Discussion Paper

Design Elements for Effective Compliance Markets

Insights From Existing Emissions Trading Schemes

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Executive Summary

How can governments design market-based compliance schemes that achieve the desired greenhouse gas (GHG) emission reductions in the most effective way, while balancing their various economic and social priorities? What are the major design options governments should consider when setting up an emissions trading scheme (ETS)? What factors influence decisions about the sectoral and GHG coverage of the system, capping emissions, distributing emissions allowances, maintaining the desired price signal, and providing flexibility for system participants? What are the major trade-offs between these options? What lessons can be identified from past experiences for new governments considering or developing market-based compliance schemes?

By addressing these questions, this paper provides a unique resource for governmental and other carbon market stakeholders seeking to understand how lessons from the world's 37 existing ETSs can inform major decisions around designing and operating new compliance schemes. The paper draws on quantitative and qualitative data from the World Bank and the International Carbon Action Partnership (ICAP) on 37 operational ETSs, complementing it with academic and technical literature in the field.

This paper comes in the context of a number of emerging economies exploring or developing ETSs. Emissions trading schemes are considered among the most effective climate policy instruments, but due to their intricate designs, are often complicated to communicate and understand. As new countries, particularly from the Global South, engage with ETSs, there is a need to unpack how existing ETSs can inform the design of new ones and how governments can build on past experiences to deliver effectiveness in varying country contexts.

Importantly, a well-functioning ETS can look very different from one country or jurisdiction to another, and there is no one combination of the various design elements that will work in all contexts. Each design element has its benefits and downsides, and needs to be considered both in the country's context and in relation to other design elements. Consequently, this paper does not seek to identify a "winning combination" of design elements for all countries to follow.

Rather, the paper identifies ETS design options in five main areas: setting up, coverage, cap, allowances, and flexibility. It presents the key considerations and trade-offs involved with each and shows how existing ETSs represent these different options and how these systems have evolved over time.

The study identifies four major patterns:

- System coverage, complexity, and stringency generally increase over time.
- Systems tend to learn iteratively from their own experiences as they accumulate more and better data and gain experience in how the market functions and how participants respond to various design levers.
- Systems also build on the experiences of others, particularly in features that provide flexibility and price stability. Yet, despite the accumulating experience, ETSs still take several years to reach full operationalization.
- Divergent allowance price trajectories in the last decade suggest that some systems actively seek to use carbon pricing to drive emission outcomes, while others appear to be deployed more as strategic signaling tools, providing industries advance notice of future carbon pricing in the context of an increasingly carbon-constrained world.

More specifically, the study identifies lessons for policymakers considering carbon market instruments as part of their climate policy toolkit in the five areas summarized below:

1. Setting up:

- Preparation requires time.
- Consider a pilot phase.
- Apply phased implementation.

2. Coverage:

- Tailor to local contexts.
- Prioritize high-emitting, easy-to-MRV sectors.
- Balance ambition with implementation feasibility.

3. Cap:

- Cap type may matter.
- Align phases with policy cycles.
- Stringency can increase over time.
- Use of multiple cap flexibility features is a general practice.

4. Allowances:

- Auctioning and free allocation play different roles.
- Data drives free allocation choices.
- Transition over time.
- ETS prices can be managed.
- Revenues can improve outcomes, cushion impacts, and secure buy-in.

5. Flexibility:

- Banking is common; borrowing is rare.
- Offsetting can support cost-effective mitigation.

The study shows in great detail the main strengths of ETSs-namely, their versatility and iterativeness: emissions trading schemes can be suited to highly diverse circumstances, and their design can evolve over time to suit governments' needs, priorities, and increasing levels of climate ambition. Also, ETSs can be tailored to suit the needs and priorities of industrialized, transitioning, and emerging economies alike.

Keywords: Emissions Trading Schemes, Carbon Market Design, ETS Policy Options, Greenhouse Gas Compliance Markets, Carbon Pricing Mechanisms, Cap and Trade Systems, ETS Design for Emerging Economies, Market-Based Climate Policies, Allowance Allocation Strategies, Carbon Offset Flexibility

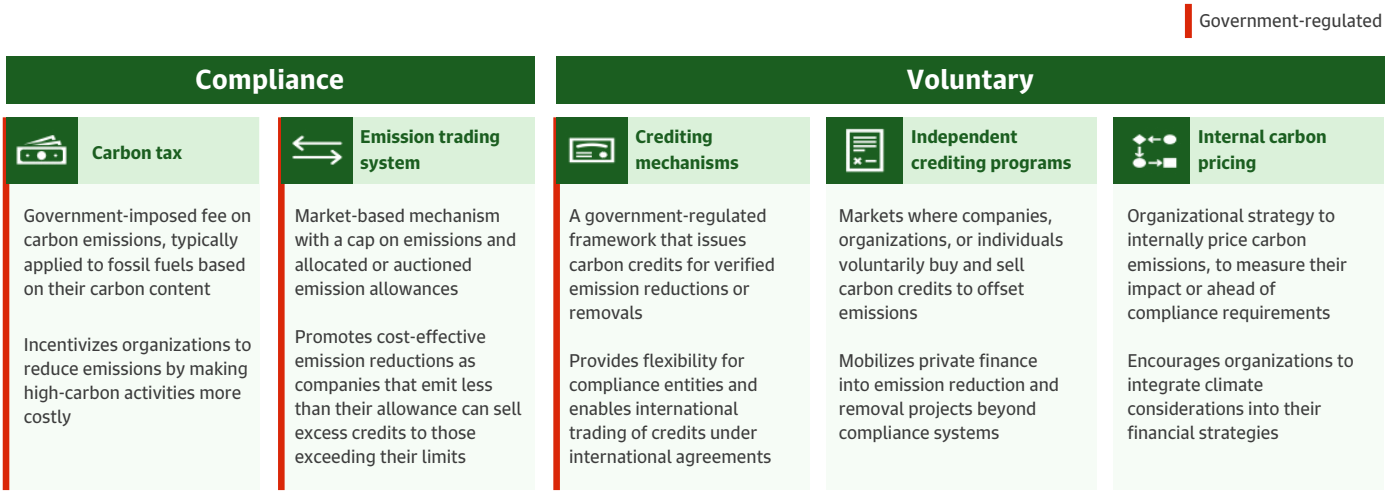
Introduction

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In the past two decades, the share of global greenhouse gas (GHG) emissions covered by a carbon pricing compliance scheme has increased from 5% to 28% (World Bank 2025a). The 38 emissions trading systems (ETSs) in operation worldwide account for the majority of this coverage (i.e., 23% of global GHG emissions).[1] In addition, many more countries are actively pursuing carbon pricing instruments. This includes a large number of emerging economies and other developing countries.

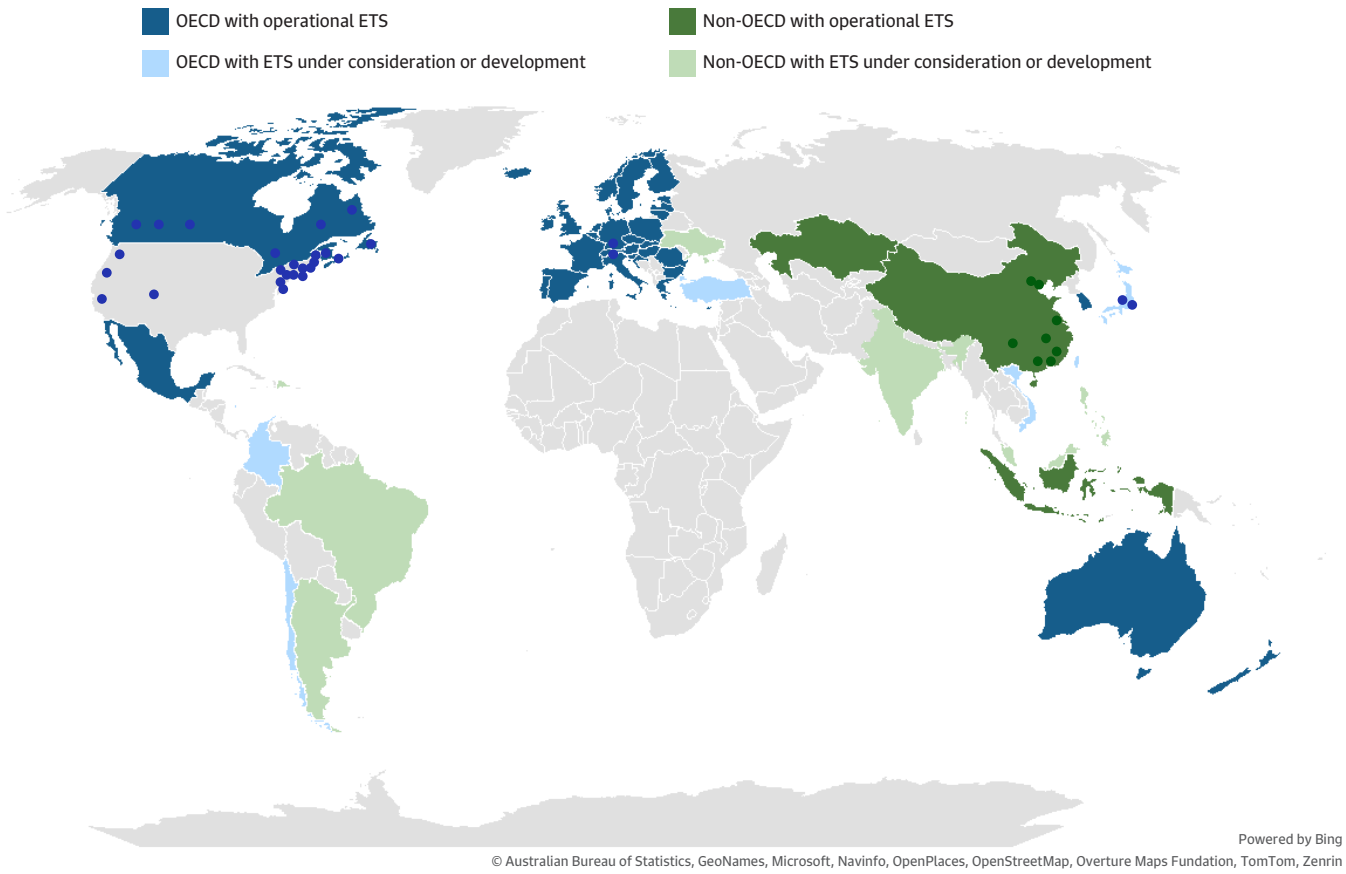
There are three main types of government-regulated carbon pricing instruments: ETSs, carbon taxes, and crediting mechanisms (see Figure 1). Two of these, carbon taxes and ETSs, are compliance-based, while participation in crediting mechanisms is generally voluntary.[2] As of August 2025, carbon taxes were in place in 31 countries and governmental crediting mechanisms in 33 countries (World Bank 2025b).[3] Regarding ETSs specifically, 26 of the operational schemes were hosted in OECD countries and 12 in non-OECD countries. In addition, a total of 16 schemes were either under consideration or development, out of which seven were located in OECD countries and nine in non-OECD countries. Figure 2 shows countries and other jurisdictions that currently have an ETS in place or are either developing or considering one.

Figure 1. Taxonomy of carbon pricing instruments.



Source: Authors.

Figure 2. Coverage of ETSs worldwide as of August 2025.



Source: Authors, based on ICAP (2025a).

Countries today are adopting ETSs for various reasons. The main drivers include countries' net-zero targets and higher NDC ambition under the Paris Agreement; carbon pricing developments in key trade partner countries, including ETSs and border carbon adjustments (BCAs);[4] and ETSs' potential to generate revenue. In 2025, ETSs were estimated to have raised a total of US$69 billion (World Bank 2025b), which many jurisdictions channeled to drive further emission reductions or support environmental sustainability more broadly. Even in existing ETSs, there is potential for greater revenue generation: as of 2025, the majority had not yet reached allowance prices considered compatible with the Paris Agreement's "well below 2°C" target by the World Bank-led High-Level Commission on Carbon Prices, in the range of US$45-$90 per tCO_2e (Stiglitz et al. 2017).

1.1 Effectiveness of ETSs as a Climate Policy Instrument

Literature, including meta-analyses of a large number of existing studies, has confirmed the economic effectiveness potential of both ETSs and carbon taxes as policy instruments in reducing GHG emissions (e.g., Ahmad, Li, and Wu 2024; Bai and Ru 2022; Özturk 2024; CPLC 2017). (See also Box 1 for a comparison of ETSs and carbon taxes.) These studies have found carbon pricing to be particularly effective in carbon dioxide (CO_2)-intensive industries (Ahmad, Li, and Wu 2024).

Box 1. ETS and Carbon Taxes in Comparison

In the climate change policy toolkit, ETSs are classified as a quantity-based economic instrument. As opposed to a carbon tax, which is a price-based economic policy tool that predetermines the price that compliance entities pay for their emissions, an ETS, via its cap, first defines the desired emissions outcome and creates a market to establish the most efficient way to stay within this limit.

Well-designed and executed ETSs can have several advantages over carbon taxes. These include greater certainty over emissions levels, cost-effective mitigation and resource allocation (i.e., easier earmarking of allowance revenue), and incentives for technological and efficiency improvements. They provide financial incentives for companies with lower abatement costs to reduce emissions and allow companies facing higher abatement costs to purchase emission allowances at a lower cost. Unlike taxes, which directly impose an explicit cost on compliance entities, ETSs can, and often do, allocate allowances for free under certain circumstances and conditions, which may facilitate industries' buy-in, while tax exemptions could more easily be perceived as unfair or as weakening the instrument.

On the other hand, carbon taxes are generally considered administratively easier, and they can facilitate broader coverage of emissions, as ETSs generally cover larger emitters only. Carbon taxes may also be a better option in countries with a strong government role in economic activity, although ETSs can be used to gradually introduce market-based tools into centralized systems. While carbon taxes generally guarantee more stable prices, price volatility in ETSs can be addressed by implementing price corridors or other types of stability mechanisms. Also, while some studies suggest that taxes can be overall more effective, they more often face challenges with public perceptions and resistance, with the recent abolition of Canada's federal fuel charge as a case in point.

Findings from literature comparing the effectiveness of ETSs and carbon taxes remain inconclusive, with some studies suggesting taxes are generally more effective and others finding the opposite – including an empirical study of 100 countries by Bai and Ru (2022). That study found that, as of 2021, ETSs had substantially contributed to both emission reductions and the scaling up of renewable energy, while carbon taxes achieved the former to a lesser extent but not the latter.

Overall, however, literature indicates that both instruments can, in practice, be designed to balance both price and certainty over emission outcomes, and their functioning and effectiveness depend both on the context in which they are implemented and the design of the instrument.

Sources: Ahmad, Li, and Wu (2024); Bai and Ru (2022); Government of Canada (2025a); Parry, Black, and Zhunussova (2022); Öztürk (2024).

At the same time, policymakers designing and operating ETSs also face potential pitfalls. For example, low-quality emissions data can undermine both trust in the market and the effectiveness of the entire system (see, e.g., EDF, CDC, and IETA 2015 for measurement, reporting, and verification [MRV]-related challenges in the Kazakhstan ETS). Also, a lack of consistent signaling in the form of frequent changes to, or limited clarity over, future ETS rules can similarly undermine both the system's credibility and environmental integrity. This can happen, for example, when decisions on ETS cap stringency are subject to political or market pressures (see, e.g., Scott 2025, on debates around the EU ETS2 for road transport and buildings). Furthermore, the introduction of other policy instruments in sectors under the ETS cap can result in unpredictable consequences, requiring adjustments and adaptability from the system's regulators (see, e.g., IEMAC 2025 for the case of California's Cap-and-Trade and renewable portfolio standard).[5] The so-called waterbed effect – in which reductions in one sector under the ETS cap driven by other policy instruments cause an increase in emissions in another capped sector because the overall limit remains unchanged – is well established (see, e.g., IEA 2020).

Yet, these same characteristics – the need for high-quality data, predictability over time, and adjustments that take into account real-life interactions with other policy instruments and economic trends – are also strengths of ETSs when well implemented.[6]

A further strength of ETSs is that they are an extremely versatile and iterative climate policy instrument, which can be tailored and adapted to countries' or jurisdictions' circumstances. They can also be implemented in short regulatory phases, which allows for the instrument's scope, stringency, and other design features to be adjusted over time based on lessons learned and changing socioeconomic circumstances.

1.2 Purpose of This Paper

As new countries, particularly from the Global South, engage with ETSs, there is a need to build on past experiences of how ETSs can be designed to deliver effectiveness in varying country contexts. While studies have confirmed the general effectiveness of ETSs in both developed and developing country contexts (Jung and Song 2023), assessments of individual ETSs have largely focused on schemes in the Global North, which have the longest cumulative experience but may not be of direct relevance to countries with developing economies and infrastructure.

Yet, while emerging economies share many structural similarities, every single economy is unique. A well-functioning ETS can look very different from one country or jurisdiction to another, and there is no one combination of the various design elements that will work in all contexts. Each design element has its benefits and downsides and needs to be considered both in the country's context and in relation to other design elements.

This paper adds a policy-relevant contribution to the toolkit of countries exploring new market-based emissions compliance schemes by providing an overview of the major design choices involved when setting up an ETS. It does this by identifying ETS design options in five main areas, presenting the key considerations and trade-offs involved with each, and showing how existing ETSs represent these different options and how these systems have evolved over time. The paper draws on quantitative and qualitative data from the World Bank and the International Carbon Action Partnership (ICAP) on 37 operational ETSs (with Montenegro's scheme excluded due to its extremely limited size).[7] For a full list of the ETSs covered in our benchmark, see Appendix 2.

The paper is structured as follows: Section 2 examines five key areas of ETS design – namely, setting up, coverage, cap, allowances, and flexibility. In each, it asks the following questions:

1. What is this design feature, and what function does it serve?
2. What are the main design choices involved in this area? What are these choices' major strengths and weaknesses, and what are their main trade-offs?
3. What patterns are distinguishable in this area across the existing ETSs today? What trends can be identified over time across or within systems?
4. What issues or challenges may newcomers face when setting up an ETS, and what does experience gained from the existing systems tell us about how to address or mitigate these?

Section 3 provides a discussion of the enabling environments that governments need to develop in parallel with ETS design and concludes with reflections on key takeaways.

ETS Design Choices and Patterns

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Once a government has decided to consider establishing an ETS, it is necessary to define the major objectives the instrument is expected to achieve. Based on our benchmark of existing ETSs, the three most common objectives are: driving emissions reductions; involving the private sector in emissions reduction efforts; and generating or retaining government revenue in systems that auction allowances.

The objectives of an ETS can also be time-specific. In China, the first compliance cycle of the national ETS had a set of initial goals related to building the market and its participants' awareness and capacity – similar to many ETS pilots.

Clarifying from the outset the overall role of the ETS in the broader climate policy instrument mix is also important, both in relation to the coverage of total emissions and in relation to other instruments implemented under the ETS cap. In many countries, ETSs serve as the leading policy instrument for emission reductions, with examples including the EU, South Korea, and New Zealand. In others, they function as part of a broader policy instrument mix, such as in California, U.S. In yet others, they target reductions in specific sectors, such as in Germany and Austria, where national ETSs currently cover sectors not yet covered by the EU ETS, or in Canada, where a national Cap-and-Trade system has been proposed for emissions from the oil and gas sector in parallel to various federal and subnational carbon pricing schemes.

Governments also need to make a number of key design choices, which relate to the phase leading up to the full operationalization of the ETS; the system's coverage, cap type, and trajectory; the method of allocating allowances and related price and revenue reallocation targets; and the use of various flexibility options. These are detailed at a high level in Figure 3. (See also Appendix 1 for a breakdown of the prevalence of each design option component across existing ETSs.) The remainder of this section provides a detailed analysis of each of these areas and uses the ETS benchmark to show patterns and provide concrete examples of the application of the different design choices. (Appendices 3-7 provide design element-specific, table-based summaries of the data underpinning the benchmark conducted in this study.)

Figure 3. Major design elements of an ETS.

Coverage		Cap	Allowances			Flexibilities
Sectors	GHG		Allocation	Price stability	Revenue reallocation	
Industry	Carbon dioxide (CO_2)	Absolute	Free allocation	Market stability reserve	No revenues (Free Allocation)	Offsetting
Power generation	Methane (CH_4)	Intensity	Partial auctioning	Price ceiling	Allocated to climate action	Banking
Mining and extractives	Nitrous oxide (N_2O)	Other	Full auctioning	Price floor	Allocated to household support	Borrowing
Buildings	Hydrofluorocarbons (HFCs)			(Introductory) set price	Government budget (unspecified allocation)	Linkages
Transport	Perfluorocarbons (PFCs)			No mechanism		
Aviation	Sulfur hexafluoride (SF_6)					
Maritime	Nitrogen trifluoride (NF_3)					
Agriculture						
Waste						

Source: Authors.

2.1 Setting Up and Piloting

The steps governments take before having a fully operational ETS in place generally follow a similar pattern: from planning to piloting to full implementation. First, governments undertake planning, which can include objective setting, initial stakeholder engagement, impact studies, and the design of the operating model for the system. Planning phases often start with an announcement of consideration and include a formal decision to implement an ETS.

Second, after a decision has been made to move forward, the next step is often a pilot phase. This period can be used to test the system design and rules in practice, as well as to identify and address potential issues before full operationalization. It can also be used to improve emissions data and related reporting systems, collect data on market behavior, and build confidence in the effectiveness and reliability of the system among market participants and other stakeholders.

Finally, an operational phase sees full enforcement kick-in, including penalties for noncompliance, possibly a broader participant base than during the pilot, and generally more stringent requirements on ETS participants than during the pilot phase. Once fully established, ETSs generally operate in phases, each with predefined design parameters and rules. Each new phase gives the government the opportunity to revise the design and rules based on experiences from previous phases. This usually means moving toward broader coverage, more stringent rules, and higher environmental ambition.

Our benchmark of existing national-level systems shows significant variation in the duration of all three steps. The average length of the planning phase has been around four years, with some countries spending as little as one year and others as long as eight years preparing the ground for a pilot.[8] Experiences suggest that this phase should not be rushed: the rapid rollout of Kazakhstan's ETS – from setting its legal foundations in 2011 to developing and approving its rules in 2012, to piloting in 2013 and full implementation in 2014 – has been identified as the major reason for the government's decision to temporarily suspend the system in 2016-2017 to make operational amendments. The accelerated implementation did not leave time for developing a strong MRV system, building capacity, establishing sound regulations, or achieving buy-in from system participants (Sammut, Gulbrandsen, and Wettestad 2018; Asia Society Policy Institute 2025a). Technical literature identifies all these as key steps in laying the ground for ETS implementation (PMR and ICAP 2021).

Once the system parameters are set, most ETSs are rolled out progressively. In the countries covered by our benchmark that had pilot-type arrangements, these were in place for an average of three and a half years, although with major variations across systems. Among the older ETSs, the EU ETS's first phase (2005-2008) was run as a pilot, and the Swiss ETS began with a five-year voluntary phase (2008-2012). By implementing eight subnational pilot ETSs, the Chinese government was able to collect a vast amount of experience for the country's national ETS (operational since 2021). These were launched in 2013-2016, and some remain active, covering sectors not yet included in the national system.

However, sometimes even long preparatory phases do not guarantee a timely launch, as in the case of Mexico, where, despite several years of preparation, followed by a two-year pilot (2020-2021) and a one-year transitional phase (2022), a national ETS had not yet been fully operationalized at the time of writing. One of the major obstacles has been the existence of subnational carbon pricing instruments (see, e.g., Gozain 2024). Unlike in China, local-level systems in Mexico were not originally designed to feed into a national-level scheme and, conversely, were not fully considered in the design of the national system, providing an important lesson on the need to take into account interactions with other policy instruments and to ensure their harmonization (see Greenhouse Gas Protocol 2014 for technical literature).

On average, the national ETSs in our benchmark took more than six years from planning to full implementation. Two key findings stand out: given the significant role ETSs tend to play in countries' industrial policies, their setup is time-intensive and needs to be context-specific. The benchmark shows that, despite the accumulating experience from different jurisdictions, ETSs still take many years to set up and require the consideration of multiple interacting variables.[9]

In parallel to designing an ETS, a robust ETS "infrastructure" is equally crucial for successful implementation and objective attainment, and these would merit a separate, deeper analysis.[10] elements of ETS infrastructure include, but are not limited to, the legal and regulatory framework; the MRV system; registries, platforms, and other data management systems; stakeholder engagement; and capacity building. The complexity of these elements and their influence by and on the ETS design requires careful planning and the mobilization of resources in the earliest planning stages, all the way through and beyond the operationalization of the system, to ensure a coherent and functioning system and to avoid delays in operationalization or a suspension of the system.

2.2 Coverage

When approaching the design of an ETS, the first substantive design element is the system's scope or coverage: which sectors and GHGs will be covered, and which entities will be subject to compliance. Ensuring the appropriate coverage is crucial for setting up an ETS, as it not only determines the type and sources of emissions to be regulated by the system, but it also influences the remaining design choices and determines the ETS's degree of ambition, impact on the economy, and administrative complexity.

The determination of coverage is unique to each jurisdiction, driven both by its economic profile (e.g., emission distribution, economic structure, and sectoral composition) and capabilities (e.g., MRV capacity, political buy-in, and infrastructure and institutional readiness). Given that these factors tend to evolve, an ETS can be designed to start with a more modest scope and expand over time in two ways:

Gradual tightening of regulations: An ETS can be introduced through a pilot that focuses on MRV and capacity building, with minimal financial obligations on the participants in the early years. More stringent environmental targets, MRV obligations, and penalties, along with more refined approaches to allowance allocation and trading, are then introduced over time. For example, the Mexican ETS launched a two-year pilot followed by a transition phase. The pilot allowed for testing of the initial ETS design and building capacity, in addition to improving emissions data. Feedback from the pilot informed enhancements to the ETS design in preparation for the introduction of financial compliance obligations in the operational phase.

Gradual expansion of scope: An ETS can also be designed to introduce obligations on a selected set of sectors and GHGs in the early phases and gradually widen the scope. This approach allows for revenue generation while also cushioning the impact on strategic and energy-intensive and trade-exposed (EITE) sectors. New Zealand adopted this approach by spreading the inclusion of sectors across a six-year period between 2008 and 2013. Similarly, the Chinese national ETS is expanding beyond the power sector to industrial sectors (Kuo 2025). Both ETSs adopted a "hybrid approach" to sectoral coverage by having a non-obligation period for the added sectors, requiring them

to report on emissions only, without introducing financial implications, to allow the participants to familiarize themselves with the system.

While the sectoral and GHG scopes should be primarily informed by the main objectives of the ETS, trade-offs accompanying related choices must be considered as a key part of the design process.

First, maximizing emission reductions requires extensive "implementing infrastructure" and MRV capabilities, which are costly for both the government and the participating entities, apart from a set of administrative and technical challenges. This specifically applies to the measurement of emissions in diffuse sectors such as agriculture, buildings, and transport. Second, the inclusion of hard-to-abate and EITE sectors increases the potential for both emission reductions and revenue generation but could also result in large financial losses for businesses and affect the jurisdiction's wider economy. Yet, if these sectors were excluded to minimize economic disruption in the short to medium term, the environmental impact of the ETS would be limited, especially if large emitters were excluded or given preferential treatment.

There are three main coverage-related design components: sectors, GHGs, and participants. Table 1 highlights five key areas to be considered when deciding on the system's coverage in light of its priorities and potential trade-offs with regard to these three components. The following subsections provide a more detailed discussion of the three coverage components.

Table 1. Areas of consideration for determining ETS coverage.

Area	Description	Key considerations
Emission contribution	The share of contribution to the jurisdiction's total emissions.	• It is important to strike a balance between emissions coverage, economic disruption, and system credibility.
Feasibility of MRV	The technical and financial ease of generating and reporting high-quality emissions data in the desired format and frequency.	• Accurate emissions data is the foundation of an ETS that delivers as designed, including by allowing regulators to ensure compliance. • High-quality data is also required to build trust in the system and market.
Trade exposure	The level of trade exposure globally.	• In many economies, the highest-emitting industries are also the most trade-exposed, which complicates decision-making on their inclusion. • Trade-exposed sectors are vulnerable due to the risk of carbon leakage and need adaptive strategies and flexibility measures to mitigate negative economic impacts, which can be achieved through tailored design choices across ETS elements.
Revenue retention potential	The level of exposure of the selection to BCAs that deduct carbon prices paid at the country of origin.	• Sectors exporting significantly to jurisdictions with BCAs (e.g., the EU Carbon Border Adjustment Mechanism [CBAM]) face carbon cost liabilities unless they can demonstrate equivalent domestic carbon pricing. • High exposure to BCA jurisdictions can erode price competitiveness, especially for carbon-intensive goods, and reduce net government revenue (hence "revenue retention potential"). • Prioritizing BCA-exposed sectors for inclusion may help maintain competitiveness and keep revenues in the country of origin.
Suitability of market-based instruments	Any major limitations or obstacles to the inclusion of the sector or GHG in an ETS.	• In some cases, market-based instruments, specifically an ETS, may not be the optimal approach for addressing emissions from certain sectors or GHGs. • This assessment is generally context-specific and can be influenced by factors such as government-led market prices or the availability of other instruments (e.g., a crediting mechanism).

Source: Authors.

2.2.1 Sectors

Most ETSs begin by covering sectors that are both highly emissions-intensive and administratively feasible to regulate – namely, electricity generation and large industrial production. These sectors offer high mitigation potential and are typically characterized by relatively centralized actors and concentrated sources of emissions, and, consequently, well-established and relatively straightforward MRV practices. In contrast, emissions from sectors such as transport, buildings, agriculture, and waste tend to be more diffuse, harder to monitor, or more politically sensitive due to the direct impact on end consumers. As a result, these sectors are frequently excluded from initial coverage or regulated through complementary policy instruments.

Several key trade-offs arise when deciding which sectors to include. Broader sectoral coverage increases emissions coverage and can improve overall cost-efficiency by enabling abatement in a wider set of activities. However, it may also increase administrative complexity, introduce greater MRV uncertainty, and raise resistance from sectors less accustomed to environmental regulation. There are both common patterns and notable differences in how the 37 existing ETSs cover sectors under their scope:

- **Industry and power generation:** Heavy industry and the power sector are the most widely covered by ETSs due to their large and concentrated emissions, alongside the mature MRV protocols in both sectors. Out of all operational systems, 34 (92%) cover large point source industries,[11] and 23 (62%) include the power sector. This not only makes them suitable for inclusion but also positions them as ideal sectors with which to launch an ETS.[12]

- **Mining and extractive industries:** Covered in 17 ETSs (46%), this specific sub-type of industry is usually included in resource-rich jurisdictions. While emissions typically originate from point sources, unlike in other industry sectors, there are still many MRV and operational challenges, as research estimates that 75%-85% of emissions are fugitive emissions (IGF 2024), which are challenging to measure, especially in mining sites where required MRV infrastructure and sensors may be difficult to set up.

- **Buildings and transport:** Covered by 13 (35%) and 12 (32%) ETSs, respectively, these two sectors are generally challenging to include in an ETS due to the diffuse nature of emissions and the degree of direct impact on households and end consumers. Some jurisdictions choose to address fuel combustion from these sectors by regulating upstream fuel suppliers (e.g., California's Cap-and-Trade system), while others are introducing a separate cap to manage emissions in these systems (e.g., EU ETS2). Some ETSs also regulate emissions associated with electricity consumption in large commercial and industrial buildings (e.g., the Japanese city ETSs).

- **Aviation and maritime emissions:** Aviation emissions are included in nine ETSs (24%), covering domestic or intra-regional flights within the jurisdiction of the ETS, while maritime is covered in just five ETSs (14%). The latter has been gaining more traction with its inclusion in the EU ETS in 2024 and with the UK conducting public consultations to study the sector's inclusion in 2026 (Reuters 2024).[13] Both the aviation and maritime sectors face multiple challenges for inclusion, such as MRV accuracy and the competitive nature of the industries. Importantly, there are parallel international developments to price and manage emissions from these sectors through the International Civil Aviation Organization's (ICAO) Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) and the International Maritime Organization (IMO).

- **Agriculture, forestry, and fishing:** Despite accounting for up to a quarter of global GHGs (IPCC 2022), emissions from these sectors are included in seven[14] ETSs (19%), driven largely by MRV complexity, given the large volume of highly dispersed point sources and the difficulty of applying a single price across diverse participants (i.e., smallholder farmers and large-scale commercial entities). New Zealand, for instance, has removed all compliance obligations on agricultural activities from the scope of its ETS, including reporting, and instead is considering a dedicated policy instrument aimed to come into force as of 2030 (New Zealand Ministry for the Environment 2024).

- **Waste:** Included in only six ETSs (16%), waste emissions are dominated by methane emitted from landfills and other industrial processes, posing high MRV challenges due to site fragmentation and the challenging site settings. Some systems, such as the Australian Safeguard Mechanism, have chosen to regulate large landfills only.

Across jurisdictions, our benchmark shows a trend of ETS regulators starting with a narrow sectoral focus and expanding over time. Another identifiable trend is the choice to target the power sector in the early stages, with technical literature generally identifying this sector as an ideal starting point, as emissions are large and centralized, and high-quality data and MRV technologies are mature (e.g., IEA 2020). This pattern is visible in the ETSs in the EU, South Korea, and China (national level), among others. A study on the Chinese national ETS notes that limiting inclusion to the power sector in the early stages of the system allowed regulators to focus on various infrastructure elements, such as MRV, in addition to operationalizing design elements such as allowance allocation in a "controlled environment" (Sun et al. 2025).

However, the same study emphasizes the importance of broadening coverage for long-term effectiveness, noting a similar pattern in China's scope expansion beyond the power sector into industrial sectors to that of the EU ETS, which started with the power sector and industry , and which subsequently expanded to include aviation, waste, maritime, and, most recently, buildings and transport through the EU ETS2 (Sun et al. 2025). Similarly, California's Cap-and-Trade system was expanded from stationary combustion to include transport and buildings through the inclusion of fuel distributors. These examples illustrate the general tendency of systems to start with a narrow scope in order to enhance the general mechanism and, once operational stability, enhancement, and optimization have been achieved, consider expansion to not only enhance environmental integrity but also improve market dynamics, as discussed further in section 2.2.3 on participants.

2.2.2 Greenhouse Gases (GHGs)

The main GHGs considered when designing ETSs are those with the highest overall global warming potential, starting with carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), followed by the four main fluorinated gases: hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3). Each of these main GHGs is unique in its origin and climate impact, as outlined in Table 2.



Table 2. Primary sources of GHGs across sectors.

		GHGs						
		CO_2	CH4	N_2O	HFCs	SF_6	PFCs	NF_3
GHG attributes	**GWP100**	1	27-30	273	124-1,526	25,200	6,630-11,100	17,400
	Atmospheric lifetime (years)	100+	11.8	109	1.4-14	3,200	Thousands	500
	Share of 2019 global GHG emissions (%)	76%	19%	5%	2%			
Sectors	**Power**	Fossil fuel combustion		Minor emissions from high-temperature combustion		Leakage from high-voltage transmission equipment		
	Industry	Fossil fuel combustion and process emissions (i.e., cement, steel, lime)	Some process-related emissions (i.e., petrochemicals)	Chemical production	Production/use in refrigeration, foams, and aerosols	Aluminum smelting and semiconductor manufacturing	Leakage during operations and maintenance of electrical switchgear	Semiconductor and LCD panel manufacturing
	Mining and extractives	Combustion in heavy equipment and processing	Fugitive emissions					
	Transport	Fossil fuel combustion		Minor by-product of catalytic converters and combustion				
	Buildings	Fossil Fuel combustion for space and water heating		Minor emissions from high-temperature combustion in heating systems	Leakage during use and disposal of cooling and refrigeration systems			
	Agriculture	On-farm fuel use	Enteric fermentation and anaerobic manure management	Fertilizers, manure, and urine deposition				
	Waste	Minor emissions from incineration of waste	Anaerobic decomposition in landfills and wastewater	Wastewater treatment and sewage sludge management	Possible leakage from discarded refrigeration equipment			Possible trace emissions from discarded electronics
	Land use, land use change and forestry	Deforestation, biomass burning, tillage, and peat drainage	Minor emissions from wetland drainage and biomass decay	Fertilized soils and drained organic soils				

Source: Authors, based on IPCC (2022).

The 37 ETSs included in our benchmark can be divided into three archetypes when it comes to GHG scope:

- **Covering only CO_2:** Fifteen ETSs (~40%) only cover only CO_2, including the Chinese (national and most pilots), German, Kazakh, and Mexican ETSs, alongside the Japanese and some U.S. subnational ETSs. These systems tend to cover CO_2-dominant, point source–emitting sectors such as power (seven ETSs) and industry (13 ETSs), but may also extend beyond, such as the German ETS, which was established to cover fuel use in all sectors not included under the EU ETS. While opting for a CO_2-only system can significantly simplify MRV requirements, it limits the system's overall impact. With the maturity of MRV protocols and technology for data collection, and its predominance across many sectors, CO_2 is the ideal candidate for systems beginning with a narrow yet impactful scope.

- **Covering a subset of gases:** Three ETSs (8%) cover CO_2 and two or three other gases. The Indonesian ETS covers CO_2, CH4, and N_2O despite only including the power sector. The EU ETS covers CO_2, N_2O, HFCs, and PFCs across the power, industry, maritime, and aviation sectors. Upon its separation from the EU, the UK opted to exclude HFCs and the maritime sector and add the mining and extractives sector instead. In some cases, jurisdictions begin by regulating targeted GHGs and expand coverage over time. This has been the case with the EU ETS, which began as a CO_2-only system and gradually incorporated select process-related GHGs in later phases. As discussed earlier, this approach can also be used to allow for the development of MRV capabilities prior to introducing financial obligations.

- **Covering all gases:** The remaining 19 ETSs (51%) cover all gases. Despite what one might expect, there is no direct correlation between the breadth of GHG coverage and sectoral scope, as only nine of these ETSs cover four or more sectors. All 19 ETSs cover industry, 13 cover power or mining/extractives, and 10 ETSs cover all three sectors. In most cases, all GHGs are included in principle but might not be actively monitored in practice due to their negligible volumes in the included sectors within the jurisdiction.[15] While covering all GHGs may increase the impact of an ETS, many technical challenges can arise. These include MRV of diffuse sources such as the agricultural sector or emissions from HFCs, which in practice have millions of sources across their value chains (e.g., leaks from refrigerants and coolants in buildings or at disposal).

It is important to note that the availability and quality of top-down emissions data – and the maturity of national MRV systems, which can form a good basis on which to build ETS MRV systems – vary significantly across jurisdictions. Generally, developed countries tend to have a longer history of collecting GHG data across a broader range of gases. While these differences reflect the principles of global climate governance, the resulting asymmetries in data quality and MRV readiness also have direct implications for the design and implementation of ETSs. Countries with more limited emissions reporting experience and capacity may therefore choose to adopt narrower gas or sectoral scopes or phase in ETS coverage gradually as MRV systems mature.[16]

2.2.3 Participants

In parallel with deciding on the sectoral and GHG scope of ETSs, the number and size of system participants (i.e., regulated entities) also require careful consideration. This is important to ensure overall efficiency, manage administrative costs, (both for the regulator and for compliance entities) and support market liquidity and stability. Too many compliance entities could make an ETS administratively complicated, while too few could result in low levels of market transactions and increase the possibility of market manipulation. Covering small emitters also generally increases administrative costs at both ends.

A key related consideration is the point of regulation, which is generally decided at the sectoral level. Once sectoral and emissions coverage have been defined, the point at which emissions are regulated in each sector provides the main mechanism for defining the number of entities covered by the ETS. Sometimes, changing the point of regulation up- or downstream from the point of emissions can enable targeting an optimal number of participants in a sector. As mentioned above, transport fuels are often regulated upstream, at the fuel supplier level, which keeps the number of ETS participants manageable, as regulating individual fuel consumers (e.g., vehicle owners) would not be practically possible. Some ETSs, such as the city schemes in Japan (Tokyo and Saitama), regulate large corporate buildings, which are situated downstream from the point of emissions. In these systems, the location of large power plants outside of the ETS jurisdictions prevented their regulation at the point source (Eden, Montes De Oca, and Haug 2019). The Tokyo and Saitama ETSs together cover approximately 1,200 buildings and 600 factory installations (ICAP 2025a).

The most common point of regulation, however, is the point source (e.g., an industrial smokestack), which is also where MRV is the most accurate and where ETSs can generally be set up in a way that balances the need for liquidity and market stability with avoiding placing undue administrative costs on smaller emitters.

Our benchmark shows that, in practice, the total number of system participants varies greatly (as ETSs are set up in highly different jurisdictions) in different institutional and structural contexts, and with different objectives. At the higher end of the range in both emissions coverage and number of participants, the EU ETS regulates a total of 8,500 installations, along with 2,600 aircraft operators and shipping companies (with a cap of approximately 1.4 $GtCO_2e$ for point source installations). The Chinese national ETS is in the process of expanding from approximately 2,200 power sector entities (with a cap of approximately 5 $GtCO_2$) to 3,700 entities also covering steel, cement, and aluminum (with a cap of about 8 $GtCO_2e$) (ICAP 2025a).

Among the smaller ETSs in terms of total emissions coverage, the Swiss ETS covers 95 stationary installations and 205 aircraft operators (caps totaling approximately 5 $MtCO_2e$) (ICAP 2025a). The sub-provincial Shenzhen pilot ETS in China regulates about 700 companies (cap of approximately 34 $MtCO_2$), and the New Zealand ETS covers 165 mandatory participating entities (cap of around 19 $MtCO_2e$) (ICAP 2025a). The low number of point source entities in the New Zealand ETS is due to the decision to regulate the system upstream, including for lower administrative costs (Eden, Montes De Oca, and Haug 2019). As already noted, California and Québec have made similar choices for transport fuels and heating.

Emissions trading schemes also usually set a minimum threshold for emissions or thermal/production capacity for the inclusion of installations (facilities/sites) as a further way to manage administrative costs for compliance entities. A commonly used threshold is 25,000 tCO_2e or equivalent in generation (for electricity) or production (for other industries) capacity (Eden, Montes De Oca, and Haug 2019), but higher and lower limits are also implemented. For example, Alberta's Technology Innovation and Emissions Reduction (TIER) Regulation and Australia's Safeguard Mechanism only require mandatory participation for facilities with emissions of 100,000 tCO_2e or higher (ICAP 2025a). At the low end is the Shanghai pilot ETS, with a threshold of 10,000 tCO_2 for certain sources (ICAP 2025a). Governments can also simplify MRV obligations for smaller entities with the same objective in mind.

Generally, systems with highly homogeneous participants (i.e., similar allowance demand and supply profiles) and/or a low number of participants can be expected to experience lower liquidity and higher price volatility. Conversely, a heterogeneous mix of compliance entities can enable more effective mitigation, as differences in marginal abatement costs are exploited more widely. Despite the scale of the Chinese national ETS, its initial exclusive coverage of the power sector has been linked to the low trading volumes and liquidity seen in its initial years (e.g., Sun et al. 2025). However, liquidity and prices are also affected by multiple other factors, including cap stringency, allowance methods (auctioning or free allocations), participation of non-compliance entities in trading activities, and how auctioning is organized, among others.

2.3 Cap

The emission cap is the most crucial feature for regulating system outcomes and setting the overall level of ambition in an ETS. The cap effectively determines how much mitigation is achieved from implementing the ETS. There are two major ways to set a cap: either by capping the total emissions or by limiting the intensity of emissions. The level and evolution of the cap over time are political choices, informed by countries' and jurisdictions' overall emissions reduction priorities and targets, but common patterns can be identified, as our benchmark shows.

2.3.1 Cap Type

All ETSs place some form of quantitative limit on emissions under their scope. There are two main approaches to this: an absolute cap, expressed as a system-wide emissions limit (tCO_2e), and an intensity-based cap, defined through industrial output-specific emissions intensity targets (tCO_2e per unit of production). In an intensity-based cap system, the cap in absolute terms is always established after the compliance period's close and equals total production multiplied by the emissions intensity target(s). Consequently, total emissions from the capped sectors in systems applying this cap type fluctuate based on industrial production rates.

Under both main cap types, emissions can in principle be driven down to achieve the same absolute emissions outcome over time by tightening emissions intensity targets. The main difference, therefore, lies in the shorter-term fluctuations in the de facto cap level. The choice of cap type, however, has implications for how an ETS operates, and each cap archetype has both strengths and weaknesses compared to the other:

- **An absolute cap**, also known as Cap-and-Trade, provides market certainty and facilitates policy planning by ensuring a fixed and easily communicable emissions outcome. In the absence of design features to provide short-term flexibility, an absolute cap can become economically constraining in periods of rapid production growth. However, when economic growth slows down, it frees up allowances, leading to lower compliance costs. Distributing a fixed volume of allowances across sectors can also be more cumbersome, given all industries' general interest in promoting a continuation of business-as-usual conditions. This requires the regulator to often make difficult decisions and gain industrial buy-in on the most effective or equitable distribution. In practice, all systems operating with an absolute cap contain mechanisms that indirectly provide flexibility to the cap (see Sections 2.4 and 2.5) in order to protect industries during periods of output growth.

- **An intensity/output-based cap** is sometimes chosen when it is deemed difficult to set an absolute cap. Many emerging economies that have opted for intensity-based caps generally have high economic growth rates, which can be perceived to complicate setting an absolute cap, where the only feasible way to implement one would be to initially allow it to increase. While intensity-based caps allow for more flexibility in fast-growing economies (or in periods of rapid production growth), they add burden on industries during economic slowdowns: industrial energy intensity tends to increase when operating at lower capacities, leading to higher demand for allowances (and hence higher compliance costs) at a time of economic hardship. Intensity-based cap systems also concentrate market participants' focus on their emissions intensity and may, in economies with increasing output levels, hinder regulators' ability to encourage companies to implement long-term mitigation strategies (Duan 2023). However, as noted above, the stringency of the cap ultimately determines its level of ambition, regardless of the cap type.

The majority of operational ETSs have an absolute cap. Out of the 37 operational ETSs included in our benchmark, 23 (62%) have an absolute cap (see Figure 4). If China and Canada – which have subnational ETSs along with a national-level scheme – are excluded from the count, 15 out of the 19 operational systems have an absolute cap. The national ETSs in China and Indonesia are the clearest examples of existing output-based systems.

Figure 4. Cap types in operational ETSs.



1. Baseline and Crediting System

Source: Authors, based on ICAP (2025a).

In China's national ETS, the output-based cap plays a transitional role. The effectiveness of this cap type in achieving the country's emission reduction targets has been actively debated, and governmental entities have indicated that the system will fully transition to an absolute cap by 2030 via a transition period during which both cap types would be implemented in parallel (Reklev 2025). Similar to many other countries, the Chinese national ETS is closely aligned with its NDC targets, which have included a peaking target and an intensity-based target, but are expected to shift to a combination of intensity-based and absolute targets (Myllyvirta 2025). Further approaches to setting a cap are discussed in Box 2.

Box 2. Cap Mechanisms Beyond Absolute and Output-Based Targets

There are a few systems with more unconventional cap mechanisms. The German and Austrian national ETSs, in implementation since 2021 and 2022, respectively, cover heating and transport fuels and operate with fixed carbon prices. However, both will transition into the EU ETS2 from 2027. Canada has had in place a federal output-based pricing system, which has given its provinces the option to implement tailored carbon pricing schemes as long as their price levels correspond to a federally set minimum.

Emissions compliance markets that operate via intensity-based caps sometimes set their targets relative to a baseline emissions trajectory, making them de facto baseline-and-credit systems, similar to the Kyoto Clean Development Mechanism. However, unlike conventional carbon crediting schemes – which are always voluntary for their participants – ETS-type crediting schemes are compliance-based and generate credits that can be traded among participants in the scheme. An example of this type is the Australian Safeguard Mechanism, which has been operating since 2016 and sets targets relative to industrial facility-specific (and, in the case of electricity, sector-wide) declining emissions-intensity baselines.

India's new Carbon Credit Trading Scheme, which builds on the country's Perform, Achieve and Trade (PAT) energy efficiency scheme and is being rolled out from 2025, is another example of a system that sets output-based caps relative to emissions baselines. Japan's voluntary Green Transformation ETS (GX-ETS), which will transition into a compliance-based ETS from 2026, also functions as a baseline-and-credit system, with companies setting their own targets relative to their 2013 emission levels, while credits are allocated only to entities that stay within a government-set threshold.

Sources: Authors; ICAP (2024a, 2025b); Government of Canada (2025b); PIB (2025); Asia Society Policy Institute (2025b).

Establishing any ETS cap requires robust emissions data, albeit early ETS phases can also be used to collect and improve this data. In practice, however, it is in principle easier to set up a multi-sector ETS with an absolute cap that uses historical emissions as the basis for allowance allocation (see Section 2.4.1) than a multi-sector ETS with output-based targets, as the latter typically requires much more detailed data about industrial processes and related emissions at the installation level, as well as product-specific output projections.

The Chinese national ETS and Indonesian ETS initially cover only the countries' power sectors, where setting a product-based cap (i.e., tCO_2/MWh) is straightforward. In China, MRV obligations for further industrial sectors have been in place since 2015 (ICAP 2025a). The Indian scheme, still under operationalization at the time of writing, is similarly based on more than a decade of data collection via the PAT scheme (see Box 2), and Turkey's ETS, which is expected to start piloting in 2026, builds on the country's well-developed MRV system (ICAP 2025c).

2.3.2 Cap Progress Over Time

As discussed in Section 2, given the uniqueness of ETSs as climate policy instruments that determine the emissions (or emissions intensity) outcome of all emitting activities covered under their cap, countries and other jurisdictions often implement them as the primary mitigation instruments in key sectors. For this reason, countries' ETSs are generally linked to or aligned with their broader mitigation targets, such as Paris Agreement targets (nationally determined contributions). Explicit examples of this include the EU and China.

Most ETSs operate in phases, which are generally divided into compliance periods. The former refers to longer-term periods with specific rules and regulations, including those related to the cap, whereas the latter are typically one-year intervals during which emissions reduction obligations are set, measured, and complied with through the surrender of allowances. Phases serve to provide longer-term signals and certainty for system participants and investors.

Consequently, longer phases are considered better from an environmental signaling perspective. Longer phases may also provide ETS participants with temporal flexibility relating to allowance purchases and emissions reductions (ICAP 2023).

At the same time, new phases provide an opportunity to expand the scope or stringency of the system via variables such as GHGs, sectors, inclusion criteria, noncompliance penalties, allowance allocation or auctioning rules, stability or flexibility provisions, or the cap itself (i.e., absolute or intensity-based limits on emissions).

Our benchmark shows that there is no standard length for an ETS compliance period, and the length of phases can vary both over time and based on context-specific factors, such as alignment with high-level climate policy targets or regulatory cycles. Shorter phases in the early years of ETSs have been typical, as they allow systems to integrate lessons learned into their market design more quickly.

The EU ETS, for example, has aligned its phases with the bloc's UNFCCC-related targets: 2005-2007 (phase 1), 2008-2012 (phase 2, aligned with the Kyoto Protocol's first commitment period), 2013-2020 (phase 3, Kyoto Protocol's second commitment period), and 2021-2030 (ending in the EU's first NDC target year). California's Cap-and-Trade system (three-year phases), the Indonesian ETS (three-year phases), and the Korean ETS (four-year phases) all started with shorter initial phases to enable faster improvements to market regulations and MRV systems. The Chinese national ETS, in turn, has started without phases. The system's compliance period was initially two years (2021-2022), which provided market participants more time to comply with the new MRV and market regulations, and the system transitioned to one-year cycles from 2023 (ICAP 2024b).

The main role of the ETS cap is to determine the level of overall ambition of the system, with the expectation that it becomes more stringent over time. Given that many ETSs expand their scope, as discussed above, examining the evolution of the total system cap alone can be misleading. Our benchmark shows that, when scope expansions are taken into account, the vast majority of the 26 ETSs that have been running for more than five years (i.e., established pre-2020) have increased the stringency of their caps over time. In only some cases have total capped emissions remained at similar levels to those at the start of operations.[17] Box 3 provides more detailed examples from the EU and Korean contexts.

Box 3. Evolution of Cap Coverage and Stringency – Cases of the EU and South Korea

The EU ETS, for example, started with a cap of 2,096 $MtCO_2e$ in 2005 (phase 1). Iceland, Liechtenstein, and Norway joined the scheme in 2008 (phase 2), and N_2O was also added to the scope. Domestic aviation was brought in under a separately calculated cap of 221 $MtCO_2e$ in 2012. In 2013, further sectors were added to the scope, the cap was set at 2,084 $MtCO_2e$, and a linear reduction factor of 1.74% was introduced (phase 3). From 2021, the linear reduction factor, which increases from 2.2% to 4.4%, will be applied through 2030 (phase 4). Also in 2021, the UK left the EU, while maritime emissions were included in 2024. In 2024, after the various expansions, the EU ETS overall cap was 1,386 $MtCO_2e$, and that for aviation 27.6 $MtCO_2e$. Even when accounting for emissions now covered under the UK ETS, 86.7 $MtCO_2e$ (2025), the overview shows that emissions covered under the EU ETS have declined significantly since the start of the system two decades ago.

The Korean ETS, which applies an absolute cap, started with an annual cap of 540.1 $MtCO_2e$ in 2015, which increased to 585.5 $MtCO_2e$ in 2017 (phase 1), and again to 593.5 $MtCO_2e$ in 2018 (start of phase 2). Phase 2 saw an increase in the sectoral scope but also a tightening of the cap to 562.5 $MtCO_2e$ in 2020. In phase 3, sectoral coverage was again expanded, and the phase started with a cap of 589.3 $MtCO_2e$ in 2021, which will decline to 567.1 $MtCO_2e$ in 2025. The fluctuation in the Korean ETS cap not only reflected the sectoral expansion but was also designed for an emerging economy context, where there was a need to account for the opening of new industrial facilities and increasing product output in existing ones.

Sources: Asia Society Policy Institute (2024); European Commission (2025a); ICAP (2025a).

Finally, there are several ways in which absolute caps also generally de facto "fluctuate" over short periods of time. This is a result of design choices in other areas, particularly related to allowance allocation and price stability (discussed in Section 2.4).

First, ETSs generally make adjustments to accommodate events such as new entrants or to better align free allowance allocations with companies' actual outputs (instead of historical output levels). For example, many ETSs include under or on top of their cap a new entrants' reserve that enables the provision of additional allowances for new industrial facilities that meet the inclusion criteria or for installations that significantly increase their output. In the case of the EU ETS, for instance, this threshold is a 15% increase in production (or a 15% decrease, which may prompt a downward revision) (European Commission 2025b).

A second example relates to the allocation of free allowances (see Section 2.4), where benchmarked, actual output-based (or so-called OBA) allocation involves fully reflecting changes in production in the level of free allocations ex post. Examples of ETSs that apply this allocation method are California, Québec, and New Zealand, albeit even ETSs that use benchmarked, historical output-based allocation also often allow for some adjustments based on actual production, such as, for example, the EU ETS in its current phase (Kuneman et al. 2022).

2.4 Allowances

Once the overall level of ambition in the ETS has been established in the system cap, governments have various ways to manage how emission reductions and related costs are distributed among system participants. Much of this happens through choices relating to how "rights to emit," or allowances, are distributed within the system. Design choices also relate to, and affect, how the carbon price signal is transmitted through the system, and how revenue generated from allowance auctions is reallocated within or outside the ETS.

2.4.1 Allocation

All ETSs operate by making available allowances that, in total, amount to the overall system cap. Each allowance equals the right to emit a tonne of CO_2e, and ETS participants (companies or industrial facilities) are allowed to trade allowances to achieve cost-effective mitigation. At the end of each compliance period, participants are required to surrender an amount of allowances equivalent to their capped emissions. Entities that face carbon price costs – either because they are required to buy all their allowances or because their emissions exceed their free allocation – can choose to either reduce emissions within their operations or purchase additional allowances, depending on the cost of either option. Compliance entities that have an excess of allowances – either because they have remained below their free allocation or procured allowances beyond their compliance requirement – can sell these on the secondary market and gain additional revenue. This way, ETSs incentivize emission reductions where they are of the lowest cost.

There are two main methods for distributing allowances under an ETS: auctioning and free allocation. Under free allocation, there are, in principle, three approaches: grandfathering (or grandparenting), fixed historical output-based benchmarks, and actual output-based benchmarks. Each of the four methods carries advantages and disadvantages (see, e.g., PMR and ICAP 2021):[18]

- **Auctioning** of allowances takes place through competitive bidding. It allows for efficient price discovery by encouraging higher market activity. It also provides the strongest price signal and promotes an effective distribution of allocations, and, consequently, cost-effective abatement. Auctioning also generates revenue for governments. However, concerns over competitiveness and carbon leakage[19] in energy-intensive, trade-exposed (EITE) industries have generally led ETSs to limit auctioning in these sectors. Full auctioning is also not generally implemented in the early stages of ETSs due to various factors, including the need to "soften" the transition for new system participants, whether from a capacity, trade exposure, or overall economic impact perspective.

- **Grandparenting** refers to granting free allocations based on compliance entities' historical emissions (e.g., relative to a base year), to which an assistance rate is generally applied. The assistance rate is determined based on the emissions intensity and trade exposure for industrial sectors. Grandparenting is generally considered an appropriate method in the initial stages of ETSs, when data required for benchmark-based allocations is not yet available. It *initially* generates a positive economic incentive for companies that are able to reduce their emissions (and

thereby sell their excess allowances), although it also carries the risk of generating windfall profits and rewarding entities that did the least to reduce their emissions prior to the introduction of the ETS. Also, major changes in emissions or production levels in either direction (e.g., an electricity sector company having shifted to cleaner fuels or an industrial facility having expanded its production) can lead to inequalities in distribution.

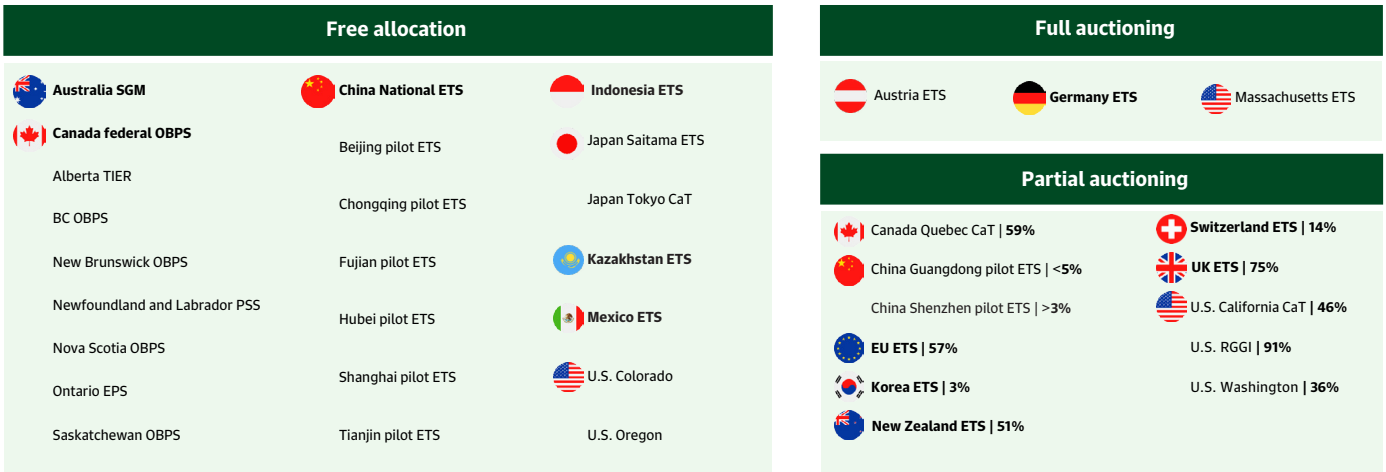
- **Fixed historical output-based and benchmarked** free allocations are based on two parameters: a sectoral product or process emissions intensity benchmark, and individual participants' historical output levels. This approach rewards companies within a sector that have lower emission intensities, which is not automatically the case with grandparenting. However, relying on past output levels for free allocation can increase the risk of carbon leakage in high-growth sectors and industries. To address this, the EU ETS, which uses this allocation method, introduced frequent revisions to production levels used for determining free allocations.

- **Actual output-based and benchmarked** free allocations are also based on sectoral product or process intensity benchmarks, but adjusted to actual output levels. This final free allocation method is considered to be the most effective in reducing carbon leakage, as it does not penalize companies for increased output. When benchmarks are sufficiently stringent, they can provide strong incentives to reduce emissions intensities, as companies performing below (i.e., better than) the benchmark can effectively receive a production subsidy in the form of surplus free allocations. Both benchmark-based allocation methods carry the shared challenges of requiring good and detailed data on industrial activity and emissions, and a careful determination of sector-appropriate benchmarks and their optimal level.

Cap choice can, in some instances, influence allowance distribution: in practice, ETSs with an absolute cap can implement any of the four approaches, in addition to a combination of auctioning and free allocation. ETSs with an intensity-based cap have generally opted for free allocations with output-based benchmarks.[20] Most ETSs see changes to allowance distribution methods and rules over time, partly conditioned by data availability.

As shown by our benchmark of 37 ETSs (Figure 5), 23 (62%) currently allocate all their allowances for free. Auctioning shares in the other systems range from less than 15% (e.g., Korean and Swiss ETSs) to around one to two-thirds (e.g., New Zealand, UK, and EU ETSs and Quebec Cap-and-Trade). Many ETSs use auctioning primarily in the power sector, given its lower trade exposure, and distribute all or most industrial allowances for free due to carbon leakage concerns. There are only a few systems with full or near-full auctioning. The Massachusetts ETS (100%) and the RGGI (91%) both only cover the electricity sector, which does not face direct trade exposure, and where renewable energy has provided lower-cost abatement options for compliance entities. The Austrian and German ETSs, in turn, which will transition into the EU ETS2 from 2027, use fixed-price or price corridor-based auctioning.

Figure 5. Allowance distribution methods across ETSs.



Source: Authors.

ETSs are, in principle, expected to transition over time from free allocations toward auctioning. Auctioning is often introduced gradually. The U.S.-based RGGI is a rare case of an ETS that started with high levels of auctioning.[21] In terms of free allocation methods, systems tend to transition from grandparenting toward benchmark-based methods as they mature. The EU ETS started with grandparenting in Phases 1 and 2, and subsequently transitioned to benchmarked and historical output-based allocations for EITE industries (PMR and ICAP 2021). The EU introduced auctioning in the power sector in 2013 and is currently rolling out auctions in EITE sectors as it phases in its CBAM, with the full transition currently expected to be completed by 2034.

The Korean ETS started with grandparenting and is currently phasing in benchmarked and historical output-based allocation, while increasing the share of auctioning in parallel (ICAP 2020). As shown by the analysis above, the appropriate allowance distribution method(s) may change over time as systems mature. Generally, systems covering EITE sectors would most likely initially apply one of the free allocation methods, potentially phasing in auctions over time, whereas the choice of the free allocation method will depend to a large extent on the availability of robust installation-level emissions and output data, among other factors.

2.4.2 Price

Price or supply adjustment mechanisms: In addition to the stringency of the cap, allocation methods, and choices, governments can also actively manage the prices of allowances via various price stability mechanisms. The main ones include price ceilings, floors and corridors, and fixed prices. These mechanisms are implemented to either prevent too low or too high prices (or both) and to avoid high price volatility, such as in situations of economic volatility. Instead of, or in parallel with, price-based mechanisms, some ETSs implement market stability reserves (MSRs), which adjust the supply of allowances in response to price signals to similarly support price stability and achieve desired prices. Some technical literature also includes mechanisms that hold back allowances for dedicated purposes (e.g., new entrants – see Section 2.3.2) as supply adjustment mechanisms (see, e.g., PMR and ICAP 2021, 90).

As of 2023, out of all operational ETSs, 15 (43%) had an MSR, 7 (20%) had a price ceiling, and 8 (23%) had a price floor (with only the Beijing pilot and the Washington Cap-and-Invest Program deploying both), and 3 (9%) had a set price. Ten (29%) systems had no price control mechanism, including both older systems, such as the Tokyo and Saitama ETSs, and recently established ones, such as the Indonesian and Mexican (pilot) ETSs. Many systems with an MSR do not implement any further price control mechanisms, but others – namely, RGGI, the California and Québec Cap-and-Trade systems, the Washington Cap-and-Invest Program in North America, and two Chinese pilots (Beijing and Guangdong pilots) – also implement price floors (and ceilings). Systems with a price ceiling only exist in Canada. For example, the Alberta TIER sets a price at which covered entities can purchase TIER Fund credits to cover emissions above their free allocation, which effectively functions as the price ceiling (World Bank 2024).

As shown by our benchmark, ETS regulators may opt not to implement price stability mechanisms or may implement them only as the system matures, as in the case of the Chinese national ETS (ICAP 2025a). An MSR is generally more complicated to administer than a simple price limit and may be administratively too complex in the initial years of an ETS. The levels of price floors, ceilings, and fixed prices can also be increased over time, as many systems in Canada, for example, do. Also, when implementing supply adjustment mechanisms, regulators are faced with a political decision on whether to implement supply increases or decreases temporarily or permanently, as the latter has direct implications for the ambition level of the cap (PMR and ICAP 2021).

Cost pass-through: The carbon price signal of an ETS is also affected by choices relating to the point of regulation (see also Section 2.2.3), as well as government regulation of energy or industrial product prices. The main function of the carbon price signal is to affect behavior. For this to happen, it must either directly reflect on the compliance entities, and/or these entities need to be able to pass the cost through to the supply chain to achieve a change in behavior elsewhere (PMR and ICAP 2021). When emissions are regulated upstream – for instance, in the case of domestically consumed fuels that are regulated at the point of distribution (e.g., California, Québec, and EU ETS2) – distributing companies must be able to pass through the cost on to consumers, as they themselves cannot affect emissions resulting from the fuel's combustion.

Most ETSs, however, regulate at point source, which means the price signal can, in principle, be directed to affect the producer, the consumer, or both. In some cases, administered prices may prevent – or be used to prevent – the carbon price

signal from being passed through to end users (i.e., industries or households). The Chinese national ETS is a prime example, where, given the largely government-administered prices, the ETS carbon price incentive currently primarily influences operational and investment decisions at power plants and has little impact on the demand side.

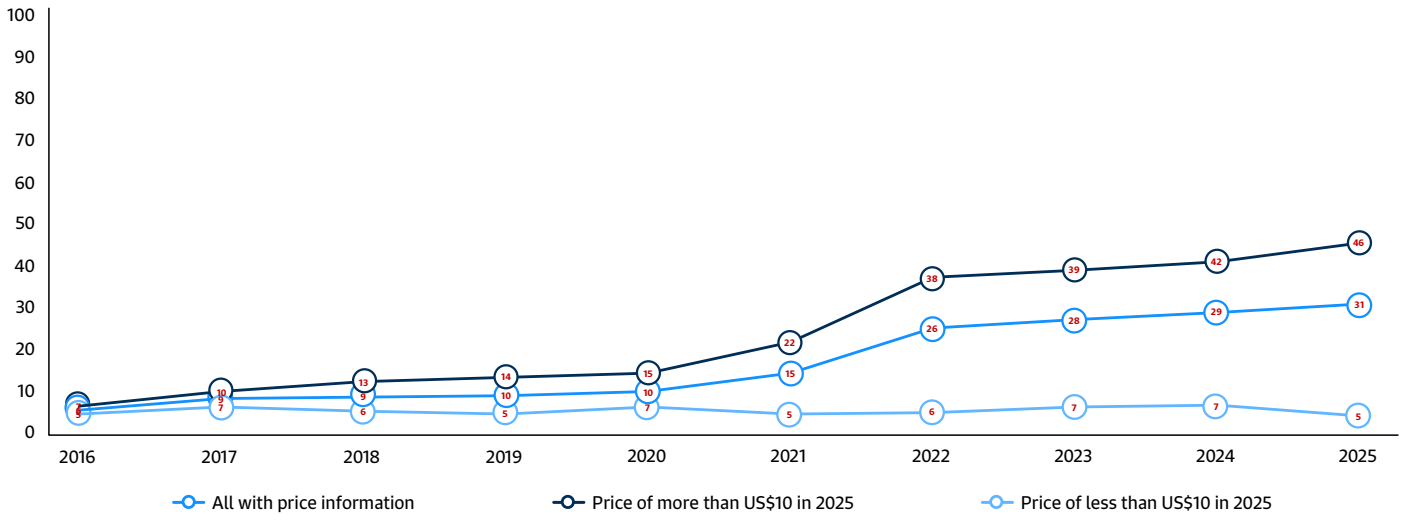
Companies' default preference is naturally full cost pass-through, but this is, in practice, often limited by international trade exposure and general market dynamics (i.e., concerns about competitiveness and carbon leakage). Allowing emitting companies to fully pass through the cost would also effectively remove any incentive to reduce emissions at point source. The allocation of free allowances via grandfathering in the EU ETS's first phases, for example, generated windfall profits for power sector companies (see Sijm et al., 2008), which in turn led the EU to introduce auctioning to this sector from 2013. Also, when product demand is inelastic and the market is noncompetitive – such as in the electricity sector in many countries – allowing full cost pass-through would have little impact on consumer behavior. In such cases, governments can use price regulation and gradual price reform to more effectively balance the distribution of the carbon price signal among producers and consumers.

Price levels: As discussed above, allowance prices function as the carbon price signal for ETS compliance entities to reduce emissions. Prices of allowances can therefore be seen as a reflection of the strength of the cap in motivating these reductions. As of April 2025, based on data from the World Bank's Carbon Pricing Dashboard (World Bank 2025b), a total of 13 systems had allowance prices of US$45/tCO$_2$e or above, which, based on some estimates, represent Paris Agreement-aligned carbon prices.[22] This included all European ETSs (EU, Switzerland, the UK, Austria, and Germany), seven systems in Canada (including the federal backstop), and the Washington Cap-and-Invest Program in the U.S. The EU (US$70) was at the high end, followed by the Canadian systems and Switzerland (US$65-66), the UK (US$57), and Washington, Austria, and Germany (US$49-50).

These higher-price systems do not all share identical features but have reached these price levels via one of two ways: either through a combination of auctioning and cap stringency (e.g., EU and UK ETSs), or a fixed, progressively increasing price (most Canadian systems, Austria, and Germany). Nine systems had prices in the range of US$10-45, and 13 systems had prices below US$10 (World Bank 2025b). Out of the latter group, six were Chinese pilot ETSs, and all but one were based in Asia.

As shown in Figure 6, in systems with 2025 allowance prices of ≥US$10, prices have increased progressively over the past decade (World Bank 2025b).[23] For systems with lower allowance prices, these have in most cases remained at similar levels. Notably, especially in the early years of ETSs, low allowance prices may not always imply a weak cap if there are significant low-cost abatement options still available under the cap – such as, for example, in an economy that is starting from low rates of clean energy in its electricity mix. (Appendix 8 provides a more detailed illustration of ETS price evolution.)

Figure 6. Allowances prices in ETSs globally, averages, 2016-2025.



Source: Authors, based on World Bank (2025b).

2.4.3 Revenue Reallocation

ETSs can also generate revenue for governments. The main mechanism for this is the auctioning of allowances. Other possible ways to raise revenue include requiring compliance entities to pay a fee for exceeding their free allocation. Under the Alberta TIER in Canada, for example, companies that do not meet their emission limits can choose between purchasing allowances from other ETS participants, buying local carbon credits from non-ETS sectors, or paying an annually increasing set fee (per tCO_2e) to a dedicated fund (Government of Alberta 2025).

Of the 37 ETSs covered in the World Bank 2025 Dashboard, 19 ETSs recorded revenue generation in 2024 of a total of ~US$69 billion (World Bank 2025b). Of these, seven ETSs yielded more than US$1 billion and constituted ~97% of the total revenue, detailed below in Table 3. The remaining 12 ETSs collectively generated US$2 billion.

Table 3. Revenues, allowance prices, and auctioning shares in selected ETSs.

ETS	Revenue (US$ billion, 2024)	Share of global ETS revenue	Allowance price (US$)	Auctioning share
EU ETS	41.7	60%	70	57%
German ETS	13.9	20%	49	100%
California CaT	4.4	6.4%	29	46%
UK ETS	3.3	4.7%	57	75%
US RGGI	1.5	2.1%	23	91%
Austrian ETS	1.3	1.8%	49	100%
Quebec CaT	1.1	1.5%	42	59%

Source: Authors, based on ICAP (2025a) and World Bank (2025b).

Emissions trading scheme revenues can be utilized in different ways, with each approach having its own incentives and trade-offs. Major examples are outlined below.

- **No revenue (free allocation):** When allowances are fully allocated for free, no revenue is generated, as entities are surrendering allowances that were provided to them at no monetary cost or fee. While this protects the competitiveness of ETS participants, as there is no financial obligation attached to obtaining or surrendering the allowances (excluding indirect costs such as MRV setup), this prevents revenue generation or retention for the governing jurisdiction and may potentially reduce participants' incentive to decarbonize.

- **Allocated to climate action:** Generated revenues could be earmarked to support climate action within and beyond the ETS sectors. Revenue earmarked for reinvestment in supporting ETS-covered EITE sectors and participants to decarbonize could catalyze sectoral transition and help address innovation gaps. On the other hand, revenue allocated to climate or social initiatives targeting sectors and entities outside the jurisdiction of the ETS allows for transformation across the economy and potentially high social returns, but may be met with political resistance, as ETS participants might apply pressure for revenue to be recycled into the same sectors to support their transition. Another challenge could be selecting which initiatives receive the allocation and balancing that opportunity with the broader climate strategy and the community's priorities.

- **Allocated to household support:** Revenue redistributed to households as rebates, tax credits, or direct deposits can raise public acceptance of the ETS and minimize the economic impact of the system on end consumers. However, if the support is not well targeted, it may undermine the required consumer behavioral change and the price signal that incentivizes decarbonization.

- **Government budget:** Revenue used to reduce the general government budget deficit and support or enhance fiscal sustainability could reflect positively on macroeconomic indicators. Nevertheless, this approach may limit governments' ability to exploit the full potential of ETSs as climate policy instruments, as the generated revenue is neither earmarked nor allocated to supporting further mitigation. It also runs the risk of declining public support for the ETS if revenue is not used to address distributional effects, such as higher consumer prices.

While revenue generation has long been one of the primary objectives of adopting the market-based approach to emissions management, revenue retention is also starting to gain traction, more recently with the announcement of the EU CBAM. The mechanism, which is expected to become fully operational from 2026, imposes a financial obligation on importers to the EU by mandating the purchase of CBAM certificates to cover the embedded emissions within certain imported products. The mechanism, however, allows for the deduction of verified carbon pricing incurred in the country of origin, resulting in the retention of this revenue at the country of origin rather than passing it to the EU importing country.

The EU CBAM has prompted many emerging economies – such as Turkey and China, for example – to accelerate the development of ETSs or expand their scope. Notably, the EU explicitly includes "encouraging cleaner industrial production in non-EU countries" among its objectives (European Commission 2025c).

When considering revenue generation as an ETS feature, governments will need to balance the benefits of free allocation with those of auctioning and related revenue. If they decide to integrate revenue-generating features, it is important to keep in mind that ETS revenues can always be channeled toward more than one purpose. Another important consideration, as shown above, is that substantial revenues can only be generated with reasonably robust carbon price levels, which again presents trade-offs – particularly for emerging and developing economies.

2.5 Flexibility

Flexibility mechanisms support an ETS in achieving its objectives while providing the regulated entities with compliance options beyond the surrendering of allowances, allowing the system to maintain its environmental integrity and the entities to reduce the compliance burden. There are generally three well-recognized ways in which governments can provide flexibility for ETS participants: temporal flexibility (i.e., banking and borrowing), offsetting, and ETS linkages, which are outlined in this subsection. Table 4 displays how these features are implemented in operational national-level ETSs.

Banking allows participants to carry unused allowances into future compliance periods. This feature permits entities to hold onto their allowances as opposed to selling them to other entities if they anticipate increased emissions in future periods. However, excessive banking poses a threat to the system's supply-demand balance, as it can lead to a surplus in allowances in future phases and, as a result, a drop in allowance prices. This was seen in previous phases of the EU ETS, in which there was overbanking of allowances from Phase 2 that led to a surplus of allowances in Phase 3 (Ellerman, Valero, and Zaklan 2015). To restore the balance, the EU ETS introduced the Market Stability Reserve (MSR) (see Section 2.4.2).

Another related risk to system effectiveness is created by entities opting for bank allowances when prices are low, which are to be surrendered in future periods as opposed to investing in decarbonization initiatives. Banking is commonly used across ETSs.

Borrowing allows entities to obtain and surrender allowances from future compliance periods. Entities can opt for this feature when they are setting up initiatives with future reductions – for instance, allowing them to avoid non-compliance until emission reductions are realized. Nevertheless, borrowing comes with the risk of future default and non-compliance if planned initiatives are not implemented as forecasted, leading to a continuous cycle of "carbon debt." As a result, regulators need to undertake a complex consideration of borrowed volumes when planning for cap adjustments and allowance allocations for future phases. Given these challenges, borrowing is not a frequently used feature in ETSs.

Offsetting allows entities to meet part of their ETS obligations using carbon credits generated from non-ETS sectors instead of using allowances. In practice, companies opt for offsetting when the prices of qualifying carbon credits are below the ETS allowance price. This allows companies to benefit from the price delta to lower their overall compliance costs, and can also prevent a sharp increase in allowance prices at times of high demand and low supply.

Generally, ETSs tend to limit the accepted carbon credits to those generated or approved under their national crediting schemes, as this allows regulators to ensure that the accepted credits satisfy the key requirements of additionality, permanence, and accurate MRV, as well as reduce the risk of double-counting. Some schemes, like the Korean ETS, allow for the use of international credits (subject to qualitative limitations). Additionally, this approach allows governments to align their compliance and voluntary mechanisms with national priorities and goals.

Perhaps most importantly, allowing for domestic carbon credits only, or prioritizing them for use, in ETS compliance supports mitigation taking place within the ETS jurisdiction or country.

While offsetting can reduce the burden on regulated entities, it is crucial to strike the right balance between its benefits and the trade-offs. For instance, allowing for a very limited margin for offsets encourages decarbonization investments. However, this might increase costs for participants and also limit the incentives for decarbonization initiatives and projects in non-ETS sectors. Conversely, allowing for too much offsetting might result in ETS entities relying on offsetting instead of undertaking investments in emission mitigation, thereby diluting the effectiveness of the ETS.

Approximately two-thirds of all existing ETSs (including subnational ones) allow for offsetting. As of 2023, 14 ETSs allowed for offsetting shares of 10% or below, while nine allowed for shares of 20%-100%. At the higher end of the range were the Indonesian, Australian, and Kazakh ETSs (World Bank 2024).

Linkages allow the connection of ETSs through the recognition of allowances across jurisdictions, enabling one system to utilize the allowances of the other for compliance purposes. This broadening of the market supports market dynamics by decreasing the overall compliance burden. It can also deliver other co-benefits, such as reducing price volatility and promoting policy strengthening and collaboration through alignment with high-ambition design features and MRV standards between the linked systems to ensure a compatible and credible market.

The establishment of linkages is not a simple task, however, as it requires alignment across many key elements within the ETS designs, including cap type and stringency, and price ranges. Collaborating ETS regulators also need to agree on the terms of the linkage, including triggers for linkage suspension or termination. By having these alignments in place, systems can benefit from the broader market while limiting challenges, which could include a wider impact from otherwise contained economic shocks, or reduced ambition and emissions impact if one system is less stringent than the other or if there is a large allowance price disparity between jurisdictions.

In practice, only a few ETSs have to date successfully completed a full linkage – namely, the California and Québec Cap-and-Trade systems, the EU and Swiss ETSs, and the two Japanese city ETSs.

Table 4. Use of flexibility mechanisms across national ETSs.

ETS	Banking		Borrowing		Offsetting		Linkages	
Australia Safeguard Mechanism	1	Unlimited banking is allowed	1	Capped at 10% with baseline adjustment in the following year	1	Unlimited, but justification is required for over 30% of baseline		
Austria ETS								
Canada Federal Output-Based Pricing System	1	5-year issuance maximum for banked credits			1	Capped at 75%		
China National ETS	1	Shifted from unlimited to 10,000 tonnes plus 1.5x net sales over 2024-2025						
EU ETS	1	Unlimited banking alongside MSR					1	Linked to Swiss ETS since 2020
Germany ETS	1	Allowed except during fixed price/corridor phase						
Indonesia ETS	1	Allowed with 2-year limit			1	Unlimited offsetting allowed		
Kazakhstan ETS	1	Allowed within phases but not across			1	Unlimited offsetting allowed		
Korea ETS	1	Allowed with some limitations	1	Allowed within a single trading phase	1	Capped at 5%		
Mexico ETS	1	Allowed, excluding pilot phase allowances	1	Allowed within phases but not across	1	Capped at 10%		
New Zealand ETS	1	Unlimited banking is allowed						
Switzerland ETS	1	Unlimited banking is allowed, including Phase 3+ EU ETS allowances	1	Allowed within phases but not across			1	Linked to EU ETS since 2020
UK ETS	1	Unlimited banking is allowed	1	Limited and implicit borrowing is allowed				
Total	**12 (92%)**		**5 (38%)**		**6 (46%)**		**2 (15%)**	

Source: Authors, based on ICAP (2025a).

Conclusions

03

This paper has provided a detailed analysis of the major ETS design choices and related considerations (i.e., strengths, weaknesses, and trade-offs) in the context of a significant increase in interest in carbon market mechanisms in emerging and developing economies. The paper also conducted a benchmark of 37 existing systems to identify patterns across ETSs and over time. Some patterns are clear, namely:

- System coverage, complexity, and stringency generally increase over time.
- Systems tend to learn iteratively from their own experiences as they accumulate more and better data and gain experience in how the market functions and how participants respond to various design levers.
- Systems also build on the experiences of others, particularly in features that provide flexibility and price stability. Yet, despite the accumulating experience, ETSs still take several years to reach full operationalization.
- Divergent allowance price trajectories in the last decade suggest that some systems actively seek to use carbon pricing to drive emission outcomes, while others appear to currently be deployed more as strategic signaling tools – providing industries advance notice of future carbon pricing in the context of an increasingly carbon-constrained world.

Overall, however, the benchmarked systems are as diverse in design as their host jurisdictions' profiles and policy objectives, showing the versatility of ETSs as a climate policy instrument. Also, given that only 16 of the benchmarked systems were established more than 10 years ago, the emergence of major trends or commonalities over time, as systems mature, may still take time to become visible.

Two related contextual observations stand out: First, the various design options under each element discussed in this paper can be combined in a large variety of ways to achieve an effective ETS. As the study has shown, each design choice comes with its tradeoffs and none of the design options is intrinsically "bad" or "good." What matters for a well-functioning ETS is how its regulators choose and combine from the broad menu of available options to fit the jurisdiction's unique context. Consequently, it is not possible to identify a single effective combination of design options that caters to all.

Second, defining what effectiveness means depends on the priorities of the jurisdiction and even the viewpoint of the observer: for an environmental policy stakeholder, an ETS that delivers ambitious emission reductions is a well-functioning one, whereas for an EITE industry, what matters most is retaining competitiveness. For governments exploring ETSs today, a successful ETS may be one that strikes the "right" balance between introducing a carbon price signal to align with broader international trends in this space while at the same time protecting growth-oriented, export-oriented heavy industries.

Defining effectiveness also relates to how cap trajectories over time are envisaged – namely, whether mitigation should be prioritized in the short or longer term. Systems prioritizing short-term action might seek a stronger price signal from the beginning, while others might focus more on creating a sufficiently strong price signal to incentivize long-term mitigation investments.

More specifically, this study has identified the following lessons that are of relevance for policymakers considering carbon market instruments as part of their climate policy toolkit:

1. Setting Up:

- Preparation requires time: Given the significant role of ETSs in industrial and climate policies, their setup needs to be context-specific and harmonized with the broader policy mix. Rushed rollouts risk system suspension due to weak MRV, limited capacity, and low buy-in.
- Consider a pilot phase: Pilot phases help test market functioning, improve data quality, and build capacity. China's subnational pilots, for example, were instrumental for its national ETS.
- Apply phased implementation: ETSs evolve in phases, with each new phase allowing for improvements in design and rules based on experiences from previous phases. This usually means moving toward broader coverage, more stringent rules, and increased ambition.

2. Coverage:

- Tailor to local contexts: Key factors influencing decisions on coverage include the distribution of emissions across sectors and sources, feasibility of MRV, trade exposure, and exposure to BCAs, along with related revenue retention potential.
- Prioritize high-emitting, easy-to-MRV sectors: Most ETSs begin with industry and power due to their high shares of emissions, easier MRV, and centralized actors. Expansion to more diffuse sectors (transport, agriculture) can be considered as the system matures.
- Balance ambition with implementation feasibility: Wide coverage improves efficacy but increases costs and system complexity. Ways to manage coverage beyond sectors include covering fewer gases and implementing higher participation thresholds.

3. Cap:

- Cap type may matter: In contexts of higher economic growth, intensity-based caps may offer a more feasible way to communicate the cap. Absolute caps, in turn, give certainty on emissions outcomes but, in the absence of well-designed flexibility features, can become economically constraining. In systems that start with a limited number of sectors (e.g., China's national ETS) or that have a good basis of data to build on (e.g., the Indian scheme), an intensity-based cap can be perceived as the less constraining option.
- Align phases with policy cycles: Many ETSs start with shorter phases and eventually tie their phases to NDC cycles or economic planning as the systems mature to align with the broader policy context.
- Stringency can increase over time: Most ETSs progressively tighten their caps. In practice, both the country's overall climate policy ambition and its economic policy drive the rate of increase in stringency.
- Use of multiple cap flexibility features is a general practice: There are several ways in which caps generally "fluctuate" over short periods of time, driven by design features "under the cap," as discussed in Sections 2.4–2.6 of the paper.

4. Allowances:

- Auctioning and free allocation play different roles: Auctioning strengthens the price signal and generates revenue but is politically sensitive in EITE sectors. Free allocation cushions competitiveness impacts but can create windfall profits.
- Data drives free allocation choices: Free allocation methods also have different strengths and weaknesses. The choice of free allocation method depends largely on the availability of robust installation-level emissions and output data.

- Transition over time: Many ETSs move from free allocation to more auctioning. Generally, sectors with more stable output and less trade exposure are the first candidates for introducing auctioning. The rise of BCAs is driven by the phase-in of auctioning in EITE sectors.
- ETS prices can be managed: Contrary to the textbook definition of high price volatility characterizing ETSs, various mechanisms have been developed to maintain allowance prices at desired levels – including simpler price floors and ceilings, and more sophisticated MSRs. The decision on the desired price levels is a political one.
- Revenues can improve outcomes, cushion impacts, and secure buy-in: Revenues from auctioning or a fixed price (see Canadian systems and the German and Austrian ETSs) can support EITE decarbonization, finance climate, or social initiatives in non-ETS sectors, or provide household rebates, among others. This is especially important in emerging economies to enhance equity and acceptance.

5. Flexibility:

- Banking is common, borrowing is rare: Allowing banking of allowances provides intertemporal compliance, but overbanking risks price crashes (e.g., the EU ETS experience). Borrowing creates a risk of future non-compliance.
- Offsetting can support cost-effective mitigation: Allowing offsetting with carbon credits generally reduces compliance costs and directly benefits national mitigation efforts – provided that the credit supply is of high quality and robust accounting rules are applied. Yet, overly generous offsetting provisions may weaken the decarbonization incentive in ETS sectors.

As shown in great detail by this study, the main strengths of an ETS are its versatility and iterativeness: it can be suited to highly diverse circumstances, and its design can evolve over time to suit the government's needs, priorities, and increasing levels of climate ambition. ETSs can be tailored to meet the needs and priorities of industrialized, transitioning, and emerging economies alike.

Fundamentally, ETS design choices should be driven by clear system objectives grounded in the country's overall climate and industrial policy and institutional context. An ETS can start simple and evolve in complexity over time. It can begin with lower stringency and more industry protections and move toward higher ambition in line with the broader global momentum.

Decisions on allocation methods, flexibility and stability, and revenue reallocation are crucial, and all effective ETSs are underpinned by robust MRV practices and implementation infrastructure.



Endnotes

[1] The Australian Safeguard Mechanism is included in this count given its compliance elements, even though it combines features of an ETS with a baseline-and-credit scheme.

[2] Exceptions exist where compliance-based market schemes apply elements of baseline-and-credit mechanisms. These include schemes in Australia and India.

[3] In addition to the governmental crediting mechanisms, there are various independent crediting programs (ICPs), which allow for voluntary trade in carbon credits either within a jurisdiction or worldwide (World Bank 2025b). Governmental crediting mechanisms generally provide flexibility for national compliance schemes – ETSs or carbon taxes – by making available carbon credits from sectors outside the compliance schemes that can be used by compliance entities in lieu of allowances. Credits from ICPs are generally purchased by companies toward voluntary GHG reduction targets. Internal carbon pricing generally involves setting a shadow price or an internal fee on emissions.

[4] Border carbon adjustments are a trade policy tool that apply a carbon price to imported goods to level the playing field for domestic producers covered by an equivalent carbon price.

[5] Structural factors can also affect the effectiveness of an ETS as a tool. Academic review studies have found that country-specific factors such as financial development and economic growth rates can impact their effectiveness, with both correlating positively (Ahmad, Li, and Wu 2024).

[6] The requirement for high-quality emissions data and strong MRV systems improves countries' understanding of their emissions and related transparency, which enables more targeted policy interventions and builds trust. ETSs as policy instruments, especially when aligned with countries' NDCs and other major climate policy documents, can also provide the long-term signals needed for ambitious climate change mitigation.

[7] According to the World Bank's and ICAP's resources, there are 38 operational ETSs. However, this study excludes the Montenegro ETS, as the system only has three compliance entities. Having an ETS in place is an EU entry requirement.

[8] Publicly available information from governments and other reputable sources was used to identify when governments initiated consideration of an ETS, and this was compared to the start of ETS pilots or de facto pilots. In addition to national ETSs, our benchmark included the California Cap-and-Trade program.

[9] Some ETSs, including pilots, have been abolished over the years. The drivers have been diverse, which is why these are not covered in the scope of this study. Examples include Australia's carbon pricing mechanism and Ontario's Cap-and-Trade system, which were repealed in 2014 and 2018, respectively, as part of fulfilling electoral campaign promises. Most cases are from Canada, where political shifts at local and federal levels create a complex carbon pricing landscape.

[10] These elements are beyond the scope of this paper. There is some technical literature in this area, particularly by the ICAP (see in particular ICAP 2020), but empirical and more academic literature remains scarce.

[11] The U.S. RGGI, U.S. Massachusetts ETS, and the Indonesian ETS are the only systems that do not include the industry sector under their scope.

[12] Nevertheless, these two sectors account for only ~45% of global GHGs (IPCC 2022), leaving countries to choose between further expansion of the ETS scope or the use of complementary mitigation instruments to ensure fair effort-sharing outside of the cap.

[13] Published interim responses show overall support for the inclusion of the sector (60% of the 75 respondents), with the remaining respondents expressing concern about overlap with IMO efforts in the case of inclusion of international voyages (United Kingdom Government 2025).

[14] New Zealand, however, is included in the count of seven ETSs, as the information sourced for the benchmark from ICAP precedes the New Zealand Ministry for the Environment's announcement to exclude agriculture from compliance obligations (New Zealand Ministry for the Environment 2024).

[15] For example, the Swiss ETS ICAP factsheet lists the following caveat: "In principle, all these gases [CO_2, N_2O, CH_4, HFCs, NF_3, SF_6, PFCs] are covered in accordance with the CO_2 Ordinance. In practice, only CO_2, N_2O, and PFCs require monitoring, as the share of the other gases is negligible" (ICAP 2025a).

[16] As part of the so-called transparency obligations under the United Nations Framework Convention on Climate Change (UNFCCC), developed countries, or Annex I parties, have long been required to submit annual GHG inventories with detailed emissions data across the major gases. In contrast, developing, or non-Annex I, countries are expected to report on CO_2, CH_4, and N_2O as a minimum and are encouraged to report any additional gases. Under the Paris Agreement, from 2024 onward, GHG emissions reporting requirements have become more stringent for developing countries, although significant flexibilities for reporting GHGs still remain.

[17] The benchmark drew on publicly available data on ETS caps and sectoral coverage, primarily from ICAP (2025). Out of the 26 ETSs, information was not available for five Canadian systems, which all operate with an intensity-based cap that builds on installation-level emissions intensity benchmarks. However, Canada's emissions overall have declined since the start of these systems in 2016-2019. A total of 15 ETSs show an increase in cap stringency over time, if scope expansions are taken into account. Three ETSs – Shenzhen, Tianjin, and Korea – seem to have maintained their cap at similar levels, although scope expansions may explain this in the case of South Korea. In the cases of New Zealand and Australia, determining the impact of the ETS is complicated by the fact that the systems have not had a clear quantitative cap until recently. New Zealand's total emissions have slightly increased, while Australia's have decreased since the start of the compliance systems, based on emissions data from Climate Watch (2025). Depending on the starting point of the analysis, the Kazakhstan ETS cap has either remained relatively constant over time or slightly increased.

[18] The bulleted list following this sentence draws primarily on PMR and ICAP (2021).

[19] Carbon leakage refers to a situation in which GHG emissions increase outside a system applying carbon pricing as a result of a company covered by said system either moving its operations to, or losing market share to companies in, a jurisdiction with a lower or no carbon price.

[20] In practice, output-based cap systems can also incorporate auctioning. The only method that is inconsistent with this cap type is grandfathering, which is based on absolute historical emissions rather than output emission intensity.

[21] A study by Huber (2013, 59) concluded that this was made possible by electricity market reform preceding the establishment of the system, which led to the absence of players opposing auctioning, while legislators in the participating states "embraced auctions as a source of revenue" to offset utility rate increases.

[22] In 2017, the World Bank's High-Level Commission on Carbon Prices estimated that alignment with the Paris Agreement's well below 2°C target would require allowance prices in the range of at least US$40-80/$tCO_2e$ by 2020 and US$50-100/$tCO_2e$ by 2030 (Stiglitz et al. 2017). Notably, since it can be argued that a uniform reference price for developed and developing countries is not equitable, the comparison here is made for general comparative purposes only. The midpoints of these ranges are taken here as the reference for 2025 (i.e., US$45-90/$tCO_2e$).

[23] Out of the 22 systems with allowance prices at US$10 or above in 2025, price data for only nine systems were available for 10 years or more, given the more recent establishment of the remainder of the systems, but most systems show an increasing trend over the years for which data were available.

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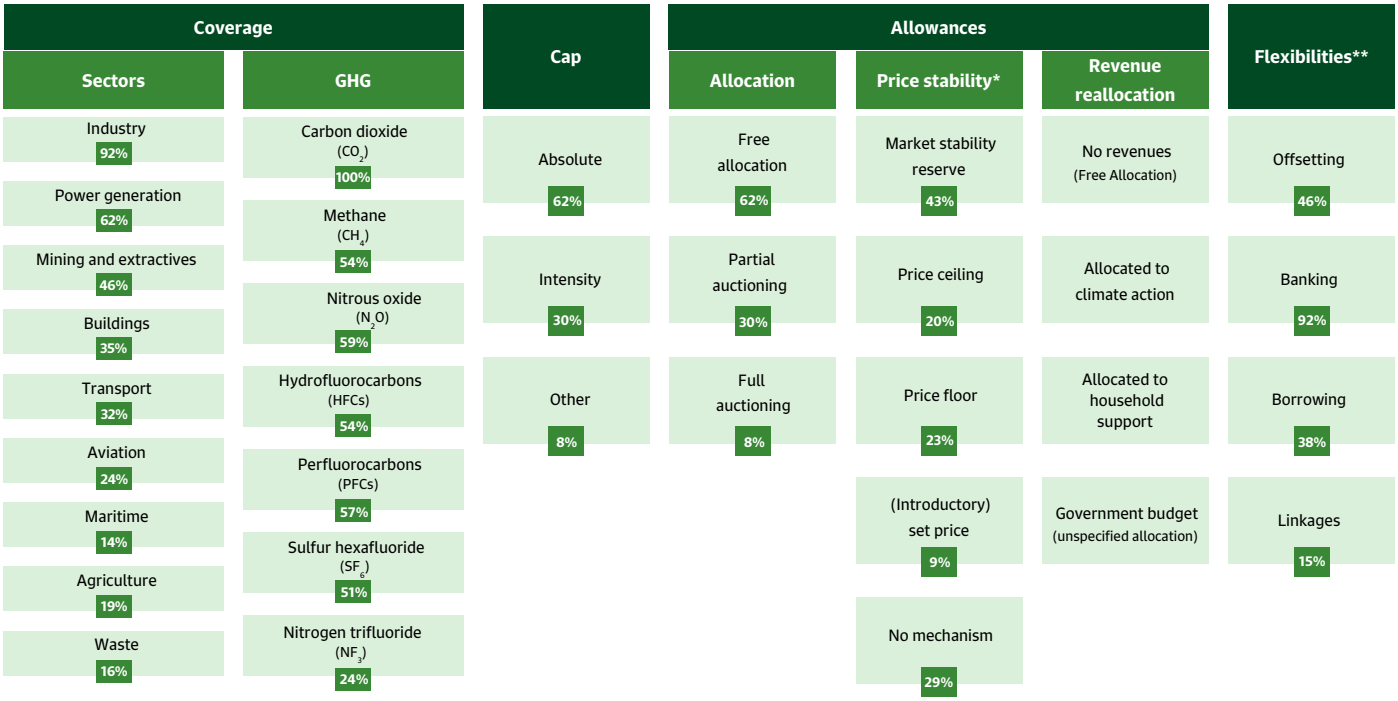
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Appendix

Appendix 1. Prevalence of major design element options in existing ETSs.



* Based on World Bank 2024 which reported 35 systems (excluding Montenegro ETS)

** Share of national ETSs (Total of 13 systems including the EU ETS)

Source: ICAP (2025a); World Bank (2024).

Appendix 2. List of operational ETSs as of August 2025.

Instrument name	Year	Type
Australia Safeguard Mechanism	2016	National
Austrian National Emissions Certificate Trading System	2022	National
Canada Alberta Technology Innovative and Emissions Reduction Regulation (TIER)	2020	Subnational
Canada British Columbia Output-Based Pricing System (OBPS)	2024	Subnational
Canada Federal Output-Based Pricing System (OBPS)	2019	National
Canada New Brunswick Output-Based Pricing System (OBPS)	2021	Subnational
Canada Newfoundland and Labrador Performance Standards System (PSS)	2019	Subnational
Canada Nova Scotia Output-based Pricing System (OBPS) for Industry	2023	Subnational
Canada Ontario Emissions Performance Standards Program (EPS)	2022	Subnational
Canada Quebec Cap and Trade (CaT)	2013	Subnational
Canada Saskatchewan Output-Based Performance Standards Program (OBPS)	2019	Subnational
China Beijing pilot ETS	2013	Subnational
China Chongqing pilot ETS	2014	Subnational
China Fujian pilot ETS	2016	Subnational
China Guangdong pilot ETS	2013	Subnational
China Hubei pilot ETS	2014	Subnational
China National ETS	2021	National
China Shanghai pilot ETS	2013	Subnational
China Shenzhen pilot ETS	2013	Subnational
China Tianjin pilot ETS	2013	Subnational
European Union ETS	2005	Regional
Germany ETS	2021	National
Indonesia ETS	2023	National
Japan Saitama ETS	2011	Subnational
Japan Tokyo Cap and Trade (CaT)	2010	Subnational
Kazakhstan ETS	2013	National
Korea ETS	2015	National
Mexico ETS	2020	National
New Zealand ETS	2008	National
Switzerland ETS	2008	National
United Kingdom ETS	2021	National
U.S. California Cap and Trade (CaT)	2012	Subnational
U.S. Colorado GHG and Energy Management for Manufacturing Regulation	2024	Subnational
U.S. Massachusetts Limits on Emissions from Electricity Generators	2018	Subnational
U.S. Oregon Climate Protection Program (CPP)	2025	Subnational
U.S. Regional Greenhouse Gas Initiative (RGGI)	2009	Subnational
U.S. Washington Cap and Invest Program	2023	Subnational

Source: ICAP (2025a).

Appendix 3. Sectoral coverage of ETS as of August 2025.

Instrument name	Industry	Power	Mining	Buildings	Transport	Aviation	Maritime	Agriculture	Waste	Σ
Australia SGM	1		1		1	1			1	5
Austrian ETS	1			1	1			1		4
Canada Alberta TIER	1	1	1					1		4
Canada British OBPS	1		1							2
Canada Federal OBPS	1	1								2
Canada New Brunswick OBPS	1	1	1							3
Canada Newfoundland and Labrador PSS	1	1	1							3
Canada Nova Scotia OBPS	1	1	1							3
Canada Ontario EPS	1	1	1							3
Canada Quebec CaT	1	1	1	1	1			1		6
Canada Saskatchewan OBPS	1	1	1							3
China Beijing pilot ETS	1	1		1	1					4
China Chongqing pilot ETS	1									1
China Fujian pilot ETS	1					1				2
China Guangdong pilot ETS	1					1				2
China Hubei pilot ETS	1									1
China National ETS	1	1								2
China Shanghai pilot ETS	1	1		1	1	1	1			6
China Shenzhen pilot ETS	1			1	1				1	4
China Tianjin pilot ETS	1		1							2
European Union ETS	1	1				1	1			4
Germany ETS	1			1	1			1	1	5
Indonesia ETS		1								1
Japan Saitama ETS	1			1						2
Japan Tokyo CaT	1			1						2
Kazakhstan ETS	1	1	1							3
Korea ETS	1	1		1	1	1	1		1	7
Mexico ETS	1	1	1							3
New Zealand ETS	1	1	1	1	1	1	1	1	1	9
Switzerland ETS	1	1				1				3
United Kingdom ETS	1	1	1			1				4
U.S. California Cap and Trade (CaT)	1	1	1	1	1			1		6
U.S. Colorado ETS	1									1
U.S. Massachusetts ETS		1								1
U.S. Oregon CPP	1		1	1	1		1	1	1	7
U.S. RGGI		1								1
U.S. Washington Cal	1	1	1	1	1					5
Total	**34 (92%)**	**23 (62%)**	**17 (46%)**	**13 (35%)**	**12 (32%)**	**9 (24%)**	**5 (14%)**	**7 (19%)**	**6 (16%)**	

Source: ICAP (2025a).

Notes: Mining: Mining and extractives; Agriculture: Agriculture, Forestry, and Fishing.

Appendix 4. GHG coverage of ETS as of August 2025.

Instrument namez	CO_2	CH_4	N_2O	SF_6	HFCs	PFCs	NF_3	Σ	Comments
Australia SGM	1	1	1	1	1	1		6	
Austrian ETS	1	1	1	1	1	1		6	ICAP mentions: Several gases (CO_2e)
Canada Alberta TIER	1	1	1	1	1	1	1	7	
Canada British OBPS	1	1	1	1	1	1		6	
Canada Federal OBPS	1	1	1	1	1	1		6	
Canada New Brunswick OBPS	1	1	1	1	1	1		6	
Canada Newfoundland and Labrador PSS	1	1	1	1	1	1		6	
Canada Nova Scotia OBPS	1	1	1	1	1	1	1	7	
Canada Ontario EPS	1	1	1	1	1	1	1	7	
Canada Quebec CaT	1	1	1	1	1	1	1	7	
Canada Saskatchewan OBPS	1	1	1	1	1	1		6	
China Beijing pilot ETS	1							1	
China Chongqing pilot ETS	1	1	1	1	1	1		6	
China Fujian pilot ETS	1							1	
China Guangdong pilot ETS	1							1	
China Hubei pilot ETS	1							1	
China National ETS	1							1	CF_4 and C_2F_6 (only for aluminum smelter sector)
China Shanghai pilot ETS	1							1	
China Shenzhen pilot ETS	1							1	
China Tianjin pilot ETS	1							1	
European Union ETS	1		1		1	1		4	
Germany ETS	1							1	
Indonesia ETS	1	1	1					3	
Japan Saitama ETS	1							1	
Japan Tokyo CaT	1							1	
Kazakhstan ETS	1							1	
Korea ETS	1	1	1	1	1	1		6	
Mexico ETS	1							1	
New Zealand ETS	1	1	1	1	1	1		6	
Switzerland ETS	1	1	1	1	1	1	1	7	All included, but only these require monitoring
United Kingdom ETS	1		1			1		3	
U.S. California Cap and Trade (CaT)	1	1	1	1	1	1	1	7	In addition to other F gases
U.S. Colorado ETS	1	1	1	1	1	1	1	7	
U.S. Massachusetts ETS	1							1	
U.S. Oregon CPP	1	1	1	1	1	1	1	7	
U.S. RGGI	1							1	
U.S. Washington Cal	1	1	1	1	1	1	1	7	In addition to other F gases
Total	**37 (100%)**	**20 (54%)**	**22 (59%)**	**19 (51%)**	**20 (54%)**	**21 (57%)**	**9 (24%)**		

Source: ICAP (2025a).

Appendix 5. Cap types of ETS as of August 2025.

Instrument name	Absolute	Intensity	Other
Australia SGM		1	
Austrian ETS			1
Canada Alberta TIER		1	
Canada British OBPS		1	
Canada Federal OBPS			1
Canada New Brunswick OBPS		1	
Canada Newfoundland and Labrador PSS		1	
Canada Nova Scotia OBPS		1	
Canada Ontario EPS		1	
Canada Quebec CaT	1		
Canada Saskatchewan OBPS		1	
China Beijing pilot ETS	1		
China Chongqing pilot ETS		1	
China Fujian pilot ETS	1		
China Guangdong pilot ETS	1		
China Hubei pilot ETS	1		
China National ETS		1	
China Shanghai pilot ETS	1		
China Shenzhen pilot ETS	1		
China Tianjin pilot ETS	1		
European Union ETS	1		
Germany ETS			1
Indonesia ETS		1	
Japan Saitama ETS	1		
Japan Tokyo CaT	1		
Kazakhstan ETS	1		
Korea ETS	1		
Mexico ETS	1		
New Zealand ETS	1		
Switzerland ETS	1		
United Kingdom ETS	1		
U.S. California Cap and Trade (CaT)	1		
U.S. Colorado ETS	1		
U.S. Massachusetts ETS	1		
U.S. Oregon CPP	1		
U.S. RGGI	1		
U.S. Washington CaI	1		
Total	**23 (62%)**	**11 (30%)**	**3 (8%)**

Source: ICAP (2025a).

Appendix 6. Allocation types of ETS as of August 2025.

Instrument name	Full auctioning	Partially auctioning	Free allocation	Auction share for partially auctioned systems
Australia SGM			1	
Austrian ETS	1			
Canada Alberta TIER			1	
Canada British OBPS			1	
Canada Federal OBPS			1	
Canada New Brunswick OBPS			1	
Canada Newfoundland and Labrador PSS			1	
Canada Nova Scotia OBPS			1	
Canada Ontario EPS			1	
Canada Quebec CaT		1		59%
Canada Saskatchewan OBPS			1	
China Beijing pilot ETS			1	
China Chongqing pilot ETS			1	
China Fujian pilot ETS			1	
China Guangdong pilot ETS		1		<5%
China Hubei pilot ETS			1	
China National ETS			1	
China Shanghai pilot ETS			1	
China Shenzhen pilot ETS		1		>3%
China Tianjin pilot ETS			1	
European Union ETS		1		57%
Germany ETS	1			
Indonesia ETS			1	
Japan Saitama ETS			1	
Japan Tokyo CaT			1	
Kazakhstan ETS			1	
Korea ETS		1		3%
Mexico ETS			1	
New Zealand ETS		1		51%
Switzerland ETS		1		14%
United Kingdom ETS		1		75%
U.S. California Cap and Trade (CaT)		1		46%
U.S. Colorado ETS			1	
U.S. Massachusetts ETS	1			
U.S. Oregon CPP			1	
U.S. RGGI		1		91%
U.S. Washington Cal		1		36%
Total	**3 (8%)**	**11 (30%)**	**23 (62%)**	

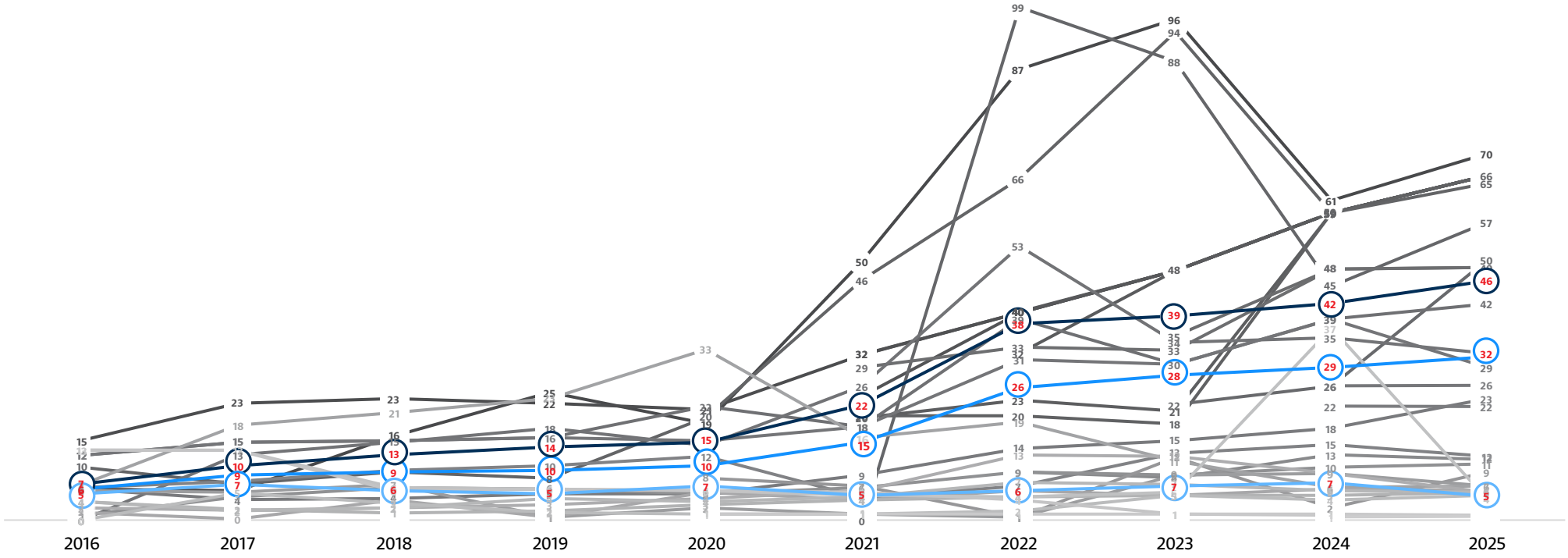
Source: ICAP (2025a).

Appendix 7. Price stability mechanisms of ETS as per the World Bank 2024.

Instrument name	Market Stability Reserve (MSR)	Price ceiling	Price floor	Set price	No mechanism	Σ
Australia SGM						0
Austrian ETS				1		1
Canada Alberta TIER		1				1
Canada British OBPS						0
Canada Federal OBPS				1		1
Canada New Brunswick OBPS		1				1
Canada Newfoundland and Labrador PSS		1				1
Canada Nova Scotia OBPS						0
Canada Ontario EPS		1				1
Canada Quebec CaT	1		1			2
Canada Saskatchewan OBPS		1				1
China Beijing pilot ETS	1	1	1			3
China Chongqing pilot ETS						0
China Fujian pilot ETS	1					1
China Guangdong pilot ETS	1		1			2
China Hubei pilot ETS	1					1
China National ETS						0
China Shanghai pilot ETS	1					1
China Shenzhen pilot ETS	1					1
China Tianjin pilot ETS	1					1
European Union ETS	1					1
Germany ETS				1		1
Indonesia ETS						0
Japan Saitama ETS						0
Japan Tokyo CaT						0
Kazakhstan ETS						0
Korea ETS	1					1
Mexico ETS						0
New Zealand ETS			1			1
Switzerland ETS	1					1
United Kingdom ETS	1					1
U.S. California Cap and Trade (CaT)	1		1			2
U.S. Colorado ETS	Not included in World Bank 2024					
U.S. Massachusetts ETS			1			1
U.S. Oregon CPP	Not included in World Bank 2024					
U.S. RGGI	1		1			2
U.S. Washington Cal	1	1	1			3
Total	**15 (43%)**	**7 (20%)**	**8 (23%)**	**3 (9%)**	**10 (29%)**	

Source: World Bank (2024).

Appendix 8. Allowance prices in ETSs globally, 2016-2025, as of June 2025.



Source: Authors, based on World Bank (2025b).

About the Team



Sarah Wahbah

Sarah Wahbah is a Senior Associate in KAPSARC's advisory team, contributing to key climate and sustainability projects in the fields of carbon markets and CCUS. Previously, she supported the establishment and operations of the Public Investment Fund's (PIF) Regional Voluntary Carbon Market Company (VCM), in addition to contributing to business development and the organization of key events, including the second carbon credit auction in Kenya and the Global South Carbon Markets Conference during the seventh edition of the Future Investment Initiative. During her time at McKinsey & Company, Sarah worked on projects spanning national strategies, organizational development, and cost optimization across the GCC. She has collaborated with diverse stakeholders across the public and private sectors, emphasizing practical solutions and innovative approaches. Sarah holds a double major in Political Studies and Public Administration Management, with a minor in Public Policy, from the American University of Beirut, where she cultivated a passion for policy and sustainable development.



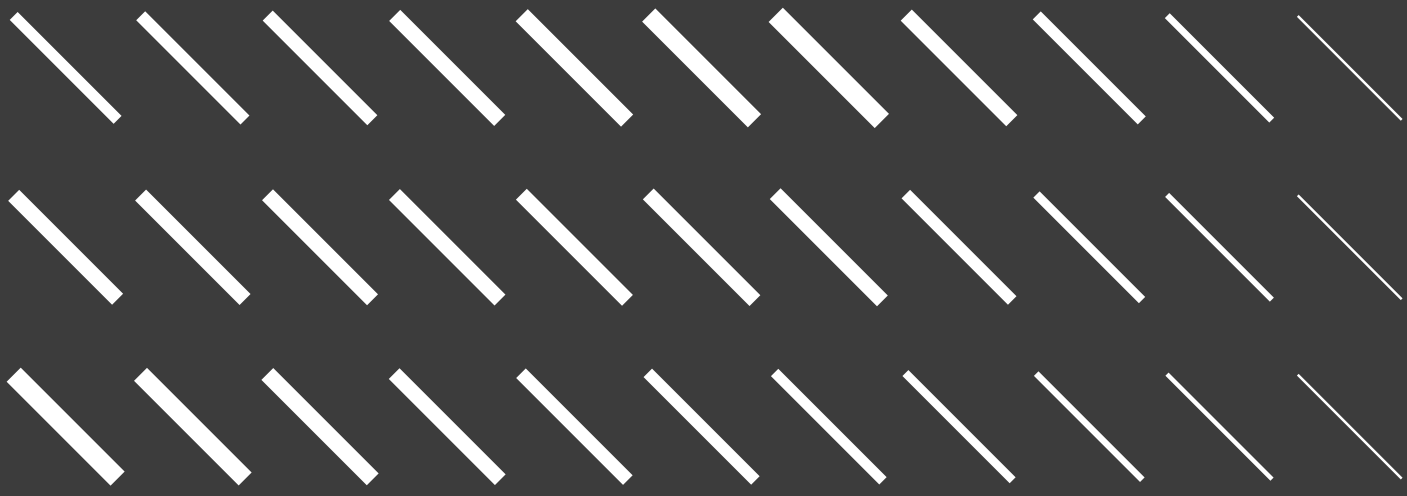
Mari Luomi

Mari Luomi is a Principal Fellow in the Climate and Sustainability Department. She is a policy-oriented social scientist who has been studying climate change, energy transitions and sustainable development policy in the Gulf and globally for close to two decades. She has worked for other leading energy, sustainable development, and foreign policy research institutions, including the Oxford Institute for Energy Studies, the International Institute for Sustainable Development (Earth Negotiations Bulletin), Georgetown University, the Finnish Institute of International Affairs, and the Emirates Diplomatic Academy. Mari holds a master's degree in Political Science and International Politics from the University of Helsinki and a Ph.D. in Middle Eastern Studies from Durham University. In addition to a broad research publications portfolio, she has substantial experience in executive training, presentations, policy advisory, and reporting services for multilateral environmental negotiations.

About the Project

Carbon markets continue to receive increasing attention from governments worldwide. This trend is particularly pronounced in emerging economies. In parallel, global carbon market cooperation has received a boost from the full operationalization of Paris Agreement Article 6 in late 2024. Titled "Elements for Effective Government-led Carbon Market Strategies in Emerging Economies," this project builds on KAPSARC's previous research on carbon markets, which centers on the role of governments in enabling effective mitigation through carbon market frameworks and policies. The project has two thematic foci: (1) identifying elements for effective emission-compliance market schemes in emerging economies, and (2) examining how credit markets can be used for cost-effective mitigation pathways.





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