tCO_2-eq/MWh). In this case, two or more variables are concerned, and the target is a level of emissions intensity that a given installation must remain below. With an intensity-based target, absolute emissions may rise. Intensity-based targets are selected where there is greater uncertainty about future levels of output and demand growth, which is the case in developing economies. They can allow installations to adjust more flexibly to changes in economic conditions. Intensity-based targets are therefore a means of applying an environmental constraint to economic activity in a flexible manner. Intensity-based systems currently exist in the Chinese emissions trading system pilots and the Canadian federal carbon pricing backstop policy (applied to large final emitters). China has also proposed an intensity-based target for its national emissions trading system.

Finally, policy makers can also choose not to set a cap if this facilitates system function. For instance, the New Zealand emissions trading scheme was designed without a domestic cap because it had full links to international carbon markets and was not intended to define a limit for domestic emissions (see also the section Alignment of emissions trading systems with national mitigation). The lack of a cap makes it hard to predict *ex-ante* the emissions reductions of the sectors covered by the system. However, not setting a cap accommodated one of the functions of the New Zealand emissions trading scheme, originally intended to provide flexibility to accommodate carbon sequestration from forestry activities and allow the use of international carbon credits from the Kyoto Protocol mechanisms. In 2019 New Zealand reformed its emissions trading scheme given its revised role: to support implementation of its nationally determined contribution under the Paris Agreement. As such, it has an absolute cap based on a provisional emissions budget for the 2021-25 period.

The long-term perspective: policy predictability

Another aspect that policy makers may want to consider when designing an emissions trading system is what role the system would play in the jurisdiction's long-term strategy, and therefore how to ensure long-term predictability of the policies underlying the system. For the private sector, the long-term policy predictability of an emissions trading system is important for guiding investment decisions because it enables management of carbon price expectations (discussed in the section "Managing interactions with wider energy transitions policies"). This is particularly relevant for capital-intensive sectors with long-term assets, such as the energy and industrial sectors.

Long-term policy predictability in Korea's emissions trading system

In Korea's emissions trading system, long-term policy uncertainty was stated as a key factor contributing to low liquidity (i.e. a low level of trading) at the end of the first commitment period (2015-17). Companies had low visibility on emissions trading system details for the coming years. To address these concerns, long-term policy predictability is now ensured through two complementary plans. The first is a ten-year Master Plan, which establishes guiding principles and considers the emissions trading system within the context of other policies and in meeting longer-term emissions reduction targets. This provides clarity to market participants on the future long-term existence of the emissions trading system. The second is a five-year Allocation Plan, which outlines the details of the emissions trading system, including the cap and allocation method for each compliance period. This provides market participants with all necessary technical details at least six months before the start of the compliance period.

The EU ETS in the long-term mitigation strategy

The European Union clearly provided long-term certainty that the EU ETS will be central in EU climate governance, i.e., it will be a key element of the long-term mitigation strategy goal of reaching climate neutrality by 2050. The EU system also provides visibility on long-term emissions reductions pathways to mid-century, based on annual linear reduction factors that will lower the cap.

Furthermore, the EU system defines rules per compliance period; each period has been longer than the last, with Phase 3 lasting eight years and Phase 4 lasting ten years. These longer compliance periods have provided greater certainty to the private sector with regard to the system's rules. The details of each compliance period were systematically released within good lead times ahead of the compliance period start. For instance, reforms for Phase 4, which begins in 2021, were agreed in 2018.

In addition, the EU ETS introduced some mechanisms, such as the Market Stability Reserve and other cancellation provisions for surplus allowances, to provide a reasonable supply-demand allowances balance and further long-term policy predictability.

Key lessons

- Clearly defining the intended role of an emissions trading system is fundamental to allow the initial design of system characteristics to be tailored to its objectives.
- The role of an emissions trading system can evolve over time, and clarity on this role can facilitate the participation of market players in response to the policy.
- The effectiveness of an emissions trading system should be evaluated based on its objective, and expectations of its outcomes should be made explicit. The system can be intended as the primary driver of emissions reductions or act as a backstop to other policies; it can be considered successful if emissions remain below a specified level, or if it leads to changes in investment or operations.
- The choice of the type of cap depends on the intended role of the emissions trading system, and the relative importance to policy makers of predictable emissions reductions. Absolute mass-based caps provide certainty on the emissions reductions performance of a system. Intensity-based caps offer flexibility in the face of uncertain economic output, but less predictability of emissions reductions.
- Ensuring long-term policy predictability of the emissions trading system is important for the private sector to guide investment decisions.

Guiding questions for policy makers

- **What is the intended role of the new emissions trading system?** Is it to prioritise emissions reductions, to create a price signal, to enhance efficiency of economic decisions or to drive a shift in investment decisions?
- **What is the most suited emissions cap design for the new emissions trading system considering its role?** How important is it for the new emissions trading system to ensure predictability of emissions reductions over providing flexibility for economic outputs?

- **How could the emissions trading system evolve** with regard to expanding greenhouse gas and sectoral coverage, and strengthening incentives and emission cap stringency? For example, will the system evolve from being intensity-based to having an absolute emissions cap?
- What role will the emissions trading system play in the jurisdiction's **long-term mitigation strategy**?
- What is the best way to ensure **long-term policy predictability** for the emissions trading system?

Managing interactions with wider energy transition policies

Carbon pricing policies are implemented alongside a wide mix of other companion policies that aim to drive clean energy transitions. The interaction of an emissions trading system with these policies can accelerate or hinder clean energy transitions, depending on the role the system is meant to play within the policy mix, and the impact other policies may have on its functioning. Other policies can support and complement an emissions trading system by:

- Overcoming market barriers that make carbon price signals less effective (e.g. non-financial barriers to energy efficiency uptake).
- Pursuing environmental policy goals beyond emissions reductions (e.g. decreasing air pollution).
- Promoting long-term technology changes that may not reduce emissions in the short term but are needed to stay on track for the long-term clean energy transition (e.g. investing in storage technologies to support integration of high shares of renewables).
- Enabling business and investment decisions in favour of low-carbon assets alongside an effectively functioning emissions trading system, where the carbon price is not sufficiently high, visible or predictable to shift action (e.g. renewable energy support policies).

However, companion policies can also have unintended effects on the carbon price and functioning of an emissions trading system. The "waterbed effect" is the phenomenon where emissions reductions induced by companion policies take place under an emissions trading system cap. This can reduce allowance demand and, in turn, allowance price. Importantly, the waterbed effect can also result in no net emissions reductions since the overall emissions level (cap) remains unchanged. This applies to both absolute and intensity-based caps.

An emissions trading system can also sit within a country's overarching, economy-wide climate change mitigation objective, including a nationally determined contribution (NDC) under the UNFCCC, or a long-term mitigation strategy. It is therefore important to understand how emissions trading systems and other policies interact to ensure that together they enable the jurisdiction to meet its mitigation objectives. This section examines experiences in various jurisdictions to shed a light on how to best manage these interactions in different contexts.

Responsiveness of an emissions trading system helps manage policy interactions

The certainty of the allowance price is a key element of emissions trading system effectiveness in driving decarbonisation in all economic sectors. Mechanisms that promote both flexibility and certainty of the carbon price are fundamental to ensure that emissions trading systems can respond to unforeseen or unintended impacts, whether stemming from companion policies or external factors, such as sudden economic downturns.

Policy makers can use several mechanisms to enhance the flexibility and certainty of the carbon price in an emissions trading system. These mechanisms can be quantity-based (e.g. allowances reserves and cancellation mechanisms) or price-based (e.g. an allowance price ceiling and/or floor), indexed regulation (e.g. intensity-based allocation, change of cap trajectory), or time-flexible quantity measures (such as banking and borrowing allowances).[1] These mechanisms can be used individually but, in practice, are usually combined, and could be designed to have automatic triggers to further enhance price certainty and minimise active intervention by policy makers.

The examples below demonstrate emissions trading system interactions with domestic companion policies and highlight how carbon price flexibility and certainty mechanisms have been used to address the unintended effects of policy interaction.

Carbon price flexibility and certainty mechanisms in the EU ETS

The EU ETS has experienced a surplus of allowances in its market due to the initial allocation rules, use of certified emissions reductions, and the effect of EU-wide energy efficiency and renewable energy targets. The European Union's 20-20-20 targets comprise a 20% reduction in emissions, 20% renewable energy in gross final energy consumption and a 20% improvement in energy efficiency from the business-as-usual scenario by 2020. While the renewable energy targets were considered in the initial EU ETS cap-setting of Phase 3 (2013-20), the energy efficiency target and use of Clean Development Mechanism (CDM) credits were not. Furthermore, the renewable energy target is set to be exceeded, creating an additional unforeseen

[1] Wang B., A. Boute and X. Tan (2020), Price Stabilization Mechanisms in China's Pilot Emissions Trading Schemes: Design and Performance.

suppression of allowance demand. The renewable energy target was surpassed mainly because: (*i*) power demand was significantly lower than expected (*ii*) renewables deployment was useful to achieve other policy objectives, such as reducing air pollution and enhancing regional energy security, and; (*iii*) cost reductions in renewable energy technologies accelerated unexpectedly. Looking ahead to Phase 4 (2021-30), evidence suggests that fulfilment of the 2030 renewable energy and energy efficiency policy targets alone could be sufficient to reach the current 2030 EU emissions target, leaving the EU ETS with little to no stringency.

In 2019, the European Union introduced the Market Stability Reserve in its emissions trading system to address the challenge of allowance surplus and to provide greater price certainty in the face of unforeseen factors. The total number of allowances in circulation is published by the European Union each year in May. This number is compared with pre-determined threshold levels representing a shortage or surplus of allowances. If there is an allowance shortage, the Market Stability Reserve is designed to release a quantity of allowances from the reserve. If there is a surplus, the Market Stability Reserve will take in allowances from the market. As these thresholds are pre-determined, the trigger is automatic and does not require approval by governments or the European Commission.

The Market Stability Reserve provides a long-term response measure for the market to manage unexpected over- or under-supply, without needing to address or manage the causes of market disruption. For example, as a short-term measure, the auctioning of 900 million allowances was postponed from the first part of Phase 3 (2014-16) to the second part (2019-20). With the Market Stability Reserve, these allowances have been placed in the reserve rather than auctioned in 2019-20. Since the adoption of the EU ETS reform in 2018, and within the first months of the functional Market Stability Reserve, allowance prices increased to reach levels not seen in a decade, signalling the positive impact of the stability mechanism even if the number of allowances in circulation remained high. Market Stability Reserve allowances exceeding the number from the previous year's auction will be cancelled in Phase 4, preventing the Market Stability Reserve from holding too many allowances. Member states can also cancel allowances if they phase out coal-fired power generation through other policies. For example, at the beginning of 2020 the German government proposed a bill to phase out coal by 2038, which will include cancelling some allowances to avoid a possible waterbed effect from the closure of the coal plants.

To create a more co-ordinated approach to meeting climate and energy goals, the European Commission in 2016 proposed a Regulation on the Governance of the Energy Union. Member states were required to define and submit integrated energy and climate plans to enhance co-ordination of policies addressing five domains: energy security, energy efficiency, climate action (including EU ETS), energy integration, and innovation. The plans could consider specific interactions between the EU ETS and other policies. The regulation also permits the European Union to intervene with member states where necessary, should the EU energy efficiency and renewable targets be jeopardised.

Box 3.1 Emissions trading system experiences in the face of unforeseen exogenous economic downturns

The carbon price is designed to fluctuate in an emissions trading system depending on the demand for allowances. Demand rises when economic activity is thriving because emissions increase, pushing up the carbon price. Conversely, when the economy slows down, emissions decrease and so does the demand for allowances, bringing their price down.

The global economic crisis induced by the Covid-19 pandemic in 2020 is not the first economic shock that emissions trading systems have experienced. In 2008, when the global financial crisis started, few emissions trading systems were operating. The EU ETS had started in 2005, while the New Zealand and Swiss systems were launched in 2008. In light of this, the EU ETS can offer some insights on the impact of the economic crisis.

In 2008, the EU ETS lacked flexibility mechanisms that could, for instance, permit adjustments of the emissions cap in the face of a sudden exogenous reduction of demand for allowances. This led to a carry-over of oversupply of around 2 billion allowances from Phase 2 (2008-12) to Phase 3 (2013-20). The price of allowances rapidly collapsed, from around EUR 30/tCO_2-eq in June 2008 to EUR 9/tCO_2-eq in February 2009.

In the first quarter of 2020, global energy-related CO_2 emissions declined by over 5% compared with the previous year as energy demand was reduced by the economic slowdown induced by the Covid-19 pandemic. In Europe, emissions fell even more than the global average, by 8%. The difference with the 2008 crisis is that this time the Market Stability Reserve was in place. The reserve stabilised EU allowance prices to around EUR 20/tCO_2-eq in May 2020, after a sudden fall from around EUR 24-25/tCO_2-eq before the Covid-19 pandemic. Nevertheless, analysts are sceptical about the mid- and long-term effectiveness of the Market Stability Reserve in handling a sustained Covid-19 crisis, as this mechanism was designed to deal with oversupply accumulated over previous years.

Alongside the EU ETS, other emissions trading systems are also being affected by the Covid-19 economic crisis. Allowance prices have declined in California and Quebec, for instance, and jurisdictions elsewhere, including Canada, Korea and some Chinese emissions trading system pilots, have been extending compliance obligation periods.

Carbon price flexibility and certainty mechanisms in California's cap-and-trade system

The California cap-and-trade system has been conceived to function as a backstop for other policies intended to achieve the majority of emissions reductions to meet the state's targets. The Renewables Portfolio Standard and electricity efficiency programmes, companion policies for the cap-and-trade system, have been extended to 2030, suggesting that the cap-and-trade system will probably continue as a backstop instrument in the near future. If these companion policies underperform, the cap-and-trade would then be relied upon to fill the emissions reductions gap. However, should these over perform, the cap-and-trade system could experience surplus allowances and low prices. To provide market stability, the system introduced an Auction Reserve Price that sets the minimum allowance price at USD 16.68 in 2020, increasing annually by 5% plus inflation. Moreover, a mechanism was approved to move allowances that remain unsold for two years to an Allowance Price Containment Reserve, where allowances are available at high prices (USD 62-77). From 2021, new provisions will help contain allowance price levels by injecting remaining allowances from the Allowance Price Containment Reserve at specific trigger points, and by introducing a price ceiling at USD 65.

California's experience also shows that the interactions of an emissions trading system with air pollution policies should be considered carefully. Local air quality is a key social and environmental challenge in many jurisdictions. Previous IEA analysis has shown the importance of analysing potential synergies between air pollution control and greenhouse gas emissions abatement, especially since the interplay between the two may not always be positive. In California, the cap-and-trade system was originally expected to reinforce air quality regulations and accelerate reductions in air pollution levels. There was also a social dimension, given that facilities with high greenhouse gas and particulate matter emissions in California tend to be concentrated in lower-income neighbourhoods. In practice, however, neither greenhouse gas nor particulate matter emissions from such facilities significantly decreased with the introduction of the cap-and-trade system. This was due to the fact that such facilities made greater use of carbon offsets to comply with the cap-and-trade regulation, rather than investing in direct greenhouse gas mitigation options. As a result, additional measures to address local air pollution were passed in 2017, as part of legislation extending California's cap-and-trade programme to 2030.

Use of emissions trading system revenues to support other climate and energy policy objectives

Emissions trading systems can be designed to support other climate and energy policy objectives with revenues generated through allowance auctions. For instance, in the EU ETS, auction revenues are used to spur investments in clean technologies. For this purpose, as part of the revision for Phase 4, the European Commission established two funds:

- **Modernisation Fund:** Of allowances auctioned in Phase 4 (2021-30), 2% will be reserved for a modernisation fund, intended to support investments in the energy systems of ten EU member states. Of these funds, 70% are to be used for energy efficiency, renewable energy, grid infrastructure or support for the energy transition in carbon-dependent regions.
- **Innovation Fund**: This fund will finance the demonstration of innovative low-carbon technologies to accelerate emissions reductions and boost competitiveness. The fund will focus on energy-intensive industries; carbon capture, utilisation and storage; renewable energy generation; and energy storage. It will aim to bridge the financing gap in the demonstration phase of the innovation cycle where private capital is scarce because project risks are high and returns are uncertain.

Another example is Québec, where the emissions trading system's revenues are used to implement measures under the climate change action plan, including steps designed to help the industrial sector become more innovative, energy-efficient and low-carbon. Quebec intends to allocate around 9% of the emissions trading system revenues to these programmes. In California, auction revenue is used to fund companion emissions reduction policies, making functioning market important to overall climate policy implementation. Measures to better manage long-standing oversupply can be important in this context; for example, when market surplus led to

35% of available allowances being sold at the May 2020 quarterly auction, only USD 25 million was raised, compared with USD 600-800 million on average per quarter.

Alignment of emissions trading systems with national mitigation strategies

Often a major part of a country's climate policy mix, an emissions trading system is generally embedded within higher-level greenhouse gas mitigation objectives, including those expressed within the country's nationally determined contribution to the Paris Agreement and its long-term mitigation strategy. Some jurisdictions have worked to align the emissions reductions trajectory and cap of their trading system with these wider mitigation objectives, though in different ways.

Top-down approaches: Experiences from the European Union and Korea

In the **EU Emissions Trading System**, switching from a bottom-up (i.e. sum of individual member state targets) to a top-down cap (i.e. set at EU level) improved the system's design. This allowed the European Union to better co-ordinate its climate governance, align the cap with EU-level mid- and long-term emissions reduction targets, and provide certainty and transparency for the cap trajectory.

During the Phases 1 and 2, the cap was determined in a bottom-up manner by aggregating EU member states' national targets. There was some top-down intervention by the European Commission, however, which negotiated with member states to ensure cap consistency with economy-wide targets at the EU level. The bottom-up cap approach over Phase 1 and 2 helped the European Union to build its experience while enhancing its member states' capacity for accounting and evaluating potential emissions reduction actions.

With the start of Phase 3 in 2013, the European Union switched to a top-down determined cap. This provides an example of a top-down determination of policies to meet the overall target, with the cap and targets for sectors outside of the Emissions Trading System determined based on disaggregation of the overall target. The annual cap has been reduced by a fixed factor ("the linear reduction factor"), in line with meeting the 2020 target.

Korea's overall emissions reduction target of 30% compared with business-as-usual by 2020 was enhanced in its first nationally determined contribution with a 37% emissions reductions target by 2030. The Korea Emissions Trading System plays a central role in achieving this target.

Since the first commitment period (2015-17), the cap for the Korea Emissions Trading System has been determined in a top-down manner in order to link it directly to Korea's emissions reductions contribution at the international level. The cap was determined using a simple method intended to treat all emitters equally, based on the share of emissions by the covered sectors in the base years 2011-13, with sectoral caps further determined by the share of each sector's base year emissions. Sectoral caps were removed for the second commitment period (2018-20).

New Zealand emissions trading scheme: Alignment of a system without a cap to Paris Agreement commitments

When launched in 2008, the New Zealand (NZ) Emissions Trading Scheme was designed as a nested system under the Kyoto Protocol. With full links to international carbon markets, it was not intended to define a limit for domestic emissions and operated without a domestic emissions cap. The majority of emitters met their compliance obligations through the purchase of international carbon credits issued by the Kyoto Protocol flexibility mechanisms (e.g. Clean Development Mechanism certified emissions reductions). The absence of a cap accommodated the unlimited generation of emission credits from carbon sequestration by forestry activities. In the absence of an explicit domestic emissions cap, there was no clear link between the level of domestic emissions reductions achieved under the NZ Emissions Trading Scheme and New Zealand's broader emissions reductions targets.

In its second statutory review in 2015, the NZ Emissions Trading Scheme became a domestic-only system in an attempt to align it with New Zealand's commitments under the Paris Agreement. As of 1 June 2015, units from the Kyoto Protocol flexible mechanisms became ineligible for surrender in the NZ system. The NZ system therefore had to introduce a new allowance allocation system, which allocated allowances freely to emissions-intensive trade-exposed sectors based on output and intensity-based benchmarks and to forestry activities for emissions removals. Alternatively, New Zealand Units (NZUs) are available for unlimited purchase at a fixed price of NZD 25 per NZU.

To provide a framework to implement climate change policies, in late 2019 New Zealand passed the Climate Change Response (Zero Carbon) Amendment Act, with the ultimate goal to reach net zero emissions by 2050. The New Zealand government considers the NZ Emissions Trading Scheme will be the main tool for meeting its 2030 mitigation targets, and will have a key role in meeting its 2050 net zero emissions target. New Zealand is also considering relinking the NZ Emissions Trading Scheme to international carbon markets (i.e. Article 6 of the Paris Agreement) if these respect high standards of environmental integrity.

Aligning the NZ Emissions Trading Scheme with New Zealand's nationally determined contribution 2030 target and net zero emission 2050 target, the New Zealand Climate Change Response (Emissions Trading Reform) Amendment Bill passed in June 2020 reformed the Emissions Trading Scheme, introducing a gradually declining cap as of 2021. The cap will be guided by emissions budgets to be recommended by New Zealand's Climate Change Commission, with a provisional budget set for 2021-25 in line with the 2050 target.

Key lessons

- Managing the interaction of emissions trading system with wider policies can be challenging.
- Mechanisms that promote both flexibility and certainty are fundamental to ensuring that emissions trading systems can respond to unexpected or unintended impacts of companion policies and other external factors, such as economic crises.
- To maximise chances of achieving meaningful reductions, it is important that the emissions reductions trajectory and cap of the emissions trading system are aligned with an overall mitigation objective (e.g. the mitigation component of a nationally determined contribution, or long-term mitigation strategies). Establishing a top-down emissions cap could be an effective way to align the emissions trading system's emissions reductions with these mitigation goals.
- Policy overlap is not inherently problematic if the policies other than carbon pricing serve different objectives or address other gaps. The challenge is to understand the overlaps – the extent to which other policies are expected to reduce emissions that are also covered by an emissions trading system – so that the emissions trading system cap and/or design can be adjusted accordingly.

Guiding questions for policy makers

- **How will the emissions trading system interact with other domestic companion policies?** What is the best way to minimise the risk that emissions reductions driven by other domestic companion policies suppress the demand for emissions trading system allowances?
- What mechanisms will be used to promote emissions trading system **flexibility and certainty** over time?
- **What role will the emissions trading system play in the long-term mitigation strategy?** Will a long-term emissions trading system policy trajectory be determined and communicated? What is the best way to align the emissions trading system with national mitigation objectives?

Tailoring emissions trading system to power market structures

Emissions trading systems are well suited to accelerate the clean energy transition in the power sector. Electricity and heat generation account for over 40% of global energy-related CO_2 emissions, with 30% of energy-related CO_2 emissions coming from coal-fired power plants.[1] The power sector is already decarbonising worldwide, due to falling low-carbon technology costs and low competitiveness risks, but not quickly enough to meet the Paris Agreement goals. The power sector is particularly well-suited to be covered by an emissions trading system. First, it is a large emitting sector with proven, low-GHG technologies that are commercially available. Second, data availability for electricity generation is on average strong across jurisdictions, which is needed to determine allocation benchmarks. Moreover, several jurisdictions already have experience in implementing power sector mitigation activities with the support of carbon pricing, for instance through crediting mechanisms such as the Clean Development Mechanism. The power sector is included in almost all operating emissions trading systems around the world, as well as in jurisdictions that are developing or considering developing an emissions trading system.

This section describes how different power market structures can affect the effectiveness of an emissions trading system and how different systems have adapted their design to local power market conditions.

Power market structure can affect emissions trading system effectiveness

Power producers generally treat the allowance cost in an emissions trading system as a marginal cost in operations decisions, and as a commodity that needs to be reflected in investment appraisals. For power consumers, the result of the application of carbon price is that carbon-intensive goods become more expensive. This effect encourages a switch to low-carbon alternatives or a change in consumption patterns.

[1] International Energy Agency (IEA) (2019) *World Energy Outlook 2019*.

In theoretically perfect carbon and power markets, the reflection of emissions trading system allowance costs in the power sector creates at least three levels of incentives to reduce emissions:

- **Investment incentives for less carbon-intensive power supply**. In theory, carbon pricing encourages investment in less carbon-intensive technologies, making high-emitting power plants less profitable. In practice, these investment incentives are sometimes limited by fossil fuel subsidies, by the lack of long-term emissions trading system policy certainty or by the lack of stability of allowance prices within the system.
- **Reduction in electricity demand.** In competitive power markets, fossil fuel power generators reflect the carbon price through the increased marginal cost of the fuel used. Increased carbon costs are passed on to consumers in power retail price increases. Higher electricity prices create incentives for end-use energy efficiency and conservation.
- **Changes in the merit order of electricity dispatch**. Carbon pricing increases the short-run variable cost of fossil fuels based on their carbon content. Less efficient, high-emitting fossil fuel power plants (such as coal-fired plants) lose positions in the merit order and their annual operating hours are reduced in an economic dispatch model. This results in lower emissions and in a reduction of the profitability of high-emitting power plants.

In practice, however, carbon pricing is not always able to completely deliver these incentives within power markets. Power markets are often fully or partially regulated, meaning producers can be constrained when it comes to decisions on investment or generation, and can face regulated wholesale and retail electric prices.

Some market structures can weaken the carbon price signal, reducing the emissions trading system's effectiveness. If retail electricity prices are highly regulated, for example, the carbon price signal will not be visible to electricity consumers. This effect limits or removes the incentive for electricity consumers to save electricity or to choose low-carbon electricity suppliers. Similarly, in market structures where wholesale prices and dispatch decisions are regulated, a carbon price would have limited impact on shifting the merit order towards low-carbon power sources.

Adapting the design of the emissions trading system to power market structures

The design of the emissions trading system should be tailored to the power market circumstances. In markets where co-generation (electricity and heat) plants are widely used, the emissions trading system should be tailored to both power and heat market structures, because if the electricity prices are liberalised but the heat prices are regulated, the pass-through of carbon pricing could be distorted. Several methods can be used to better reflect the emissions trading system carbon price signal while taking into consideration existing power market regulations:

- **Coverage of indirect emissions.** To reflect the carbon price in regulated electricity prices, large electricity consumers could be required to surrender emissions trading system allowances for their indirect emissions associated with electricity consumption. This creates a carbon pricing signal reflected in increased final end-use consumer prices, and encourages energy savings and energy efficiency. However, competitiveness and double counting issues could arise, since allowances are required from both electricity generation and consumption.
- **Consumption charge**. A consumption charge could facilitate downstream emissions reductions when regulations prohibit explicit retail or wholesale carbon price pass-through. Final and intermediate consumers may experience a consumption charge at the discretion of the government even under an unchanged electricity price. The consumption charge does not create double counting or competitiveness issues.
- **Climate-oriented dispatch.** The climate-oriented dispatch is a broader regulatory framework for the power sector under an emissions trading system. When the production of electricity is regulated, an "administrative" electricity dispatch could be implemented to deliver the effect on dispatch that an emissions trading system is designed to deliver. For instance, emission levels and fuel efficiency can be used as prioritisation criteria for the "administrative" electricity dispatch.
- **Carbon investment board.** Within a regulated investment environment, governments could mandate the planning body to integrate predefined carbon prices (also called "shadow prices") when making investment decisions. When an emissions trading system co-exists with regulated investments, the resulting allowance price could be used to infer the level of the shadow price.
- **Pricing committee.** When the market has either a regulated wholesale price or a regulated retail price, a pricing committee can help set and review the rules for determining how the wholesale or retail prices could reflect carbon pricing and emissions trading system allowance price fluctuations. The committee could

allow the impact of a carbon price on the utility's cost of electricity production to be passed through into wholesale or retail tariffs.[2]

Placing additional costs on power plant operations or raising consumer electricity prices to reflect the price of carbon can be politically challenging. Policy makers often struggle to find a balance among competing objectives, such as reducing emissions while ensuring electricity security and affordability. One way of managing this challenge is to build revenue streams into an emissions trading system, such as through auctioning mechanisms, to compensate electricity consumers for price increases. An example of this is California's Cap-and-Trade System, included below among other examples of how various systems have adapted their design to the structure of the local power market.

Managing regulated dispatch and retail prices in Korea's emissions trading system

The power sector is the highest-emitting sector in Korea, responsible for over 54% of the country's CO_2 emissions in 2018. Coal-fired power plants emit about 80% of the CO_2 emissions of the sector. Korea's emissions trading system operates in an open wholesale electricity market with regulated retail prices, where additional carbon costs are not reflected in wholesale dispatch bid prices or in retail prices.

Korea has a cost-based wholesale electricity market based on day-ahead settling. All dispatchable plants submit their available power generation to the Korea Power Exchange a day in advance and the power exchange plans power generation based on the generators' variable fuel costs. The emissions trading system carbon price does not influence dispatch of different power plants, since this is not incorporated in the assessment of direct fuel costs for the power generation plan.[3]

In the first phase of Korea's emissions trading system (2015-17), electricity generators found themselves short of allowance units, as free allocations based on historical baselines did not account for increased coal power generation. Power generation companies had to purchase additional allowance units, but the cost of these was covered by the electricity retailer, Korea Electric Power Corporation, meaning the extra cost was not paid by the power generators.

[2] Boute, A. (2017), The Impossible Transplant of the EU Emissions Trading Scheme: The Challenge of Energy Market Regulation.
[3] Davies L. et al. (2017), Climate Regulation of the Electricity Industry: A Comparative View from Australia, Great Britain, South Korea, and the United States.

At the retail level, regulated prices limit the level to which the emissions trading system carbon price is reflected in end-user electricity prices. For instance, retail electricity prices remained constant from 2013 to June 2016, even though Korea's emissions trading system started operating in 2015. Historically, Korea Electric Power Corporation has experienced cases of surplus and deficit allowance units, because of its inability to pass wholesale cost fluctuations onto consumers. This has led to the development of a separate mechanism to tackle electricity consumption in Korea's emissions trading system, extending its coverage to indirect emissions associated with electricity and heat consumption by large industrial users by increasing their allowance allocation.

Overall, the implementation of Korea's emissions trading system has not managed to reflect a significant price signal for both electricity consumers and power generators so far. The Korean government is trying to address some of these challenges by studying options to reflect the emissions trading system carbon pricing in the power generation plan in the wholesale electricity market, including a framework for a shadow price for environmental dispatch.

Balancing the carbon price signal: California's cap-and-trade

California's cap-and-trade experience shows that it is possible to achieve two seemingly conflicting objectives: reflecting carbon pricing in final consumer prices in a regulated retail market and addressing political concerns of the cost impacts for final consumers. The return of the allowance value to consumers ensures consumer protection from electricity price increases due to carbon pricing in an efficient way that enhances environmental effectiveness. California has a competitive wholesale electricity market, while the retail electricity is operated as a monopoly, with regulated prices for most electricity consumers. Over 75% of power is generated by private investor-owned utilities (IOUs) regulated by the California Public Utilities Commission, with the remaining electricity share produced by public-owned utilities and non-profit agencies, which are often run by the government and not regulated by the commission.

In 2010, the California Air Resources Board suggested including a carbon price reflecting marginal greenhouse gas abatement costs in the electricity retail price while protecting ratepayers from electricity price rises. To obtain this effect, the California Public Utilities Commission and the California Air Resources Board created a mechanism based on two steps. First, in 2014 the commission approved a mechanism to incorporate carbon pricing into the retail electricity prices, as a response to the increased carbon costs of various climate policies, including California's cap-and-trade. This resulted in an increase of the final retail electricity price.

Second, the California Air Resources Board devised an economic compensation mechanism through which IOUs use the revenues generated by the consignment auctioning under the cap-and-trade system to mitigate the final price increase for electricity consumers. The consignment auctioning mechanism requires IOUs to sell (consign) 100% of their freely allocated allowances at quarterly auctions and to subsequently repurchase them to meet their compliance obligations. Around 70% of the revenues raised through consignment auctions are used to keep retail electricity prices stable, as the IOUs return these to customers twice a year via a lump sum called Climate Credit, equalling about USD 30 to USD 40 per household. As a result, although retail prices go up, overall electricity expenditures remain stable.

China emissions trading system pilots: Including indirect emissions

All of China's regional emissions trading system pilots include indirect emissions associated with electricity and heat consumption. This design is mainly driven by two considerations. First, as the dispatch and retail prices for electricity and heat are highly regulated, there is only a weak price signal to consumers to drive demand-side conservation. Inclusion of indirect emissions aims to provide incentives for major consumers to limit their electricity consumption, and ensure that trading system participants must take action to reduce emissions from electricity and heat use, rather than lowering emissions by switching from direct fossil fuel use to electricity and heat.

Second, as the emissions trading system pilots are applied only to certain provinces and municipalities, coverage of indirect emissions ensures that emissions associated with electricity and heat that are consumed locally but imported from other regions are equally considered in the emissions trading system. The scale of imports can be significant, with potentially up to 80% of emissions associated with products consumed in coastal areas being generated elsewhere. The inclusion of indirect emissions thus helps to mitigate the carbon leakage concern. The Chinese national emissions trading system is considering covering indirect emissions from purchased electricity to manage regulated electricity and gas markets.

In practice, the effect of indirect emissions coverage is difficult to assess. Allowances have been generally abundant under the regional pilot output-based schemes, and most pilots have adopted grandfathering for allowance allocation in non-power sectors which cover indirect emissions from electricity and heat consumption.[4]

Including indirect emissions could lead to double counting of emissions reductions. Double counting could be mitigated by adopting consistent standards for the allowance allocation design systems and the manner in which emissions reductions are counted. Including indirect emissions also raises concerns over the accuracy of the emission factors used, which may increase the risk of over- or under-allocation and hence distort the carbon price. The Chinese emissions trading system pilots have been using the regional grid average emission factors for indirect electricity emissions, while recent reporting guidelines for the upcoming national emissions trading system have used national grid average emission factors for non-power sectors, which could be less representative than the regional factors. In case of deviation, an adjusted emission factor needs to be applied to minimise the gap between the actual emissions from electricity consumption and the estimated indirect emissions.

Tokyo's emissions trading system: Accounting for the high electricity consumption of commercial buildings

The Tokyo municipal emissions trading system also covers both direct and indirect emissions. Indirect emissions are included in the emissions trading system specifically to cover the emissions from electricity consumption in commercial buildings. In Tokyo, electricity represents 40% of energy consumed, but 90% of this electricity is produced outside of the geographic boundaries of the city. A fixed emissions factor is therefore used to calculate CO_2 emissions from electricity use, to separate out efforts made to reduce electricity demand from fluctuations in the CO_2 emission factor on the supply side. Since 2006, facilities have been required to calculate and report their emissions to the national government, including CO_2 emissions related to fuel usage, and the use of electricity and heat. This mandatory data collection in the years before the emissions trading system is recognised as a key to the success of the programme, allowing facility-level understanding of indirect emissions through electricity and heat use.

[4] Zhang J., Z. Wang and X. Du (2017), Lessons Learned from China's Regional Carbon Market Pilots.

Key lessons

- An emissions trading system's effectiveness can be limited in power markets where the carbon price signal is inhibited. An emissions trading system operates most efficiently in electricity markets where the carbon signal can be distributed across all market players, affecting decisions at both the power plant level and consumer level through market forces.
- The design of an emissions trading system will be shaped by the power market structure. Several options can be used to reflect and strengthen the carbon price effect, depending on institutional arrangements within jurisdictions. These include consignment auctions, covering indirect emissions, consumption charges, climate-oriented dispatch rules, carbon investment boards and pricing committees. Further research and lessons learnt from empirical experience could improve understanding on how effective these options are.

Guiding questions for policy makers

- How does the specific power market structure **impact carbon price signals**, and in turn the **required design features** of the emissions trading system?
- **How can the carbon price be reflected** in the expansion planning, power plant dispatch decisions and end-use prices?
- In markets where electricity supply is liberalised but heat supply remains regulated, **how is the carbon pricing allocated to the electricity and heat output** of co-generation plants?

Facilitating low-carbon transitions in industry through emissions trading systems

As in the power sector, a carbon price applied to the industry sector would ideally reach both producers and consumers of industrial products. In theory, producers would perceive the carbon price through the increased cost of carbon-intensive inputs and processes. This would encourage them to switch to lower-carbon production processes and to invest in carbon-intensity reduction technologies. Consumers would be affected by higher final costs for carbon-intensive industrial products and would be encouraged to purchase less carbon-intensive alternatives. In practice, however, several barriers can prevent these effects from happening.

This section provides an overview of the main issues that jurisdictions often have to address when trying to reduce emissions from industry via an emissions trading system. These include addressing industry competitiveness and carbon leakage concerns, phasing out transitional assistance and free allocation in favour of auctioning.

Emissions trading systems and industry: Context and objectives

How the industrial sector is included in an emissions trading system needs careful consideration. On one hand, policy makers should estimate the greenhouse gas mitigation potential available in industry and reflect on the role of their industry within the wider decarbonisation of the economy. On the other hand, introducing an emissions trading system in the industrial sector may affect some companies' international economic competitiveness. Therefore, it is important to estimate the potential economic impact that an emissions trading system would have on the various players in the sector.

The introduction of an emissions trading system would also occur within a context of other companion policies affecting the stakeholders in the industry. Examples of companion policies in industry are air pollution control regulations, industrial energy conservation programmes, environmental taxation, and other policies for long-term economic restructuring and ecological industrial development.

Carbon pricing can play a key role in emissions reduction from industry, given that operational and investment decisions are highly cost-sensitive. In the medium term, a carbon price can make energy efficiency improvements at scale more cost-effective, and in the longer term it can be a key incentive for investments in innovative technologies, such as carbon capture, utilisation and storage, and electrolytic hydrogen (e.g. in the steel sector).

Competitiveness and carbon leakage concerns for industry

Bringing industry into an emissions trading system that also covers the power sector can raise near-term competitiveness concerns. It can also create socio-economic concerns if investments in industry fall and jobs are lost. And environmental concerns arise from carbon leakage, the potential displacement of industrial production (and associated pollution) to jurisdictions with less stringent environmental controls or emissions reductions requirements. All current emissions trading systems are attempting to prevent the carbon price from lowering the competitiveness of specific sectors or the entire economy of the jurisdiction by including features aimed at reducing the extra costs that an emissions trading system can bring for some industries.

The importance of the identification of industries with highest risks of carbon leakage

Different emissions trading systems have faced the same concerns on the application of a carbon price to similar types of industries. These include emissions-intensive industries, which could face higher costs to reduce emissions, and trade-exposed industries, which could lose competitive economic advantage and face carbon leakage. The industrial sectors and products often deemed at risk of carbon leakage include cement, aluminium, iron and steel, paper, refineries and chemicals. It is important to identify specifically which industries could be the most affected by carbon pricing, as well as their trade exposure.

The EU ETS, for example, determines which industries are at risk based on the impact of production costs as a proportion of gross value added, and trade exposure as the ratio between the value of trade to countries outside the European Economic Area (EEA) (exports and imports) and market size within the EEA.

These calculations would ideally include both direct and indirect costs. Direct costs refer to the costs of implementing mitigation measures and acquiring allowances. Indirect costs refer to an increase in the price of other products covered by the emissions trading system, which in industry often refers to increases in the cost of electricity and heat. The indirect costs imposed on industry will vary according to their carbon intensity and other structural factors. In practice, the regulatory framework of the electricity market and the contractual arrangements between industry and electricity suppliers will also affect indirect costs.

Other costs related to the introduction of an emissions trading system can also affect competitiveness. These can include: investment risks if there is uncertainty associated with emissions trading system policy design; changing market share as the value of low-carbon products and services increases compared with high-carbon ones; and compliance costs, such as measurement, reporting and verification. One-off fees and payments may also be required to cover the administrative costs of developing and implementing an emissions trading system.

Free allowance allocation as a response to industry competitiveness concerns

The distribution (allocation) of emission allowances among the industrial entities covered in an emissions trading system determines how the burden of meeting the target is shared across the sector. Allowances can be allocated for free or put up for sale at auctions.

If an emissions trading system auctioned all the allowances, this would impose costs on industry, potentially impacting competitiveness, which might result in industrial production losses in certain sectors at a level that would be economically damaging. Therefore, most emissions trading systems aim to reduce one of the key direct costs by providing free allowances to industries considered at risk of carbon leakage. Free allowance allocation has also proved to be more politically and economically feasible than other options, such as financial compensation, exemption from the emissions trading system or border carbon adjustments.

In this context, most emissions trading systems allocate a significant share of free allowances to industrial sectors considered at risk of carbon leakage and the remaining allowances are put up to auction. The EU ETS also includes a financial compensation approach, whereby member states can compensate industries that face significant indirect cost increases due to their electricity intensity.

There are two main methods of free allowance allocation in emissions trading systems:

- **Grandfathering**: Free allowances can be provided to industries based on their historical emissions over a specified period. If historic data is available, this approach is straightforward. This approach was used in the EU Emissions Trading System's first pilot phase. Grandfathering, however, is often regarded as rewarding the status quo rather than better performers and could penalise "early movers" who invested in emissions reduction measures at earlier stages.
- **Benchmarking**: Most emissions trading systems have moved towards allocating free allowances on a "benchmark" basis. The "benchmarking" approach provides free allowance allocation to companies that perform below a set level of emissions, e.g. emissions per unit of product or emissions intensity. This approach encourages and rewards early action and higher environmental performance. Benchmarking requires an understanding of complex industrial processes as well as a high level of data availability. Different benchmark methodologies would give a different benchmarking level for a given industry. For example, the benchmark could be set at the "best achieved level", or "best available" level, average of top X% performers in the industry, average level or a hybrid model (e.g. average level of the X and Y percentile). The level at which the benchmark is set is important for the industrial stakeholders covered by the emissions trading system, as this would determine the amount of allowances that the facility would receive and would impact its compliance obligations. The benchmarking level is also affected by and depends on other factors, including technical assumptions in the calculations and where the industrial facility emission boundaries are set. Therefore, the benchmarking methodology chosen can have a significant impact on the obligations of the industries covered by the emissions trading system.

Examples of free allowance allocation application to industry

In its first phase (2015-17), Korea's emissions trading system granted 100% free allocation using a mixed approach of grandfathering and benchmarking. The benchmarking approach was applied only to three sectors (grey clinker cement, oil refineries and domestic aviation) due to the limited availability of historic data. In Phase 2 (2018-20), 97% of allowances were freely allocated, with around 50% of these being allocated with a benchmarking approach. The remaining 3% of allowances were auctioned. The benchmarks for domestic aviation, grey cement clinker and oil refining are set at the weighted average emission intensity level of entities covered by the emissions trading system.

Korea's emissions trading system was implemented in an environment of extreme competitiveness concerns and strong opposition from industry due to a perceived initial under-allocation of allowances. Some industrial companies sued the government on the basis that non-compliance penalties were too high and because of limitations on the use of carbon offsets for obligations compliance with obligations under the emissions trading system. To manage these concerns, the government auctioned the reserve allowances and established stability mechanisms, such as more flexible banking rules, price control mechanisms and generally greater flexibility for industry (e.g. increasing ability to borrow allowances). The result of these trade-offs is a less clear and less predictable policy signal, which could lead to delayed investment in greenhouse gas abatement measures.

The EU emissions trading system also followed a phased approach with regard to allocation. In Phase 1 (2005-07), allowances were allocated through grandfathering, with a mix of auctioning and benchmark allocation varying among member states. In Phase 2 (2008-12), 90% of allowances were grandfathered, still using a mixed approach between benchmarking (the overwhelming majority) and auctioning. In Phase 3 (2013-20), 43% of allowances were allocated through the benchmark approach and 57% via auctions. For the industrial sector in particular, free allowance has followed a benchmark approach, setting the benchmark level at the average emissions of each sub-sector's 10% best-performing facilities since 2013. Industries considered at risk of carbon leakage receive free allocation at 100% up to a predetermined benchmark. The gradual shift towards stricter benchmarking since 2013 lowered over-allocation of free allowances and mitigated carbon leakage risks.[1]

In the European Union, free allocation may be updated annually in Phase 4 (2021-30) in the case of sustained changes in production, i.e. if the industrial annual output changes by more than 15% compared with the average baseline of the two previous years. In times of economic crisis, such as the 2009 financial crisis or the one induced by the Covid-19 pandemic at the beginning of 2020, industry activity levels generally fall drastically, which could lead to a significant reduction of the level of free allowance allocation under current EU Emissions Trading System rules. Therefore, some industries argue that keeping the crisis year (e.g. 2020) outputs as part of the

[1] Sartor O., C. Pallière and S. Lecourt (2014), Benchmark-based allocations in EU ETS Phase 3: An early assessment.

benchmark calculation for free allowance allocation would distort the results and could further hinder their competitiveness.[2] The EU ETS will review its rules in 2021 to address these concerns.

Phasing down free allocation as transitional assistance over time in favour of allowance auctioning

Emissions trading systems that address competitiveness and carbon leakage concerns through free allowance allocation often gradually phase down free allowance allocation in favour of auctioning, for three main reasons:

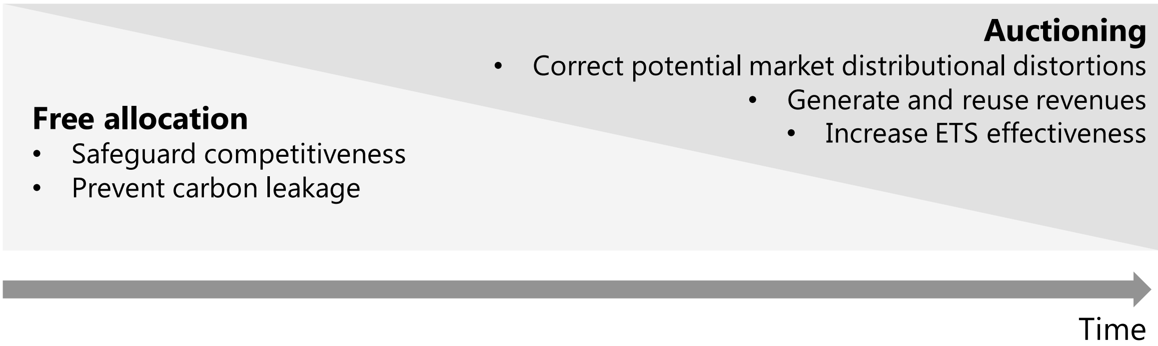
- **Correcting potential market distributional distortions**: Free allowance allocations act as a subsidy, reducing costs only for those who receive free allowances, at the expense of those who do not and who bear more costs (e.g. consumers or industries ineligible for free allowances). Providing free allocation only to certain types of industries can also have regional impacts, depending on the geographical distribution of industries within a country. If this is uneven, costs may not be evenly spread, potentially complicating burden-sharing arrangements across subnational jurisdictions. Reducing free allocation can help address distributional distortions. These include effects such as windfall profits, whereby industries that receive free allowances pass carbon costs entirely through to consumers (e.g. due to international trade exposure), thus realising additional profit.
- **Generating and reusing revenues from auctioning**: Allowance auctioning creates revenues for the government. These can be used to invest in further climate mitigation action or to address distributional impacts, such as providing compensation for low-income households. Allocating some allowances for free reduces the amount of allowances destined for auction, which in turns reduces the potential auction revenues that could be spent on further climate mitigation action. In California's cap-and-trade system, 85% of the revenues from electricity sector allowance auctions are used to ultimately offset customer cost increases. Of these revenues, 3% are to be used to help industry become more efficient, for example through utility rebates or incentives that benefit industrial energy efficiency investments, and therefore reduce the effect of electricity cost increases on industry. In the EU ETS, at least 50% of revenues from allowance auctions are used to support climate and energy activities, both domestically and internationally. Most member countries use these revenues to invest in domestic climate and energy measures, including renewable energy, energy efficiency and

[2] Carbon Pulse (2020), Analysis: EU industry seeks to safeguard flow of free carbon units as virus impact skews.

sustainable transport, and to compensate energy-intensive companies for increased energy costs resulting from the emissions trading system. A part of these revenues is also channelled to the Innovation Fund, one of the instruments designed to help the European Union reach its target under the Paris Agreement.

- **Free allocation can lower the emissions reduction effectiveness of emissions trading systems:** In theory, the allocation method should not affect the effectiveness of the emissions trading system in reducing emissions. In practice, under intensity-based caps, receiving 100% of allowances for free effectively provides no incentive to reduce emissions. Free allowances can also weaken incentives to invest in less carbon-intensive technologies, lowering the overall efficiency of the system. This could have consequences beyond the timeline of the trading system if high-carbon assets are locked in.

Figure 5.1. Phasing down free allocation as transitional assistance over time in favour of allowance auctioning



Allocating free allowances to trade-exposed industry assumes that these industries would struggle to pass carbon costs through to final product prices because of the competitive nature of international trading markets. In the EU ETS, at current carbon prices trade-exposed industries, including cement, iron and steel, and oil refineries, have passed through the costs of allowances to varying rates, creating windfall profits. Phase 3 allocation rules are likely to have limited the risk of windfall profits by reducing free allocation overall, including auctioning the overwhelming majority of allowances in the power sector and shifting towards benchmark allocation. The experience from the EU ETS shows that interactions between benchmark design and pass-through of carbon (opportunity) costs need careful consideration and need to be followed over time as carbon prices varies. Overall, while free allocation reduces costs to industry, it is unclear how it affects competitiveness and carbon leakage, both in the short and long term.

Key lessons

- Potential competitiveness and carbon leakage impacts on industry stemming from the implementation of an emissions trading system should be examined closely. Efforts to ease such impacts should focus on industries that may be truly at risk of carbon leakage.
- Free allowance allocation has been widely used by various emissions trading systems as a way to address competitiveness and carbon leakage concerns for the industrial sector. There exist different design methodologies to allow free allocation of allowances, which require varying degrees of inputs. The choice of the allocation method is important for industries covered by the emissions trading system, as this would determine the amount of allowances that the facility would receive and would affect its obligations under the system.
- Gradually phasing down free allocation in favour of auctioning can help correct potential market distributional distortions, create the possibility of generating and reusing revenues from auctioning, and increase the emissions trading system's emissions reductions effectiveness.

Guiding questions for policy makers

- **How can the impact of competitiveness and risks of carbon leakage be accurately identified for different industries?** Are data available for authorities to understand the carbon intensity, the possible abatement options, trade exposure and cost pass-through ability of different industries? Are data accessible to gauge impacts of the emissions trading system on these industries? If not, how can these data be collected and monitored?
- **How can allocation decisions balance concerns** about near-term competitiveness with the need to ensuring cost efficiency and distributional equity? Is free allocation to industry necessary to address industry competitiveness and carbon leakage concerns? If so, how can free allocation be gradually phased down?
- **In which industries are sufficient data available to develop benchmarks?** Which alternative methods of determining allowance allocation will be needed where necessary data are not available across all industries?

Conclusions

Carbon pricing initiatives are spreading throughout the world. Over 60 countries, cities, states and provinces have implemented or are planning to implement carbon pricing schemes, with a fairly balanced distribution between emission trading systems and carbon taxes. When the emissions trading system in the power sector of China starts its implementation, carbon pricing initiatives will cover one-fifth of global greenhouse gas emissions.

Emissions trading systems present many benefits. They help to expose emitters to the external costs of emissions in the most flexible and least costly way, and as such reduce emissions cost-effectively. Trading systems can also stimulate technological innovations, support climate risk quantification and multilateral co-operation, and create synergies with energy and environmental policies. Emissions trading system are useful policy instruments that facilitate the acceleration of clean energy transitions and emissions reductions. However, the practical policy implementation of an emissions trading system needs to be designed in a way that fits with local contexts and integrates with other policy priorities in each jurisdiction.

Defining the role and function of emissions trading systems

Jurisdictions need to fully understand their own energy and low-carbon development conditions, to carefully define the expected role and functions of establishing an emissions trading system, and to discuss the system's objectives with major stakeholders. The long-term policy predictability of an emissions trading system is an important factor for guiding private sector investment decisions. Policy makers should further consider what role the emissions trading system would play in the jurisdiction's long-term strategy and consider how the role and functions of the system will evolve within their longer-term strategy for both climate policy and industrial and social development.

Managing emissions trading system interactions with wider energy transitions policies

Jurisdictions should carefully assess interaction issues between emissions trading system design and other energy-related domestic companion policies, which may include air pollution control, renewable energy, energy conservation, economic restructuring and power sector reform. A top-down approach for setting the emissions trading system cap could help better align the system with national mitigation objectives, such as nationally determined contributions to the Paris Agreement or other long-term strategies.

Tailoring emissions trading systems to power market structures

The power sector is a major source of emissions in most jurisdictions and as such it is included in most of the operating emissions trading systems around the world. In theory, the reflection of emissions trading system allowance costs in the power sector creates various levels of incentives to reduce emissions. However, in practice power markets are often fully or partially regulated, and some power market structures can weaken the carbon pricing signal, reducing the emissions trading system's effectiveness. Jurisdictions should analyse how the carbon signals affect the different level of potential emissions reductions in the power sector, including in investment, dispatch, and wholesale and retail markets.

Facilitating low-carbon transitions in industry through emissions trading systems

How the industrial sector is included in an emissions trading system needs careful consideration because it can raise economic competitiveness concerns, such as a potential decrease in investments in industry and potential job loss. Environmental concerns can also arise, notably carbon leakage, the potential displacement of industrial production (and associated pollution) to jurisdictions with less stringent environmental controls or emissions reductions requirements. Free allowance allocation has been widely used by various emissions trading systems as a way to address competitiveness and carbon leakage concerns for the industrial sector. Gradually phasing down free allocation in favour of auctioning can help correct potential market distributional distortions, create the possibility of generating and reusing revenues from auctioning, and increase the emissions reductions effectiveness of the emissions trading system.

Abbreviations and acronyms

CAD	Canadian dollar
CDM	Clean Development Mechanism
CO_2	carbon dioxide
ECC	IEA Environment and Climate Change Unit
EEA	European Economic Area
EED	IEA Energy and Environment Division
EU ETS	European Union Emissions Trading System
GDP	gross domestic product
GHG	greenhouse gas
GIZ	German Agency for International Co-operation
ICAP	International Carbon Action Partnership
IEA	International Energy Agency
IOU	investor (privately)-owned utilities
NDC	Nationally Determined Contribution
NZD	New Zealand dollar
NZU	New Zealand Units
RGGI	Regional Greenhouse Gas Initiative
TCFD	Task Force on Climate-related Financial Disclosures
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States dollar

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