Enhancing China's ETS for Carbon Neutrality: Introducing Auctioning

Lessons from international experience

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Abstract

The pace of emissions reductions of the People's Republic of China ("China" hereafter) over the coming decades will be an important factor in global common efforts to limit global warming in line with the Paris Agreement. China's national emissions trading system (ETS) came into operation in July 2021, and is an important policy instrument for achieving its stated climate ambition of peaking CO_2 emissions before 2030 and achieving carbon neutrality before 2060. This report, *Enhancing China's ETS for Carbon Neutrality: Introducing Auctioning – Lessons from international experience*, responds to the Chinese government's invitation to the IEA to co-operate on carbon emissions trading systems. It shows how introducing auctioning could strengthen its national ETS and help China accelerate the clean energy transition and advance towards its climate ambitions. Drawing on international experiences on implementing allowance auctioning in ETS systems, this report explores policy aims and outcomes, key design and implementation elements, and the use of auction revenues. It aims to inform policy makers in China and other jurisdictions considering including allowance auctioning in their ETS design or development. It includes a series of policy insights tailored to China's national circumstances to inform the domestic policy making process.

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For questions and comments, please contact EED at climate.change@iea.org.

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Executive summary

In September 2020, President Xi Jinping announced that China will "aim to have CO_2 emissions peak before 2030 and achieve carbon neutrality before 2060" (the "dual carbon" goals). In so doing, China set a clear vision for a profound transformation as well as a framework for sustainable socio-economic development. The pace of China's emissions reductions over the coming decades will be an important factor in global common efforts to limit global warming in line with the Paris Agreement, as the country accounts for one-third of the world's annual CO_2 emissions from the energy sector.

China's national emissions trading system (ETS) – which came into operation in July 2021 – is an important policy instrument for achieving the country's "dual carbon" goals. The system covers around 4.5 Gt CO_2 of annual power sector emissions – about 40% of China's energy sector CO_2 emissions[1] in 2020 – which makes it the world's largest ETS in terms of covered emissions. Coverage is expected to expand further in the coming years to include energy-intensive industrial sectors, which are responsible for another 30% of China's energy sector CO_2 emissions. Strengthening the national emissions trading system can send a robust price signal for decarbonisation, drive cost-effective emissions reductions and guide low-carbon investments – all of which can help to accelerate the clean energy transition and China's progress towards its climate ambitions.

While China's national ETS currently allocates all allowances for free, it has indicated its intention to explore the introduction of auctioning of emission allowances (China, MEE, 2021a; China, State Council General Office, 2021). In response to the Chinese government's invitation to the IEA to co-operate on carbon emissions trading systems, this report analyses international experiences in implementing allowance auctioning, with a focus on policy aims and outcomes, key design and implementation elements, and the use of auction revenues. The report aims to inform policy makers in China and other jurisdictions where allowance auctioning is being considered in the design or development of emissions trading systems. It includes a series of policy insights tailored to China's national circumstances to inform the domestic policy process.

Key lessons from international experience

In jurisdictions that have adopted emissions trading systems, the use of allowance auctioning has gradually replaced or complemented free allowances over time.

[1] Energy sector CO_2 emissions include CO_2 emissions from fuel combustion and from industrial processes.

This has been motivated by the many advantages of allowance auctioning, primarily:

- **enhancing environmental effectiveness** of an ETS by changing how emitters perceive carbon costs and strengthening incentives for cost-effective emissions reductions
- **creating an additional revenue stream** that can be used to invest in clean energy deployment and innovation as well as energy efficiency, and which can be redistributed to companies and/or citizens to address social and competitiveness concerns
- **addressing windfall profits,** a problem that can arise with free allocation
- **increasing liquidity and transparency** of the carbon market, which strengthens price discovery, reduces non-compliance risks and facilitates the implementation of price and supply adjustment measures
- **preparing domestic industry for potential other international climate policies** by strengthening domestic climate policy and supporting cost-effective decarbonisation.

As jurisdictions introduce allowance auctioning, they generally face three main areas of concern: carbon leakage[2], adverse economic and social consequences linked to cost increases for emitters, and challenges related to lack of cost pass-through in regulated markets. The key instruments used to address such concerns include the recycling of auction revenues (for clearly earmarked purposes), the targeted use of free allowances, and more recently, border carbon adjustment measures on imports. Consignment auctions (described in detail below) could be another way to combine certain advantages of conventional auctioning and partially address the concerns above, since any auction proceeds would eventually be returned to covered entities.

More mature ETS systems have converged towards adopting auctioning as the default allocation method for emission allowances. However, free allowances are often still granted in a limited number of sectors after an assessment of the underlying economics, the exposure to carbon leakage risks, the effects on competitiveness and the capacity for covered entities to pass on their carbon costs. These assessments are typically conducted using standardised and quantitative criteria and focus on two dimensions: emissions intensity and trade exposure. The appraisal results also provide a basis for determining the pace of introducing auctioning as well as the balance of auctions versus free allocations in different sectors. While details vary by jurisdiction, the process often includes a more rapid introduction and higher share of auctioning in sectors that face little or

[2] Carbon leakage refers to the phenomenon where, for reasons of costs related to climate policies, firms transfer production to other jurisdictions with less stringent climate policies, or where firms from outside the jurisdiction gain market share. Carbon leakage can lead to an increase in overall emissions.

no leakage risk and can pass on their carbon costs (e.g. the electric power sector and fuel suppliers). This is followed by a progressive phase-in of auctions for sectors facing moderate leakage risks, and a slower introduction for highly emissions-intensive and trade-exposed (EITE) sectors. Even for sectors eligible for free allowances, some jurisdictions have found alternative ways to phase down free allowances to incentivise more efficient production and investments in decarbonisation. Such methods include introducing increasingly stringent benchmarks for the allocation of free allowances as well as other reduction or correction factors.

Auction revenues have increased in importance and are seen as a major benefit of this approach. The jurisdictions analysed have increasingly converged on solutions that deploy auction proceeds through dedicated funds that earmark spending for specific purposes. These investments can finance additional investments in greenhouse gas mitigation, help address competitiveness concerns or lower the long-term costs of decarbonisation through enhanced innovation. They can also be used to reduce the impact of carbon costs on vulnerable citizens, or to support economic development programmes in regions affected by industrial transitions. Appropriate and transparent governance arrangements for the use of auction revenues are widely seen as essential for achieving the intended objectives, strengthening public acceptance, and minimising administrative costs. Such arrangements often involve cross-ministerial collaboration between the ETS regulator and the finance ministry. In addition, governance frameworks for auction revenues may need to evolve over time as the emissions trading system matures and as priorities shift for the use of revenues.

Policy insights for China

Adopting partial allowance auctioning in China's emissions trading system could strengthen its environmental and cost-effectiveness, and its role in supporting the achievement of China's "dual carbon" goals. A gradual introduction of auctioning, with a share of around 25% for the power sector by 2035, could potentially double emissions reductions in the sector (reducing CO_2 emissions by an additional 840 Mt in 2035) compared to an entirely free allocation system. This approach – which would have a limited impact on total system costs – could create a new annual revenue stream of about USD 39 billion (CNY 260 billion) (IEA, 2022a). Auctioning can also improve the functioning of China's carbon market and help address certain challenges experienced in the first compliance period by increasing market liquidity, strengthening carbon price discovery, and enabling the implementation of price and supply adjustment measures. The main issues to tackle in introducing auctioning relate to the structure of the power market, competitiveness and leakage risks, as well as potential social impacts and governance complexities. Considering the benefits and challenges related to

introducing auctioning of emission allowances in China, the following insights could help guide policy decisions going forward:

- **Rapid but limited introduction of auctioning**. Introduce, as soon as possible, a small share of allowance auctioning (e.g. 5% to 10%) for electricity production. Increase the share gradually, in line with power market reforms, to account for the increased ability of power entities to pass their carbon costs through to customers. Emissions trading in the power sector could adopt either conventional auctioning or employ consignment auctions as a transitional method, whereby revenues are returned to covered entities. This could help facilitate political acceptance and reduce the need for cross-ministerial coordination for revenue governance.
- **Establish quantitative EITE criteria** in tandem with the extension of emissions trading to industry, to determine the sectoral coverage of allowance auctioning. These criteria would also help ensure that decisions on how fast to introduce auctions for industry are made within a predictable and transparent framework.
- **Use leakage risk assessments for EITE sectors to determine industry auctioning share**. Consider starting with a moderate share of auctioning for emissions-intensive and trade-exposed industries, including through consignment auctions, to ensure sufficient decarbonisation incentives for industry while maintaining competitiveness in an evolving international context.
- **Implement price or supply adjustment measures alongside the introduction of allowance auctions**. Auctioning provides an opportunity to introduce an auction reserve price or cost containment mechanisms to help stabilise the allowance price signal and provide greater visibility for investment decisions.
- **Establish a dedicated auction revenue fund with cross-ministerial participation** led by the Ministry of Ecology and Environment (MEE) and the Ministry of Finance (MOF) to ensure harmonised, fair, transparent and effective use of revenues. If a consignment auction method is adopted, establish clear rules in advance on how covered entities can use the revenue and be sure to enforce this through monitoring and reporting.
- **Earmark auction revenues** for the support of climate mitigation investments as well as social and economic development in provinces that are most affected by carbon costs. This includes financing clean energy deployment, research and development (R&D), energy efficiency in covered sectors as well as support for workers, industrial and economic diversification and for communities in fossil-fuel dependent provinces. Depending on China's progress towards power market reform and the deregulation of its electricity markets, direct support to electricity-intensive industries and/or households might become necessary.

Introduction

Climate change has emerged as the defining challenge of this generation and the energy sector is a major contributor to global greenhouse gas (GHG) emissions. In recent years, governments around the world have responded by ramping up their climate ambitions, including new targets for reaching net zero emissions. To achieve these ambitious goals, policy frameworks that enable deep decarbonisation of the energy sector by mid-century need to be adopted in this decade. The pace of China's emissions reductions over the coming decades will be an important factor in global common efforts to limit global warming in line with the Paris Agreement, as its economy accounts for one-third of the world's annual CO_2 emissions from the energy sector. The statement by President Xi Jinping that China will "aim to have CO_2 emissions peak before 2030 and achieve carbon neutrality before 2060" sets out a clear vision and timeline for a profound transformation of the country's socio-economic development.

Carbon pricing is a powerful instrument for driving clean energy transitions

Integrating carbon pricing into the national policy mix can be a highly effective way to steer energy producers and users to the path of emissions reduction. A carbon price aims to capture the "externalities" of emissions by requiring the emitter to absorb their costs (also known as the polluter-pays principle). Carbon pricing gives a clear price signal to reduce emissions and creates incentives for the adoption of clean technologies. Using carbon allowances to allocate emissions rights and allowing for the exchange of these rights – as in an emissions trading system – can incentivise the implementation of emissions reductions measures where they are cheapest. But given variations in the pace of economic development, the structure of markets and the capacity of institutions across economies, it is important that any emissions trading system be tailored to fit national circumstances.

As of April 2022, 23% of global GHG emissions were covered by some form of carbon pricing instrument – the majority by an emissions trading system and the rest by a carbon tax (World Bank, 2022a). Until recently, the use of carbon pricing was largely concentrated in advanced economies. But emerging market and developing economies have increasingly begun to explore emissions trading. China's national ETS came into operation in July 2021, covering around 4.5 Gt CO_2 from the power sector (electricity and heat generation) – making it already the world's largest by volume of covered emissions. Meanwhile, Indonesia is scheduled to implement carbon pricing at the end of 2022 in the form of a carbon

tax, with the intention of introducing an ETS by 2025. Brazil, Thailand and Türkiye are also looking into carbon pricing schemes (World Bank, 2022a). India adopted a framework carbon pricing law in August 2022 in preparation for a national carbon trading mechanism (India, Lok Sabha, 2022). Alongside these national initiatives, cross-border approaches such as border carbon adjustment measures (European Commission, 2021d) as well as climate club discussions (G7, 2022) are gaining traction as governments seek new ways to address the challenges emanating from clean energy transitions at different speeds across countries.

The current global energy crisis also impacts the functioning of carbon markets. In the European Union (EU), for example, it has hampered efforts to drive a switch from coal to gas and has led to volatility in the price of emissions allowances. Notwithstanding, emissions trading systems remain an effective instrument for accelerating clean energy transitions and reducing the reliance on fossil fuels: they provide a long-term investment signal, make emissions-intensive fuels like coal an unattractive long-term solution and encourage efficiency measures as well as other demand-side responses.

Carbon pricing can also support clean energy transitions by generating substantial revenues. Global revenues from carbon pricing grew strongly and reached about USD 84 billion in 2021, largely driven by emissions trading systems that use allowance auctioning. Revenue from emissions trading systems amounted to more than USD 56 billion in 2021 – doubling from a year earlier, and surpassing revenues from carbon taxes for the first time (World Bank, 2022a). The main reasons for the sharp gains were higher allowance prices and an increase in the number of allowances being auctioned.

China's national ETS as a key instrument for achieving its climate goals

China's national emissions trading system started operating in July 2021, currently covering the power sector which is responsible for about 40% of national energy sector CO_2 emissions. China's high-level Guidance for achieving its carbon peaking and carbon neutrality targets identifies the national ETS as a key market-based policy instrument. It highlights the need to accelerate the system's development "by gradually expanding its coverage, diversifying trading types and means, and improving the allocation and management of allowances" (China, CCCPC and State Council, 2021). Coverage is expected to soon include energy-intensive industrial sectors – including petrochemicals, chemicals, building materials, iron and steel, non-ferrous metals, paper and domestic aviation – which account for another 30% of energy sector emissions. China currently allocates all carbon allowances for free, based on predetermined emissions intensity benchmarks. But the country has indicated its intention to explore the introduction

of paid allocation methods such as auctioning (China, MEE, 2021a; China, State Council General Office, 2021).

The first compliance period of China's national ETS was concluded successfully in December 2021, achieving a compliance rate of 99.5%. Allowances in the secondary market mostly traded at around USD 6 to USD 9/t CO_2 (CNY 40 to CNY 60/t CO_2), but the market has shown limited liquidity: cumulative trading represented only about 4% of annually covered emissions as of the end of 2021 (China, MEE, 2021b). Trading activity in 2022 has remained at low levels as the market awaits the government's allocation plan for 2021-2022 emissions.

Despite efforts to limit coal consumption and the rapid expansion of alternative fuels – especially renewables – over the past decade, China's power sector remains highly reliant on coal. With more than 1100 GW of largely state-owned coal-fired power capacity, coal fuelled more than 60% of China's electricity production in 2021, resulting in the sector's large emissions footprint. In addition, the average age of the country's coal-powered fleet is less than 15 years, which increases the risk that emissions will be locked in and assets will be stranded. China aims to limit the increase in coal consumption over the current Five-Year Plan period (2021-2025) and to phase it down in the following period (2026-2030), as well as to develop a new power system based on new energy sources (mainly wind and solar). Until now, most of the dispatch and pricing of electricity in China has been determined administratively. But ongoing reform of the power system are strengthening the role of markets in electricity pricing and resource allocation, and China envisions the establishment of a unified, national system of competitive power markets by 2030. Power market reform has profound implications for China's emissions trading system: In addition to enabling an effective carbon price signal, it could make it easier for power companies to pass through carbon costs. It will also affect how the ETS impacts industry (for more information see IEA, 2022a).

As China seeks to explore the introduction of allowance auctioning in its national emissions trading system, this report draws on international experiences and focuses on policy aims and outcomes, key design and implementation elements, and the use of auction revenues. It includes a series of insights tailored to China's national circumstances to inform the domestic policy process related to ETS enhancement. The systems analysed include emissions trading systems in the European Union, Korea and New Zealand as well as California's Cap-and-Trade Program, the Regional Greenhouse Gas Initiative (RGGI) in eastern United

States [3] and Quebec's Cap-and-Trade System. [4] The report is structured as follows:

- **Chapter 1** summarises different rationales for introducing auctioning in an emissions trading system and discusses key benefits and challenges
- **Chapter 2** presents the key elements of the process of implementing auctioning
- **Chapter 3** provides an overview of different uses of auction revenues
- **Chapter 4** concludes with key policy insights for China's ETS.

[3] As of September 2022, the Regional Greenhouse Gas Initiative (RGGI) involves the US states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont and Virginia.

[4] The jurisdictions have been selected based on size of the system, years of operation and auctioning use, and system representativeness. This report therefore did not analyse some systems that are closely related to the EU ETS and/or very recent systems, including national systems in Switzerland, the United Kingdom and Germany as well as the Cap-and-Trade Program in the Canadian province of Nova Scotia.

Chapter 1. Why auctioning?

This chapter explains how allowance allocation is linked to the main rationale of establishing an emissions trading system, briefly presenting the two main methods of allowance allocation. It provides an overview of the reasons different jurisdictions have introduced allowance auctioning, and further explains how allowance allocation enhances the effectiveness of an ETS.

Allowance allocation methods

Setting up an emissions trading system involves creating allowances to emit a certain quantity of emissions, which can be bought or sold, and need to be allocated to market participants. The method used to allocate these tradeable assets ultimately determines how costs are distributed among the emitters covered by the ETS, and ultimately the broader economy. It impacts how covered emitters react in terms of production volumes, investments and cost-pass through to consumers. In general, there are two main methods to allocate allowances:

- **Auctioning** is the allocation of allowances through a competitive bidding process. Entities request a certain number of allowances and submit the price they are willing to pay for those allowances. After receiving the bids, the regulator then sells the allowances to bidding entities at a given price.
- **Free allocation** provides (all or a part of) emissions allowances to the covered entities for free. This is generally done in one of three ways: **grandfathering**, i.e. using historical emissions as the baseline; **fixed benchmark** allocation, which sets emissions intensity limits and uses historical output levels; or **output-based benchmarking**, which uses intensity benchmarks and current production volumes.

It is possible to combine both allocation methods. Indeed, most jurisdictions that have adopted allocation by auction use a hybrid approach: covered entities in specific sectors receive some of their allowances for free but must purchase the remainder via auction. Typically, the balance is adjusted over time, increasing both the coverage and proportion of auctioned allowances (World Bank, 2021). The adoption of auctioning establishes a primary market for the initial distribution of allowances, in addition to the secondary market where entities subsequently trade their allowances – either on an exchange, "over the counter" or in the form of financial products ("derivatives") (Box 1.1). In systems that exclusively allocate allowances for free (as is currently the case in China), covered entities can only use the secondary market to purchase additional allowances or to sell excess ones.

Both allocation methods serve different objectives. Auctioning can strengthen the emissions trading system as a policy instrument for effectively and efficiently reducing emissions, by creating an explicit carbon cost, increasing incentives for cost-effective abatement and enhancing the markets' price discovery. It can also reduce the possibility of windfall profits and generate an additional revenue stream. Free allocation, on the other hand, can help – under certain circumstances – to manage the transition to an emissions trading system, lower the carbon cost for covered entities and reduce the risk of carbon leakage and loss of competitiveness – particularly for emissions-intensive, trade-exposed industries. Since allocation methods can alter the carbon price signal and change incentives for emissions abatement, it is crucial that policy makers carefully consider different allocation options given their unique national circumstances and decarbonisation strategies.

Box 1.1 Interaction of the primary and secondary allowance markets

The **secondary market** is where emissions allowances are traded among market participants after the initial allocation by the regulator to covered entities. Allowances can either be traded directly between market participants, "over the counter" through a broker, or through exchange-based platforms. In addition, there can be trading activities with financial products linked to the original allowance (derivatives). Introducing (partial) allowance auctioning establishes a **primary market** where covered entities purchase allowances from the regulator. Free allowance allocation, in contrast, only creates a secondary market. The regulator only allocates allowances and does not engage in trading.

A well-functioning secondary market is essential for increasing **allowance price stability**, a key parameter for the effective operation of an emissions trading system. Among other regulatory decisions (e.g. eligibility to participate in the secondary market), the design of the initial allocation greatly impacts outcomes in the secondary market. Introducing allowance auctioning can be useful for steering the operation of the secondary market through a primary market:

- Frequent allowance auctions help to **increase market liquidity** by regularly injecting new allowances into the system via the primary market, which facilitates covered entities in meeting their compliance requirements.
- The price information submitted from the primary market can, together with enhanced trading activities in the secondary market, lead to more **efficient price discovery**.
- Auctioning makes it possible to implement price and supply adjustment measures in the primary market (see Chapter 2) that can help to reduce price volatility in the secondary market. While prices in the secondary market can

still diverge from the primary market price, arbitrage mechanisms align allowance prices on both markets and thus help to stabilise the price level.

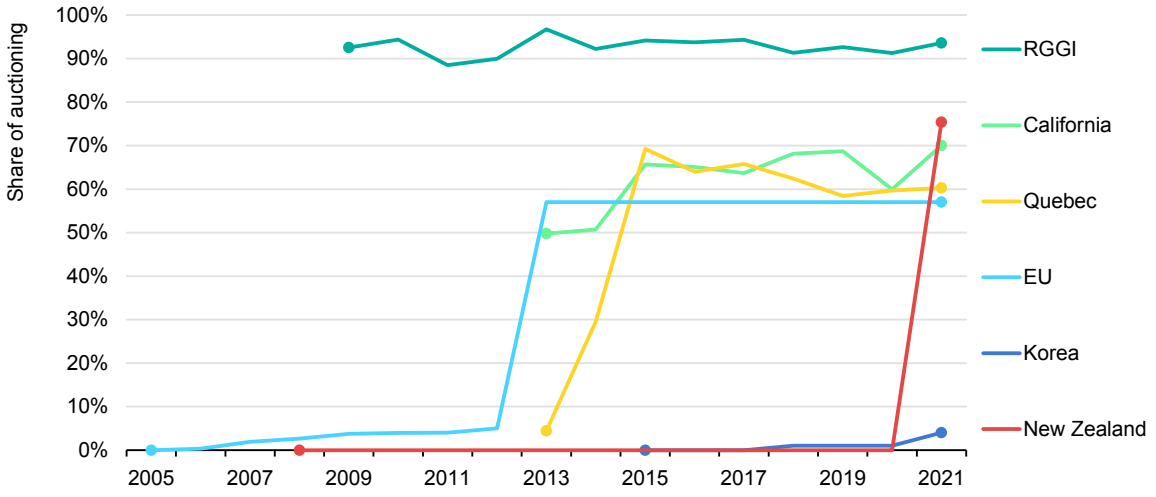
While not directly linked to auctioning, a well-functioning secondary market can further provide access to risk management products – for example, futures contracts that allow participants to hedge the risk between long-term price expectations and expected production.

Source: World Bank (2021), UK Government (2022), Narassimhan et al. (2018) and C2ES (2016).

Status quo of allowance auctioning

In 2021, most of the selected emissions trading systems auctioned more than 50% of allowances, apart from Korea (Figure 1.1). Of the six systems analysed, none allocated allowances entirely by auction, but most have moved towards increasing the share of allowances auctioned. The one exception is RGGI, which opted for nearly full auctioning from the start. The pace of introduction differed widely, including direct adoption of a substantial auctioning share (RGGI and California) adoption of a substantial auctioning following major reform (European Union and New Zealand) and gradual introduction (Korea).

Figure 1.1 Development of allowance auctioning in existing systems over time



Notes: RGGI = Regional Greenhouse Gas Initiative. Share of allowances auctioned calculated based on historical data on verified emissions, allowance allocation and auction results of the respective jurisdiction. Allowances auctioned under consignment are included for California.

The **EU ETS**, the first emissions trading system starting in 2005, initially used free allowances as the main allocation method in Phases 1 and 2, allowing auctioning for up to 5% and 10% of the allowances in the two phases. But EU member states were reluctant to subject their domestic entities to auctioning, and consequently,

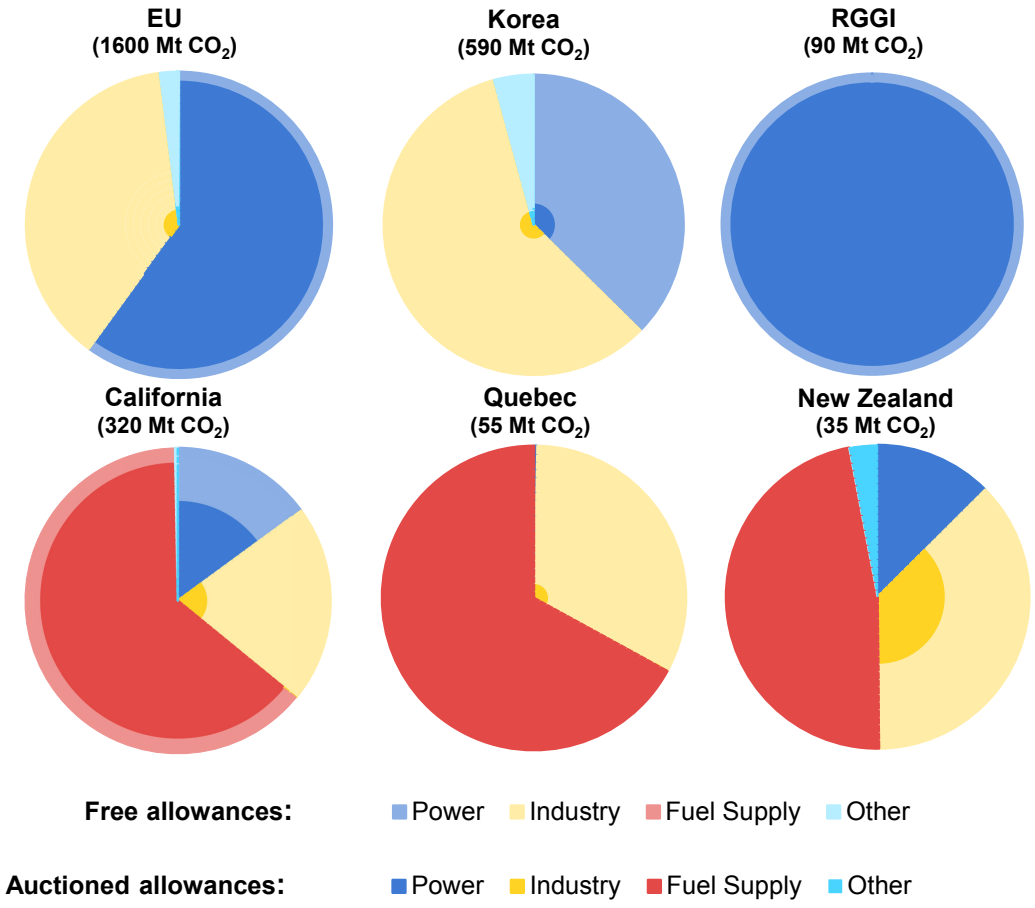
by 2012, less than 5% of allowances were being auctioned. Meanwhile, the EU ETS suffered from a significant oversupply of allowances and allowance price erosion following the 2008 financial crisis, which limited its ability to send a strong price signal for decarbonisation. The European Union reformed the system's framework for Phase 3 (2013-2020), adopting auctioning as the default method for allowance allocation with an auction share of 57%. While the same share is maintained for Phase 4 (2021-2030)[5], the European Union is discussing proposals to further reduce free allowances to industry and aviation to increase the effectiveness of the ETS while preventing carbon leakage in parallel to introducing a Carbon Border Adjustment Mechanism (CBAM).

Emissions trading systems in North America, including **RGGI** and **cap-and-trade programs in California** and **Quebec** – which were conceived or launched while the EU ETS was in Phase 2 (2008-2012) – opted for a substantial share of allowance auctioning, introduced either in the first compliance period or shortly thereafter. Considerations included ETS effectiveness, revenue generation, risk of windfall profits with free allowances and lessons learned from the European experience. RGGI has been auctioning around 95% of its allowances since the beginning – by far the highest share among existing systems – partly because it covers only the power sector. California and Quebec also auctioned allowances for the power sector from the beginning while simultaneously granting free allowances to industry. The share of auctioned allowances has increased to around two-thirds since 2015 as the systems expanded to cover fuel suppliers (who are subject to a higher share of auctioning).

The **Korea ETS** was launched in 2015 and because of the country's industrial structure and highly regulated power market, the plan was to gradually introduce allowance auctioning during the first three phases. The Korea ETS started with entirely free allocation in Phase 1 (2015-2017) and gradually introduced a small share of auctioning to sectors that were not emission-intensive or trade-exposed, resulting in around 4% of total allowances being auctioned in 2021. Korea has indicated that the current auctioning level is insufficient and it is looking for ways to scale it up – while maintaining competitiveness – in light of strengthened decarbonisation goals and international developments, including the European Union's CBAM proposal (Carbon Pulse, 2022).

[5] The actual share of auctioned allowances in the EU ETS can vary due to rules related to the free allocation buffer, limited flexibility for member states' effort sharing, and allowances made available to the Innovation Fund and the Modernisation Fund. For the period 2021-2025, around 51.5% of the annual EU ETS cap will be initially auctioned.

Figure 1.2 Status quo of allowance auctioning by sector in existing systems, estimated for 2021



Notes: RGGI = Regional Greenhouse Gas Initiative. Pie slices show the share of the respective sectors in covered emissions; Number in brackets states the system's overall emissions coverage (cap). Colour shading indicates allowance auctioning versus free allocation in each sector. Assessment is conducted for 2021 based on the most recent available data on verified emissions, 2021 allowance allocation and auction results reports of each jurisdiction. For California, consigned allowances auctioned are included.

Meanwhile, significant differences exist in the extent to which allowance auctioning is implemented across sectors (Figure 1.2). Power generation – including electricity and heat generation – faces the highest share in every system apart from Korea's: 100% in New Zealand and Quebec, 95% in RGGI states, 94% in the European Union and 65% in California. In the European Union, for example, auctioning is the default allocation method for the power sector except for heat co-generation and electricity produced from waste gases. California, Quebec and New Zealand – the three systems that cover emissions from fuel suppliers (e.g. transport fuels) – auction at least 90% of the sector's allowances. In contrast, industry still receives mostly free allowances. While all systems except RGGI cover industry, only New Zealand and California auction more than 15% of allowances for the industrial sector. In the European Union, Korea and Quebec,

industrial emissions make up more than one-third of covered emissions, but auctioned allowances account for less than 5% of the emissions allowances for industry.

Benefits of auctioning

Auctioning enhances environmental effectiveness of an ETS

Auctioning enables an emissions trading system to send a clear price signal for decarbonisation as it strengthens incentives for cost-effective emissions reductions and shifts how firms perceive carbon costs. Freely allocating allowances within an emissions trading system (provided those allowances meet the entities' allowance needs) establishes only an "opportunity cost": a firm that fails to reduce emissions below the quantity it received in allowances faces a potential loss from not being able to sell unused allowances. By contrast, auctioning requires a firm to purchase allowances to cover its emissions, creating an explicit cost. While a firm should, in theory, treat opportunity and explicit costs equally, practice has shown that allowance auctioning has a stronger impact on operational decisions and, hence, is an incentive for cost-effective abatement (Stefano et al., 2018). By encouraging firms to think strategically about low-carbon investments and adopting energy efficiency measures, auctioning also rewards first movers since they will have to purchase fewer allowances in future auctions (World Bank, 2021). This has the benefit of speeding the clean energy transition. In 2021, **New Zealand** introduced auctioning explicitly to increase the system's effectiveness in reducing emissions (New Zealand, Ministry of Environment, 2018). Likewise, **Korea** plans to keep phasing in larger shares of auctioned allowances as its system shifts towards active encouragement of emissions reduction (Republic of Korea, Ministry of Economy and Finance, 2014).

Auctioning addresses issues of windfall profits

The free distribution of allowances can lead to substantial windfall profits[6] in certain sectors – which can be avoided by auctioning (Hobbie et al., 2019). Windfall profits can occur for two reasons. Firms may receive a larger number of free allowances than they require for compliance, which means they can monetise the surplus. Under China's current system, ultra-supercritical coal-fired power plants could outperform the emissions intensity benchmark used for setting their free allocation and end up having 34 million surplus allowances in 2025, which could be worth around USD 950 million, or CNY 6 billion (IEA, 2022a). Windfall profits can also

[6] In this case, windfall profit can be defined as a rise in value of assets (in the form of emissions rights) without a comparable cost increase for regulated firms.

arise if covered entities manage to pass opportunity costs on to their customers in the form of price increases, while not having incurred any actual carbon cost.

The extent to which firms can pass through costs depends on a variety of factors, although in general, the ability to do so is very dependent on the market structure of a given sector. It is especially reduced by the presence of competitors who face a lower carbon cost (or none at all) – for example, through international trade (Neuhoff and Ritz, 2019). Research on **EU ETS** finds high-cost pass-through rates in Phases 1 and 2 (2005-2012) in multiple European countries especially in the power sector (Fabra and Reguant, 2014), which can be explained by a lack of non-European competition in this sector. Such findings were also one of the main reasons for the introduction of auctioning for the power sector in the EU ETS starting in 2013. Findings on energy-intensive industrial producers such as iron and steel, cement or refineries are sparser and indicate a wide range of cost pass-through rates with a high dependency on the product analysed (Cludius et al., 2020; European Commission, 2015). Nevertheless, the overall rates identified indicate significant cost pass-through, suggesting an increase in consumer prices. However, previous studies analysing cost pass-through occurred when the price of an EU emissions allowance was well below its current level of around EUR 70-80. It could be that there is a maximum level at which the additional carbon costs can no longer be passed through to customers.

With auctioning, both sources of windfall profits can be mitigated because covered entities face an actual, explicit carbon cost as they need to purchase the quantity of allowances required for compliance, and have therefore an interest in minimising this cost.

Auctioning generates a revenue stream

Auctioning emissions allowances generates a new source of revenue that governments can use to pursue different political objectives. How auctioning revenue is governed and used generally depends on the priorities and circumstances of a given jurisdiction, which may also evolve over time. How different jurisdictions are governing and making use of their auction revenues is discussed in detail in Chapter 3.

Auctioning increases transparency

Auctioning is the most transparent, fair and inclusive allowance allocation mechanism for all actors involved. For governments, auctions tend to be simpler to administrate and implement than free allocation, which requires a complex set of rules. With auctioning, all market participants must play by the same rules. This greatly increases the transparency of allowance allocation for all parties, decreases opportunities for lobbying by parties seeking preferential treatment and

reduces economic inefficiencies. In addition, auctioning can decrease operational complexities, since data collection needs are much greater under a free allocation system. This is particularly relevant when a system is expanded to cover more entities. Requiring regulated entities to join and participate in auctions also directly engages them in the mechanism. Confronting them with the process of allowance auctioning and price setting can lead to a greater understanding of the system's purpose and functioning, which can foster trust and acceptance. Allocation rules that are simple, clear and predictable help new participants to enter and navigate the carbon market (ICAP, 2019). In many jurisdictions such as the European Union or California, regulators offer training courses before auctions to facilitate entry into the system. A transparent recycling strategy for auction revenues can also play an important role in building public acceptance of the system (World Bank, 2022b).

Auctioning improves the carbon market's functioning

Auctioning also brings about a range of technical benefits which can substantially improve the functioning of carbon markets. Allowance auctions introduce a natural price discovery function: regularly publishing an updated allowance price strengthens the carbon price signal which is important for the market to deliver cost-efficient abatement and to reduce transaction costs for participants (World Bank, 2021).

Regular auctions that involve many regulated entities also increase market liquidity. Systems with a high proportion of freely allocated allowances might experience low trading activity in the secondary market, since many covered entities will have already obtained most of the allowances they need for compliance and therefore don't need to purchase more. Auctioning, by contrast, establishes a primary carbon market which allows covered firms to regularly purchase allowances directly from the regulator and encourages participants to trade allowances among themselves. This can further reduce the risk of non-compliance for firms which need to buy allowances but face difficulties in a secondary market with low liquidity. For instance, in **Korea's ETS**, liquidity challenges have been a concern, and limited auctioning as well as low engagement by market participants are both cited as contributing factors (Vivid Economics, 2020). Frequent auctions of smaller amounts of allowances also reduces the risk of market manipulation by larger participants. Where governments are reluctant to introduce conventional auctioning, consignment auctions like those used in California's Cap-and-Trade Program are another way of establishing a primary market that helps to improve price discovery and increase liquidity (see Box 2.1).

Through regular price discovery and updating, auctioning also facilitates the use of price and supply adjustment measures that have proven useful in stabilising

carbon markets and safeguarding the function of an emissions trading system. One main argument for introducing auctioning in **New Zealand**'s ETS has been the wish to implement a cost containment reserve with a trigger price. A second example is the adoption of the **European Union**'s Market Stability Reserve (MSR), a quantit y-based adjustment measure. Since the start of its operation in 2019, it helped to reduce oversupply in allowances by reducing auctioned quantities.

Auctioning strengthens domestic industry's preparedness for other international climate policies

Alongside the adoption of national carbon pricing measures, cross-border approaches are also gaining traction as countries seek new ways to address the risk of carbon leakage (see below, Risk of competitiveness loss and carbon leakage) as they raise their domestic climate ambitions. So far, these approaches are based on the comparability of carbon price levels between jurisdictions. Auctions are seen as a credible way to demonstrate carbon price equivalency, which might not be possible with free allocation.

Although important political and technical uncertainties remain, if implemented, cross-border measures could impact the competitiveness and market share of affected industries. Since these measures typically take equivalency in carbon pricing or similar policies and product emissions intensity into account, governments can help industry adjust by strengthening domestic climate policy and supporting cost-effective decarbonisation (Adelphi and Tsinghua University, 2021).

Chapter 2. Implementing auctioning

This chapter provides an overview of how allowance auctioning has been implemented in the selected emissions trading systems, including decisions on sectoral coverage, the pace of introduction and share of auctioned allowances, auction administration and design, and how auctioning can facilitate the use of mechanisms for adjusting allowance price and supply.

Defining sectoral coverage of auctioning

The design of allowance auctioning and how quickly it is introduced depends on the specificities of each jurisdiction (see Chapter 1, Status quo of allowance auctioning). However, most systems tend to converge on a similar set of considerations for selecting which sectors should be subject to auctioning and which are eligible for free allocation. This has led to emissions allowances for the power sector and fuel suppliers being mostly allocated via auction, while industry tends to receive a substantial share of free allowances.

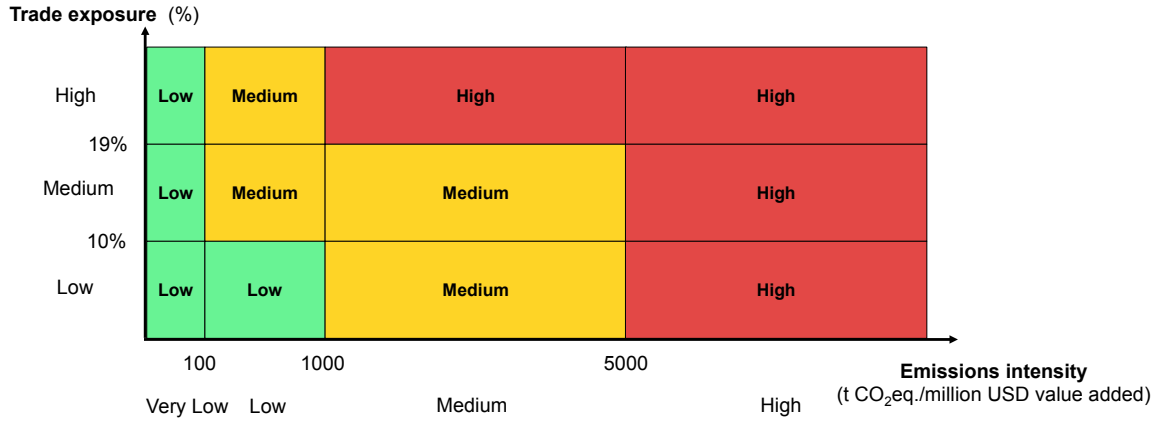
Except for the European Union, most jurisdictions have not sought to establish a specific share of allowances that needs to be allocated via auction for the entire system. Instead, they generally define criteria for determining an activity's eligibility to receive free allowances and how many they can receive, while auctioning is the default allocation method for those sectors found to be ineligible. **Korea**, meanwhile, takes a different approach: free allocation is the main allocation method, while the government designates the share of allowances to be auctioned for sectors subject to partial auctioning following defined rules.

To avoid carbon leakage and loss of competitiveness, most systems have granted free allowances to sectors that face a risk of carbon leakage or which cannot pass their carbon costs through to customers (see Chapter 1, Risk of competitiveness loss and carbon leakage). Typically, the main eligibility criteria are the emissions intensity of a sector and its trade exposure (Table 2.1). The emissions intensity of a sector – or a cost increase criterion,[7] which is used in some systems (e.g. **EU ETS Phase 3** and **Korea ETS**) – serves as an indicator of whether additional costs from carbon pricing would substantially impact production costs. Meanwhile, trade exposure – typically measured by the proportion of value that imports and exports

[7] Evaluating potential cost increase due to carbon pricing, considering emissions intensity multiplied by an assumed carbon price or average price over a defined period.

represent within a sector – is used to assess how much carbon cost an industry can pass through without losing significant market share. In most systems, quantitative thresholds are defined for both indicators (either separately or combined) to assess whether a sector is sufficiently emissions-intensive and/or trade-exposed to be granted free allowances. To differentiate the extent to which a sector can receive free allowances, some jurisdictions, including **California**, **Quebec** and **New Zealand,** define multiple leakage risk tiers with different thresholds (Figure 2.1).

Figure 2.1 California's tiered categorisation of leakage risk based on EITE* criteria



Notes: * EITE = emissions-intensive, trade-exposed.
Source: IEA, based on California Air Resources Board (2010) and California Air Resources Board (2013).

In addition to the criteria for emissions intensity and trade exposure (EITE), some jurisdictions grant free allowances to certain activities according to additional considerations, including distributional effects, the ability of certain non-EITE sectors to pass through carbon costs, or objective limits to a sector's decarbonisation potential. For example, in the **European Union**, electricity producers are subject to full auctioning for allowances for electricity generation. However, lower-income member states may grant a limited number of free allowances to electricity companies to support investments to diversify and modernise their energy sector. Heat production is eligible for free allowances in the European Union due to lack of low-carbon alternatives and limited cost pass-through capacity. The aviation sector also receives most of its required allowances for free because cost-effective alternatives are currently limited and international initiatives to decarbonise the sector are being developed. **California** and **Quebec** grant free allowances to power suppliers bound by legacy contracts because they cannot pass through the carbon cost under fixed-price contracts signed before the introduction of the emissions trading system.

Table 2.1 Defining exposure to carbon leakage risks: EITE* criteria

ETS	Emissions intensity	Trade exposure	EITE sector / Carbon leakage risks criteria
European Union	**Phase 3 (2013-2020):** Cost criterion = $[(direct\ emissions * auctioning\ factor) + (electricity\ consumption * electricity\ emission\ factor)] * \frac{carbon\ price}{gross\ value\ added}$ **Phase 4 (2021-2030):** Emissions intensity = $\frac{direct\ emissions + electricity\ consumption * electricity\ emission\ factor}{value\ added}$	$\frac{exports + imports}{turnover + imports}$	**Phase 3 (2013-2020):** • Cost increase > 5%, trade exposure > 10%; or • Cost increase > 30%; or • Trade exposure > 30% **Phase 4 (2021-2030):** • Trade exposure x emissions intensity > 20%; or • Trade exposure x emissions intensity > 15% but < 20%, determined by a qualitative assessment based on abatement potential, market characteristics, and profit margins.
Korea	Cost criterion = $\frac{GHG\ emissions * average\ allowance\ price}{value\ added}$	$\frac{exports + imports}{sales + imports}$	**Phase 2 (2018-2020):** • Trade exposure > 30%, or • Cost increase > 30%, or • Trade exposure > 10%, and cost increase > 5% **Phase 3 (2021-2025):** • Cost increase x Trade exposure ≥ 0.2%
California	$\frac{GHG\ emissions}{value\ added}$	$\frac{exports + imports}{value\ of\ shipments + imports}$	Three leakage risk tiers based on emissions intensity and trade exposure, with greater weight given to emissions intensity**. Emissions intensity tiers: • High: > 5 000 t CO_2e / million USD value added • Medium: 1 000–4 999 t CO_2e / million USD value added • Low: 100–999 t CO_2e / million USD value added • Very Low: < 100 t CO_2e / million USD value added Trade exposure tiers: • High: > 19 % • Medium: 10-19% • Low: < 10%
RGGI	N/A	N/A	N/A [Power sector only]
Quebec	$\frac{GHG\ emissions}{GDP}$	$\frac{exports + imports}{domestic\ production + imports}$	Three leakage risk tiers based on emissions intensity and trade exposure, with greater weight given to emissions intensity. Emissions intensity tiers: • High: > 2 500 t CO_2e / million CAD GDP • Medium: 500–2 500 t CO_2e / million CAD GDP • Low: 100–500 t CO_2e / million CAD GDP Trade exposure tiers: • High: > 30 % • Medium: 20-30% • Low: 10-20%
New Zealand	$\frac{GHG\ emissions}{revenue}$	If there is transoceanic trade in the good produced.	Two leakage risk tiers based on emissions intensity (quantitative) and trade exposure (qualitative). Emissions intensity tiers: • High: > 1 600 t CO_2e / million NZD revenue • Moderate: 800-1 600 t CO_2e / million NZD revenue Trade exposure: if there is transoceanic trade in the good produced.

Notes: * EITE = emissions-intensive, trade-exposed; GHG = greenhouse gas. ** California Air Resources Board (2010), California Air Resources Board (2013), see Figure 2.1 for California's categorisation of leakage risk tiers.

Defining the auctioning share

Having determined the EITE criteria and other considerations for obtaining free allowances, jurisdictions then define the share of allowances to be auctioned and establish allocation rules for each sector (see Annex, Table A.1).

Due to their limited exposure to trade, the power and fuel supply sectors normally do not meet emissions intensity or trade exposure criteria and must therefore buy at least some of their allowances via auction. In jurisdictions that allow for full cost pass-through for fuels used for electricity and transport (e.g. the **European Union**, **North America** and **New Zealand**) power companies and fuel suppliers typically need to purchase between 90% and 100% of their required allowances – either through auctions or in the secondary market. **California** uses a unique approach, allocating allowances to electrical distribution utilities and natural gas suppliers through consignment auctions (Box 2.1). Investor-owned electric utilities must consign all their free allowances, while publicly owned ones are allowed to decide their consignment share. Natural gas suppliers are required to consign a gradually increasing share of their allowances every year until they reach 100% in 2030. Meanwhile, in **Korea** – where a regulated electricity market limits the pass-through of carbon costs – free allocation remains the main allocation method for most sectors. Power producers and other sectors that do not meet emissions-intensity or trade-exposure criteria must purchase a small portion – currently 10% – of their allowances at auction. Korean regulators are planning to gradually increase the share of auctioned allowances over time. As mentioned above, in 2022, Korea introduced a climate-oriented dispatch framework to ensure carbon prices are reflected in dispatch decisions and wholesale electricity pricing.

Box 2.1 Consignment auctions

Under consignment auctions, regulated firms are allocated allowances for free but are subsequently obliged to return – or "consign" – them for auction, where they then bid for the number of allowances they require. After the auction, firms receive the proceeds from their consigned allowances. However, those revenues can only be used for strictly defined purposes.

While this method seems cumbersome at first glance, it does manage to combine the technical benefits of auctioning with the political advantages of free allocation – making it particularly interesting for use in the early phases of an emissions trading system. Consignment auctions also:

- Transform a carbon charge from an opportunity cost into an actual, operational cost. In turn, cost pass-through is reinforced, which can encourage changes in demand-side behaviour.

- Maximize the technical benefits from conventional allowance auctioning. They oblige regulated firms to actively participate in auctions from the beginning, improving their understanding of the system and increasing market liquidity. This also ensures regular price discovery and allows for the implementation of price- and supply-containment measures.
- Can mitigate competitiveness concerns of industrial entities, because entities recover the proceeds from their consigned allowances and therefore do not bear the full carbon cost.
- Limit the role of revenue-managing authorities to the setting of rules for and monitoring of the use of auction proceeds (although they do not allow for centralised governance and coordination).
- Can facilitate a smoother transition to conventional auctioning.

California's cap-and-trade program is currently the only active emissions trading system that applies partial consignment auctioning to certain electric utilities and natural gas suppliers. Entities are obliged to use consigned allowance proceeds for emissions reduction measures or to compensate customers for price increases – and they must provide an annual accounting to regulators. Entities are required to dispense their allowance proceeds within 10 years of auction. Proceeds that remain unused after 10 years are automatically returned to customers.

Source: California Air Resources Board (2021), World Bank (2021), California Environmental Protection Agency (2020).

Most emissions-intensive industries such as iron and steel, cement, pulp and paper and non-ferrous metals are often deemed vulnerable to carbon leakage and eligible for free allowances (either through grandfathering, fixed benchmarks or output-based benchmarks),[8] while most industries that are not emissions-intensive or trade-exposed tend to be subject to partial or full auctioning. In jurisdictions that define tiers of leakage risk – including **California**, **Quebec** and **New Zealand** – "assistance factors" are established to determine the level of free allocation per eligible sector. The assistance factor reflects a sector's exposure to carbon leakage and helps to define the pace at which free allowances are phased down over time. For instance, Quebec has set its assistance factor at 100% for all emissions-intensive and trade-exposed sectors for its first three compliance periods. But in the fourth period (2021-2023), the factor depends on a sector's leakage risk level, ranging from 100% for high-risk sectors to 90% for lower risk

[8] Rules determining how free allowances are allocated have considerable impact on the incentive for emissions reduction They also influence social impacts, competitiveness, market functioning and policy design (World Bank, 2021). While the design should be tailored to national circumstances, international experience shows that most jurisdictions have adopted benchmarking methods to encourage efficient production and decarbonisation. Benchmarking methods mean that free allowances are distributed according to a pre-defined threshold, often reflecting the carbon intensity of a product (e.g. tCO_2 per tonne of crude steel produced).

ones. New Zealand adopts a similar approach, with a 90% assistance factor for highly emissions-intensive or trade-exposed activities and 60% for moderate ones. However, due to the predominance of emissions-intensive industries in ETS systems, most of the covered industry emissions have largely been shielded from auctioning. For example, during Phase 3 (2013-2020) of the **EU ETS**, more than 97% of total covered industrial emissions received 100% their allowances for free at a predetermined product benchmark level (European Commission, 2019). While the tightened criteria in Phase 4 significantly reduced the number of sectors qualifying for the so-called carbon leakage list to around 60 (from 170 previously), those eligible still accounted for more than 90% of covered industrial emissions (ICAP, 2020).

Nonetheless, for these sectors, jurisdictions have used various methods to preserve incentives for decarbonisation and to ensure that free allowances remain within the cap trajectory. Some of these methods include:

- **Better-than-average benchmarks**: Some jurisdictions choose emissions-intensity benchmarks for free allocation that are set below the sectoral average. This is done to ensure stringency, to create an incentive for decarbonisation and to reward top performers. Examples include the EU ETS, where product benchmarks are based on the average emissions intensity of the 10% most efficient plants and are updated to reflect technological progress[9] (European Commission, 2018). California sets product benchmarks at 90% the average emissions intensity or at the value of the most GHG-efficient plant if no installation meets the 90% average (California Air Resources Board, 2010b).
- **Cap adjustment factor or annual declining factor**: California and New Zealand apply a factor that aims to ensure that the level of free allowances falls over time, and Quebec will introduce a cap reduction factor starting from 2024. In California, the factor is set in proportion to the annual reduction of the overall cap (California Air Resources Board, 2022).
- **Cross-sectoral correction factor**: The EU ETS introduced this during Phase 3. It reduced the volume of free allowances by the same percentage for all sectors when the bottom-up calculation of free allowances exceeds the number of allowances that are available to be handed out to industry for free. For the period 2021-2025, the factor is set at 100% (i.e. no correction) because the demand for free allowances is not projected to exceed the available amount, but adjustments could apply for later periods.

As countries raise their climate ambitions, jurisdictions are exploring new ways to increase the share of allowances being auctioned while preserving industrial competitiveness and political support for the system (see Chapter 1). For example,

[9] The revision of the EU ETS product benchmarks for free allowance allocation for 2021-2025 applied annual benchmark improvement rates of minimum 0.2% and maximum 1.6% over a 15-year period (reflecting 2008 to 2023) to benchmark values determined based on production and emissions data for the years 2016 and 2017. Product benchmark improvement rates for the 2026-2030 period have not yet been determined.

Quebec has introduced its 2030 Plan for Green Economy. This plan commits to setting new rules for free allowance allocation that will include consignment auctions for industrial emitters starting from 2024 (Government of Quebec, 2020).

Administration of auctioning

Jurisdictions need to consider various practical design elements of auctioning, such as auction frequency, bidding format, bidding limits and participation. These elements can impact the market's accessibility, liquidity, price formation, and influence on the secondary market.

- **Frequency**: This can impact participants' access, market liquidity and the price. Frequent and smaller auctions are easier for smaller entities with limited financial resources to access and can help to provide steady liquidity to the system. In addition, they can minimise the impact on the secondary market as well as reduce the risk of market manipulation (Hepburn et al., 2006). In practice, auction frequency ranges from weekly in the European Union to monthly in Korea, and quarterly in California, RGGI, Quebec and New Zealand. Irrespective of the frequency, jurisdictions generally hold auctions regularly and communicate scheduling as well as auction volume well in advance to provide transparency and predictability.
- **Format**: Most systems use single-round, sealed-bid, uniform-price auctions for simplicity and for preventing collusion among participants (Hepburn et al., 2006; World Bank, 2021). In this format, participating bidders submit confidential bids in the form of demand schedules, which specify how many allowances a bidder would be willing to buy and at which price. These bids are added together to form an aggregate demand curve and a market clearing price is determined where the aggregate demand equals the supply. This price then becomes the price to be paid by every winning bidder. Typically, auctions are administered on an online platform, which tends to be the same trading platform or exchange used in the secondary market. Jurisdictions have often provided comprehensive training materials for participants on the platform's functions and the bidding process.
- **Bidding and holding limits**: Systems often set a maximum number of allowances that a single bidder can acquire at one auction (or within a given period). This is to prevent individual participants from accumulating excessive market power. Limits are set as a percentage of available allowance volume at an auction, ranging from 15% in Korea to 25% in RGGI, California and Quebec.[10] The European Union allows for bidding limits to be imposed in response to reports of market abuse or criminal acts (European Commission, 2010) but so far this option has never been used. In addition to bidding limits, California, Quebec and Korea

[10] California and Quebec set a 25% bidding limit for compliance entities and a 4% limit for non-compliance entities. Compliance entities are entities that need to surrender allowances for their emissions in each compliance period, whereas non-compliance entities are entities that participate in the market as intermediaries for compliance entities or for investment purposes (e.g. banks, hedge funds).

restrict the maximum number of allowances that an entity can hold in its account. This is to limit the market power of any one participant and discourage the excessive use of allowance banking and borrowing. These limits are often set either as a specific amount of allowances or as a share of the annual emissions cap of the entire emissions trading system.

- **Participation**: Deciding who can participate in auctions can have an important impact on market liquidity and competition. Wider access supports competitive bidding and liquidity, which are both vital to successful auctions, and encourages the development of an active secondary market. It also allows entities – especially smaller ones – to obtain their allowances easily. The European Union, California, Quebec and RGGI have granted access to non-compliance entities such as financial institutions, though they may be subject to different rules (e.g. bidding limits). Korea restricts participation in auctions to compliance entities that do not receive 100% of their required allowances per year for free.

Implementing price or supply adjustment measures

Price and supply adjustment measures are tools designed to provide greater price predictability and help make emissions trading systems more resilient to external shocks. They are typically implemented by regulators by fine-tuning the number of allowances available for auction according to well-defined criteria – which makes auctions a critical element.

Adjustment measures can take many forms (see below). Some target a minimum or maximum price, while others address the balance of supply and demand. The two most used are the auction reserve price and the cost containment reserve (see Table 2.2, with more details in the Annex, Table A.2). Ultimately, the choice and design of an adjustment measure will depend on a jurisdiction's priorities, but providing predictability without restricting the market's ability to deliver efficient emissions reductions are key considerations.

- **Auction reserve price**: sets a minimum price at which allowances can be sold
- **Cost containment reserve**: releases a limited number of additional allowances – often set as an additional volume available at auctions – when a pre-defined "trigger" price is reached
- **Price ceiling or floor**: explicitly legislated or regulated maximum or minimum price in the emissions trading system
- **Emissions containment reserve**: applies an automatic adjustment to the allowance supply when a predetermined minimum "trigger" price is reached
- **Quantity-based measure**: increases or decreases the number of allowances available for auctioning triggered by a predetermined quantity of allowances in circulation in the market

- **Discretionary measures**: provide flexibility as to when and how to intervene but risk creating uncertainty and undermining predictability. Examples include Korea's Allocation Committee, which is authorised, but not required, to intervene in the market under a list of predetermined situations. The committee could release allowances from a reserve and adopt a price ceiling or floor, for example. Or it could modify the rules on allowance holding, borrowing or offsets.[11]

Table 2.2 Price or supply adjustment measures by system, 2021

ETS	Emissions containment reserve	Auction reserve price	Price floor	Cost containment reserve	Price ceiling	Quantity-based measures	Discretionary measures
European Union		X				X	
Korea		X					X
California		X		X	X		
RGGI	X	X		X			
Quebec		X		X			
New Zealand		X		X			

All the analysed systems have adopted an auction reserve price, with designs broadly reflecting two approaches. One sets a pre-defined price level that increases over time, with the aim to prevent the allowance price from falling below the pre-defined level and maintaining a minimum price signal to encourage decarbonisation (California, Quebec, RGGI, New Zealand). The other involves a reserve price that references the prevailing price on the secondary market to ensure strong price continuity between the primary and secondary markets (European Union, Korea, New Zealand).

As an example of the first approach, **California** set the initial reserve price at USD 10 for 2013 allowances with an annual increase of 5% plus inflation, reaching almost USD 20 in 2022. While the measure does not set an actual price floor – and occasionally secondary market prices have dropped below the auction reserve price[12] – prices have generally remained above the reserve price, since covered entities must purchase their allowances at auctions (IETA, 2018). Thus, the auction reserve price provides a predictable minimum price signal. Prices have also risen over time, which is very important for emissions reduction efforts as well as investment decisions. The **European Union** and **Korea** have taken a different approach, basing the auction reserve price on recent price levels in the secondary

[11] A carbon offset is a reduction or removal of CO_2 emissions made to compensate for emissions released elsewhere. Such offsets are often sold in the voluntary carbon markets – in contrast to regulated markets – and can be generated, for example, from forestry, energy efficiency or carbon capture projects.
[12] For example, California's allowance price temporarily dipped below the reserve price in 2016, mainly due to legal and political uncertainty about the cap-and-trade program.

market. This approach minimises the impact of auctions on price signals in the secondary market, but it is less predictable than a set reserve price.

New Zealand's system combines both approaches. In addition to a pre-defined, gradually increasing auction reserve price, it sets a "confidential reserve price." This establishes an additional reserve price using a confidential methodology that references secondary market prices. If the confidential price is higher than the pre-defined reserve price, it becomes the new reserve price for a given auction. This provides both a minimum price and ensures a strong price linkage between the primary and secondary markets. Following the recommendations of its Climate Change Commission, New Zealand will increase its reserve price from USD 21 in 2022 to USD 28 by 2026 (New Zealand, Climate Change Commission, 2021).

With a cost containment reserve, jurisdictions need to decide on the size of the reserve, the quantity of additional allowances that can be released when triggered, and the trigger prices. Reserves for cost containment purposes have been set at up to 10% of a system's emissions cap, and trigger prices among the studied systems are currently set at around USD 30 to USD 40, with plans to increase over time. RGGI is the exception, setting its trigger price at around USD 15. While the measure aims to limit excessive prices – and therefore costs – for covered entities, it is important that the trigger prices leave sufficient room for allowance price discovery: If trigger prices are set too low, the allowance price may not be able to reach the level required to reflect the true supply and demand balance, creating market inefficiency. The trajectory of the trigger price over time should also account for the price level required to incentivise decarbonisation.

The **European Union**'s Market Stability Reserve (MSR) is a unique example of a quantity-based adjustment measure. The MSR automatically adjusts the quantity of allowances available for auctioning based on pre-defined rules for the number of allowances in circulation, which is a metric reflecting allowance surplus or shortage in the market. While the MSR was implemented in a context of substantial surplus in the EU ETS, it is designed to address both oversupply and undersupply scenarios. Its aim is to maintain the price level within a reasonable range without directly interfering with the market's price discovery and to enhance the system's resilience. Since its introduction in 2019, the MSR has effectively reduced oversupply in the EU ETS, strengthened the price signal and supported the system to withstand shocks linked to the Covid-19 pandemic (European Commission, 2021b).

Chapter 3. Revenue use

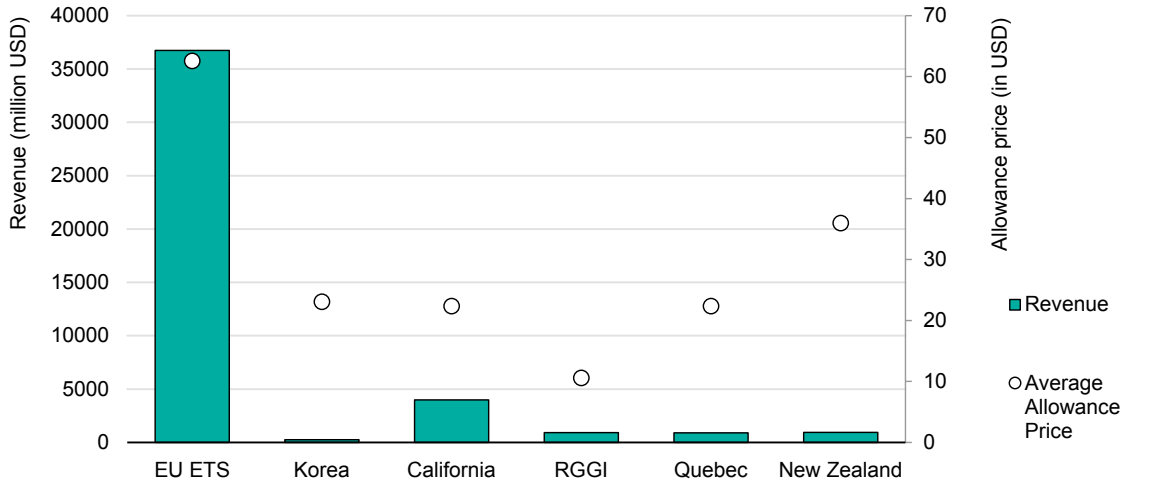
Revenue generation is an important feature and benefit of auctioning, with potential for managing socio-economic challenges stemming from carbon pricing. This chapter provides an overview on the generation of auction revenue, the ways that selected jurisdictions have used those revenues and how the collection and disbursement of auction revenues is currently governed.

Status quo of auction revenue generation

Revenue generation is integral to a well-designed emissions trading system. Auction revenues capture rents and potential windfall profits for society and they can be especially helpful in fostering political and social acceptance of the system. Revenues can be deployed to address equity and competitiveness issues – for example, by compensating for price increases induced by a carbon price. They can also be used to help lower the costs of the clean energy transition by supporting investments in energy efficiency and low-carbon technologies. Since 2008, about USD 161 billion in revenues have been generated worldwide through auctioning in an ETS (ICAP, 2022).

The generation of auction revenue differs significantly across jurisdictions and is heavily influenced by the allowance price, the percentage of allowances that are auctioned and the size of the emissions trading system itself (Figure 3.1).

Figure 3.1 Auction revenues and allowance price in selected emissions trading systems ordered by size of the system, 2021



Notes: RGGI = Regional Greenhouse Gas Initiative.
Source: IEA, based on ICAP (2022).

Covering about 1.6 $GtCO_2e$, the **EU ETS** is the second-largest emissions trading system in the world after China's national ETS. In 2021, the European Union generated auction revenues of around USD 37 billion – by far the most of all the systems studied. This high number reflects the relatively large share – 57% – of allowances that the EU ETS attributes via auction as well as a significant increase in the allowance price to an average of USD 63 in 2021. In contrast, **Korea's ETS** generated only around USD 258 million in auction revenues in 2021, even though its system covers about 600 $MtCO_2e$. But the share of allowances auctioned in Korea is small, at just 4%, and the average price was around USD 23.

Ways of using auction revenue

Emissions trading revenues are used differently across jurisdictions, reflecting the priorities of each system. There is no single best practice for using auction proceeds, and uses have tended to evolve as policy priorities in the different jurisdictions have changed. Auction revenue is often used to support additional mitigation through investments in renewables and energy efficiency, for example. Other uses include support for technological innovation that can lower the long-term cost of decarbonisation, as well as funding climate adaptation efforts. Most of the jurisdictions studied also devote a portion of their auction revenues to supporting communities or households directly, either through rebates on electricity bills or by providing financial support to carbon-dependent regions. By communicating the financial benefits of allowance auctioning to households and communities, jurisdictions can build and strengthen public support for emissions trading. Table 3.1 summarises the primary ways in which auction revenues are currently being deployed.

Table 3.1 Main uses of auction revenue in selected emissions trading systems

Jurisdiction	General budget	GHG mitigation support*	Technological innovation support	Climate adaptation	Energy system modernisation**	Household / community support	Industry support
European Union	x	x	x	x	x	x	x
Korea		x	x	x	x	x	
California		x				x	x
RGGI	x	x			x	x	
Quebec		x		x			
New Zealand		x				x	

Notes: * Greenhouse gas (GHG) mitigation support includes the use of auction revenues to fund clean energy deployment (e.g. low-carbon transport or renewable energy) as well as energy efficiency programmes.
** Energy system modernisation includes support for the modernisation of energy networks and energy storage. For RGGI, this includes "beneficial electrification" which is the displacement of direct fossil fuel use with electric power.

The **EU ETS** requires member states to spend at least 50% of their auction proceeds on climate- and energy-related projects. In 2020, member states spent 72% of these revenues for climate and energy purposes, with the vast majority used to provide direct support for domestic deployment of renewables and energy efficiency investments as well as some spending for R&D and transport decarbonisation. About 15% was used for climate adaptation (European Commission, 2021c). The remainder went into the general budgets of the member states. To avoid carbon leakage in electricity-intensive sectors, the provisions of the EU ETS also allow member states to use up to 25% of their auction proceeds to pay compensation to companies for higher electricity charges due to the carbon price.

Not all auction revenue is managed by the member states, however. The European Union also created two funds – the Innovation Fund and the Modernisation Fund – that are financed through auction proceeds. The Innovation Fund supports demonstrations of low-carbon technologies in energy-intensive industries, as well as carbon capture (CCU and CCS), renewable energy generation and energy storage. It is being funded by the auctioning of 450 million allowances between 2020 and 2030, which is expected to raise around USD 45 billion, depending on the carbon price. Meanwhile, the Modernisation Fund is expected to generate up to USD 57 billion between 2021 to 2030 through the monetisation of allowances. This fund, which targets 10 lower-income member states, aims to help modernise energy systems and improve energy efficiency. It is an important pillar of the just transition in the European Union and is key to generating political support for the EU ETS. Some of the fund's projects in 2021 and 2022 relate to the decommissioning of coal-fired plants and the fund also has made supporting the reemployment and re-skilling of workers in carbon-dependent regions a key priority (EU Modernisation Fund, 2022).

California is another interesting example. Through its consignment auction system – as explained in Chapter 2 – the state requires investor-owned utilities (which make up almost 70% of the market) to distribute all their auction proceeds to industrial, small business and residential customers. In 2020, 87% of these revenues were returned as lump-sum rebates to households and 11% to industrial and small businesses, while 2% was invested in clean energy and energy efficiency programmes. Meanwhile, state-owned utilities must transfer their auction proceeds to the Greenhouse Gas Reduction Fund, which supports state programmes in clean transportation, sustainable communities, clean energy, energy efficiency and waste management. The state mandates that 35% of these funds go to supporting disadvantaged and low-income communities. By prioritising direct payments to households and investments in low-income communities, California has successfully increased the political and social acceptability of its cap-and-trade programme. In addition, using lump-sum payments preserves the

cost pass-through of the carbon price signal to consumers and thus maintains the incentive to reduce electricity demand.

Governance of auction revenue

Appropriate and transparent governance arrangements for auction proceeds are essential to ensure that objectives – including stronger public acceptance, and minimal administrative costs – are achieved. This involves establishing legal and administrative frameworks, processes for managing revenue flows, effective stakeholder engagement as well as accountability measures. In **California**, for example, the California Air Resources Board (CARB) is the agency that administrates the cap-and-trade programme, while the state's legislature directs the spending of associated funds, which include auction proceeds. As explained above, auction proceeds from investor-owned utilities are returned to those utilities but are earmarked for certain purposes. State-owned utilities must transfer their proceeds to the Greenhouse Gas Reduction Fund for uses that are also clearly defined (California Climate Investments, 2022). Indeed, in most jurisdictions, auction revenue is fully earmarked and administered through dedicated funds, as seen in Table 3.2.

Table 3.2 Administration of auction revenues in selected emissions trading systems

Jurisdiction	Administrative body	Earmarking of revenues	Dedicated Fund(s)
European Union	European Commission; European Investment Bank; member states	Partial	Yes (Modernisation Fund, Innovation Fund, Member State Funds)
Korea	Ministry of Environment; Ministry of Economy and Finance	Full	Yes (Climate Response Fund)
California	California Air Resources Board; California state legislature	Full	Yes (Greenhouse Gas Reduction Fund)
RGGI	States	Partial	Yes but depends on state (e.g. Maryland Strategic Energy Investment Fund)
Quebec	Ministry of Environment and Fight against Climate Change	Full	Yes (Electrification and Climate Fund)
New Zealand	Ministry for the Environment; The Treasury	Full	Yes (Climate Emergency Response Fund)

Typically, managing auction revenues involves a collaboration between the ministry or agency responsible for operating the emissions trading system and the jurisdiction's treasury or finance ministry. In **Korea**, the Ministry of Environment has overall responsibility for its ETS but the Ministry of Economy and Finance chairs the Allocation Committee and has also a key role in the Climate Response

Fund that is supported with auction revenues. In the **EU ETS**, the largest share of auction revenues is managed by member states while the European Commission is responsible for operating the emissions trading system. Only some proceeds are managed by the European Commission – with the help of the European Investment Bank – through the dedicated funds mentioned above. In some cases, member states and the European Commission share decision making power – for example, they are represented on the Investment Committee of the Modernisation Fund (EU Modernisation Fund, 2022).

Where there is at least partial earmarking, creating a dedicated body (such as a fund) is usually justified to facilitate the governance and administration of auctioning proceeds. It also ensures a more stable source of financing for the designated projects and raises awareness generally about the benefits of auctioning emissions allowances. In **New Zealand**, the emissions trading system is administered by the Ministry for the Environment and until the end of 2021, revenues from the ETS were returned to the national general budget. In 2022, the government created the Climate Emergency Response Fund – with an initial investment of USD 2.85 billion from auction proceeds – as a dedicated mechanism for funding additional emissions reduction policies and for mitigating equity effects. The fund, which was established under the purview of the Treasury, aims to provide "funding certainty over multi-year periods and a dedicated funding source for public investment on climate-related initiatives distinct from the main budget allowances" (New Zealand, Treasury, 2022).

Among the important insights from this review is that governance frameworks for managing auctioning proceeds evolve as an emissions trading system matures and as policy priorities shift. Such reforms can become especially important when the carbon price of an ETS increases – which generates more auction revenues but also affects the system's potential impact on competitiveness and social equity. This may require jurisdictions to dedicate a larger share of auction proceeds to supporting households or specific sectors – which in turn necessitates changes to governance arrangements. Ideally, the need for such evolution would be considered when planning revenue governance within the ETS design process. It is also critical that appropriate reporting and tracking frameworks for auction proceeds are included from the outset.

Chapter 4. Policy insights

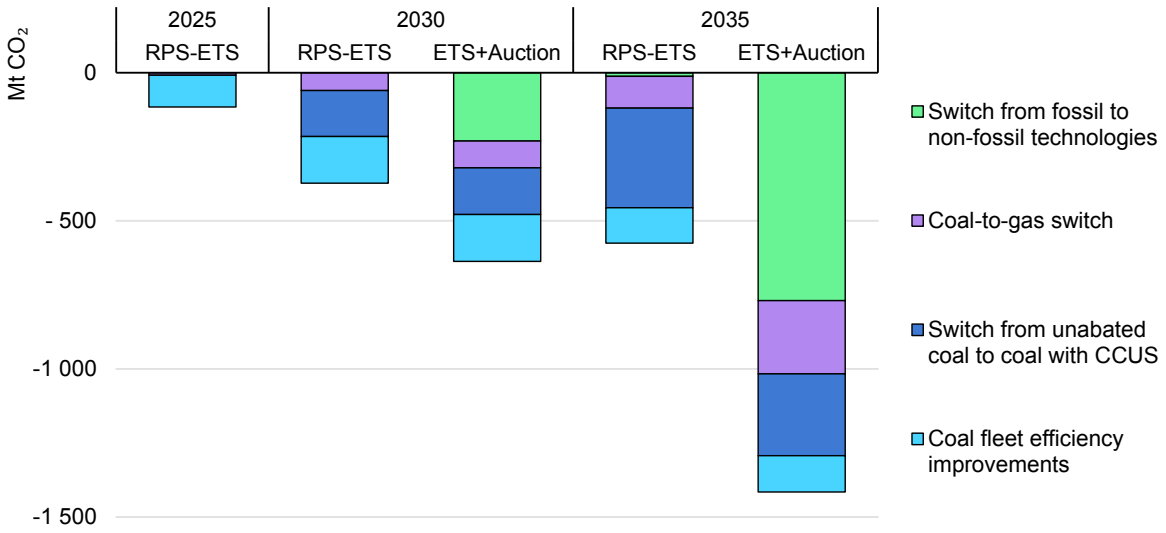
This section provides policy insights specific to introducing allowance auctioning in China's ETS. The recommendations are based on the experiences and lessons learned from other jurisdictions, as presented in the previous chapters. The section sums up the key benefits of allowance auctioning for China as well as the different options for introducing auctioning in its national ETS. It also includes recommendations on governance and the use of auction revenues.

Key benefits of introducing allowance auctioning in China's ETS

Auctioning could strengthen the environmental effectiveness of China's national ETS. IEA analysis has modelled the impacts of introducing allowance auctioning in China, assuming a 17.5% share of auctioned allowances in 2030 and about 25% in 2035, respectively. It found that by shifting from the current design of the system with free allocation (RPS-ETS scenario) to partial auctioning of allowances (ETS+Auction scenario) but retaining the same benchmark tightening[13], China's electricity-related emissions reductions could be doubled and an additional 840 Mt CO_2 could be saved in 2035. This additional abatement potential through a change in allocation method is especially important as China's national ETS does not currently have an emissions cap to ensure a certain level of reductions. Moreover, under China's current system – which grants free allowances based on benchmarks for coal- and gas-generated power – most emissions cuts would likely be achieved through improvements in coal fleet efficiency and deployment of carbon capture utilisation and storage (CCUS) technologies in coal power from 2030 onward. By introducing allowance auctioning, however, the bulk of emissions reduction would be achieved through fuel switching to non-fossil fuel technologies, mainly onshore wind and solar PV (Figure 4.1) (IEA, 2022a).

[13] In China's national ETS, allowances are currently allocated for free using four different benchmarks for coal and gas power (e.g. tCO2 per MWh produced). These benchmarks are being lowered over time. In both, the RPS-ETS and the ETS+Auction scenario, the same magnitude of benchmark tightening is assumed to isolate the impact of the introduction of allowance auctioning in the ETS+Auction scenario.

Figure 4.1 Additional emissions reductions by channel compared with the counterfactual RPS Scenario, 2025-2035

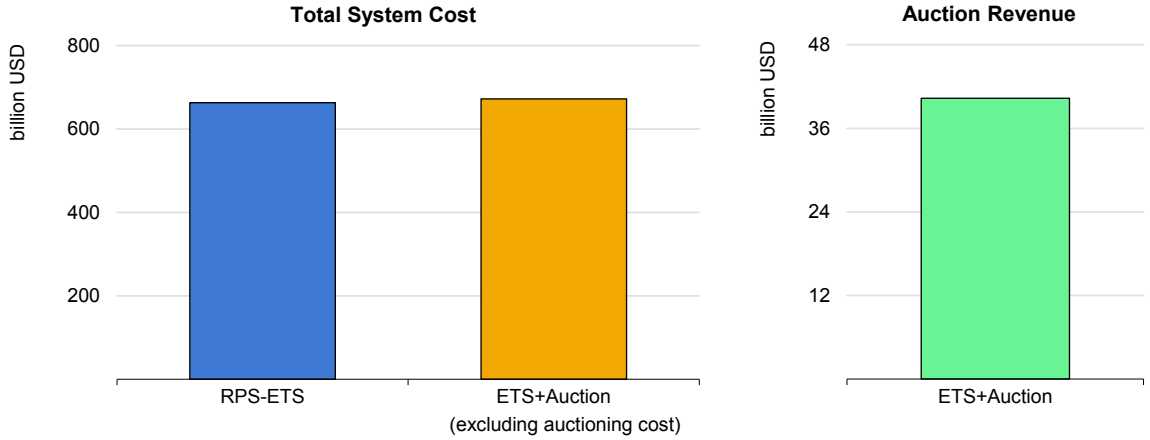


Notes: RPS = Renewable Portfolio Standard. The RPS-ETS Scenario is a current policy scenario including China's current RPS set-up and an intensity-based ETS with 100% free allocation. The ETS+Auction Scenario is designed to achieve an electricity-related emissions trajectory aligned with China's stated goals for carbon peaking and carbon neutrality. It introduces partial auctioning of emissions allowances in the intensity-based ETS. By 2035, 23.5% of the allowances are auctioned. The RPS sets minimum levels for the consumption of renewable energy. Further information on scenario assumptions is available in IEA (2022a).

Auctioning can enhance the cost-effectiveness of China's ETS. By prioritising the lowest-cost abatement opportunities, especially fuel switching with a more diverse decarbonisation mix, introducing allowance auctioning can limit increases in total system costs. By 2035, China's total system cost increases in the power sector could be limited to 1.4% relative to the current policy design, which achieves only half the volume of emissions reductions (Figure 4.2) (IEA, 2022a).

Auction proceeds can help promote a more equitable clean energy transition. Were China to introduce partial auctioning – 25% of allowance allocations – by 2035, the government could generate an annual revenue stream of about USD 39 billion (CNY 260 billion) (Figure 4.2). These proceeds could be used to invest in clean energy, addressing competitiveness concerns or alleviating the adverse effects of carbon pricing on fossil-fuel reliant sectors or regions. Additional options for revenue use are discussed below.

Figure 4.2 Total system costs and auction revenues, 2035



Notes: The RPS-ETS Scenario is a current policy scenario that includes China's current RPS policy set-up and an intensity-based ETS with 100% free allocation. The ETS+Auction Scenario is designed to achieve an electricity-related emissions trajectory aligned with China's stated goals for carbon peaking and carbon neutrality. It introduces partial auctioning of emissions allowances in the intensity-based ETS. By 2035, 23.5% of the allowances are auctioned. Further information on scenario assumption is available in IEA (2022a).

Auctions can improve the functioning of China's ETS by establishing a primary allowance market, increasing market liquidity and facilitating carbon price discovery. The first compliance period of China's ETS was successfully completed with a 99.5% compliance rate. While allowances generally traded at around USD 6 to USD 9/t CO_2 (CNY 40 to CNY 60/t CO_2), liquidity in the secondary market was limited. The cumulative trading volume of 179 million allowances by the end of 2021 represented around 4% of annual covered emissions and most transactions occurred in the month of December, just before the compliance deadline (China, MEE, 2021b). In 2022, trading continued at prices of around USD 9/t CO_2 (CNY 60/t CO_2), but market activity has remained low. Low levels of activity weaken the price discovery function of the market and increase the risk of non-compliance of firms that need to obtain additional allowances. Introducing regular allowance auctions in China's ETS could help covered entities to more actively engage in allowance trading, enabling a range of technical benefits. Introducing regular auctions would also establish a primary carbon market, which allows firms to directly purchase the allowances they need to meet regulatory requirements. In addition, it could encourage more trading on the secondary market and help to spread activity more evenly throughout the year. Greater liquidity can reduce the risk of non-compliance, enhance price discovery and further help to moderate price volatility. Introducing auctioning also creates a basis for introducing price and supply adjustment measures in future design developments.

Box 4.1 Enabling conditions for allowance auctioning in China

Allowance auctioning could bring considerable benefits to the effectiveness of China's ETS. Meanwhile, a number of enabling conditions, related to market and institutional set-up, as well as policy design, are required for allowance auctioning to properly function and deliver the intended benefits, while mitigating potential negative socio-economic impacts:

- Data collection and stakeholder engagement for defining auctioning scope: while auctioning reduces data collection needs for defining allowance allocation rules, such as for defining allocation benchmarks, substantial work is needed to determine the scope and extent of allowance auctioning, typically in relation to a (sub-)sector's exposure to carbon leakage. While China's ETS currently only covers the power sector, it is intended to include energy-intensive sectors for which such an assessment is particularly relevant.
- Power market reform and cost pass-through ability: while it is possible to introduce allowance auctioning in a context of regulated power market, power market reform could considerably impact the functioning and effectiveness of allowance auctioning for China's ETS. It would allow power generators to pass through the carbon cost and better adjust their operation. The reform could also enable a stronger price signal for power consumers and better incentivise demand-side response. With a regulated power market, the implementation of the ETS likely needs to consider mechanisms such as an inclusion of indirect emissions for end-use sectors or environmental dispatch, and avoid excessive cost burden on power generators who cannot pass through costs. As power market reform progresses, auctioning should be phased-in to strengthen the impact of an ETS and avoid windfall profits for generators. Auction revenue could also be used to manage socio-economic implications.
- Appropriate revenue governance and management: clarity on auction revenue governance and management needs to be established prior to introducing allowance auctions to ensure effectiveness and transparency. As the management of ETS revenue typically involves multiple government functions, cross-ministerial coordination and shared governance is often required. The effective use of revenue can strengthen climate mitigation and help address concerns around equity, energy affordability and industrial competitiveness (see section Options for the governance and use of auction revenue in China).
- Capacity building: training for both ETS administrators and for market participants on key rationales, implications, and processes for allowance auctioning, such as through dedicated workshops, will be an important step for its smooth introduction, effective functioning and policy acceptability.

Options for introducing auctioning in China's national ETS

Considering international experiences with allowance auctioning, this section provides suggestions for incorporating auctions into China's emissions trading system. Table A.3 in the Annex outlines the key design elements and framework that informed the development of these options.

Introduce auctioning as soon as possible, starting with a small share (e.g. 5% to 10%) of allowances for electricity production. Gradually increase the volume of auctioned allowances in coordination with the pace of power market reform. This will enhance the effectiveness of the ETS and will drive more efficient deployment of resources in the power sector. It will also introduce much-needed liquidity and price discovery to the market, while considering the limited cost pass-through in China's still regulated electricity market. By ensuring close coordination between auctioning and ongoing reforms in the power market, China will also be able to prevent power generators from reaping windfall profits as they gain the capacity to pass their carbon cost on to customers. Companion policies, such as capacity markets, might be necessary to avoid the stranding of certain power assets and to mitigate undue cost burdens on power companies – as well as to ensure energy security in situations where carbon costs cannot be fully passed on.

In the power sector, China could either adopt conventional auctioning or use consignment auctions as a transitional method. Compared to conventional auctioning, consignment auctions might be easier to introduce, since they reduce the need for complex coordination across ministries for revenue governance. The fact that consignment proceeds are eventually returned to the covered entities might also help to build political acceptance. That said, consignment auctions would require clear rules for how covered entities can use their auction proceeds, as well as the capacity to police the market to prevent windfall profits. A consignment approach also reduces the government's ability to have a coordinated approach on ETS revenue allocation such as for investment in low-carbon technologies and cross-regional redistribution. Thus, consignment auctions are best used as part of a transition towards conventional emissions allowance auctions. It gives time until ETS revenues grow larger and covered entities get familiar with carbon management and the auction process.

Possible approaches for phasing in auctions include:

- applying an auctioning share equal to the share of electricity directly sold on the wholesale market or under floating-price contracts

- defining a target year for reaching 100% auctioning in the electricity sector and increasing the share of auctioned allowances annually in line with the trajectory of power market reforms
- introducing consignment auctions if politically necessary, starting with 5% to 10% of allowances and steadily increasing the share (e.g. by 10% per year) until 2030, China's target date for completing a unified system of competitive power markets (China NDRC and NEA, 2022) and with a subsequent transition to conventional auctioning.

Establish quantitative emissions-intensity and trade-exposure (EITE) criteria to determine sectoral coverage of allowance auctioning and support decision on pace of introduction. While China's national ETS is likely to cover the power sector and energy-intensive industries in the coming years, not all sub-sectors will be affected by carbon pricing or exposure to international competition in the same way. An EITE assessment with pre-defined thresholds will help to identify the sectors most vulnerable to carbon leakage. It will also help to identify opportunities for introducing auctions and help to define appropriate auction shares and speeds for different sectors. In addition, establishing clear criteria will set a transparent framework if the national ETS is expanded to more sectors, including less energy-intensive industries or tertiary sectors.

Determine industry auctioning share based on leakage risk assessment and consider options to gradually introduce a moderate share of auctioning for EITE industries, including through consignment auctions. This approach helps maintain decarbonisation incentives for industry while also safeguarding competitiveness in a rapidly evolving international context. Once the magnitude of the carbon cost impact for a sector or product is established – as well as the sector's ability to absorb the cost burden – policy makers can tailor the share and pace of auctioning to each sector's emissions intensity and/or trade exposure. It is important to remember that free allowances, while commonly used to limit carbon leakage risks for exposed industries, tend to weaken the price signal for decarbonisation compared to auctioning (European Commission, 2021d). In addition, as cross-border initiatives to carbon pricing gain traction elsewhere,[14] a pro-active approach to fostering cost-effective decarbonisation in industry will become increasingly important for maintaining China's industrial competitiveness.

One option could be to introduce consignment auctions for covered industries with a requirement that entities reinvest the proceeds in low-carbon solutions. A small share of allowances – for example 5% — could be auctioned by consignment to start, gradually increasing depending on the evolution of international context.

[14] This includes border carbon adjustment measures under discussion in the European Union, Canada, United Kingdom and United States as well as the international carbon pricing floor initiative advocated by the International Monetary Fund and World Trade Organization, and the G7 Climate Club.

Compared to standard auctioning, consignment auctions might build more political acceptance among covered entities and help China to overcome some of the complexities of revenue governance – thereby accelerating introduction of the system. Other possibilities include the adoption of differentiated assistance factors based on exposure to leakage risks. This could be accompanied by an annual reduction factor for free allowances to industries that is in line with the emissions trajectory for industry to achieve China's 2060 carbon neutrality target.

Consider using the introduction of auctions as an opportunity to implement price or supply adjustment measures to stabilise the allowance price signal and to provide greater visibility for investment decisions. Measures such as an auction reserve price, cost containment mechanisms or quantity-based measures need to consider the price levels needed to incentivise and safeguard investments in low-carbon solutions, while also leaving room for adequate price discovery in the ETS. A dual approach for setting the auction reserve price, as in New Zealand, could be considered to both provide solid guidance through the reserve price and to improve price continuity between the primary and secondary markets.

Options for the governance and use of auction revenue in China

The magnitude of the revenues that China could generate from auctioning emissions allowances requires that appropriate and transparent governance structures be set up in time. If China were to introduce partial auctioning – with an auction share of around 25% for the power sector – by 2035 in its national ETS, it could generate annual revenues of around USD 39 billion (CNY 260 billion) (IEA, 2022a). That would be on par with the annual revenues generated by the EU ETS in 2021 and would represent more than 20% of the funding needed for clean energy investments in power generation in 2035 for China to meet its carbon neutrality goal. The ministry responsible for China's ETS, the Ministry of Ecology and Environment (MEE), could also be given oversight responsibility for allowance auctions – in conjunction with the Ministry of Finance (MOF) and ideally a single emissions exchange – and the administration of auction proceeds. This would ensure that changes to revenue generation are directly considered when further developing the system's design. Provincial governments could be enlisted to help administer the distribution of auction proceeds. In the case of conventional auctioning, a dedicated fund could be set up in close collaboration with the MOF to ensure transparent governance of revenues. Should China opt for consignment auctions, rules need to be established in advance for how auction proceeds may be used – and those must subsequently be enforced through monitoring and reporting.

The establishment of a dedicated fund with cross-ministerial participation can ensure harmonised, fair, transparent and effective use of revenues. Since allowance auctions are likely to generate revenues over a prolonged period – and those revenues are likely to increase with a higher auction share and carbon price – setting up more permanent administrative structures, such as a centralised fund, for the collection and disbursement of auction proceeds may be justified. Such a fund has the added benefit of being a more visible representation of the benefits an ETS can provide and can be used to support political messaging. Cross-ministerial participation in the management of the fund could ensure that all relevant expertise is available and help to cultivate broad political support. The ministry responsible for the emissions trading system would ensure that ETS and fund regulations are aligned and that its investment priorities are complementary to the ETS. China's Ministry of Finance could ensure that auction revenues are spent according to the fund's regulations and in close coordination with other government funding vehicles. In addition, the Ministry of Finance can provide expertise on which types financing instruments (e.g. grants, loans, debt, equity or tax credits) would have the most impact as well as ensure that financing complies with China's tax regulations. Involvement of other ministries, such as the National Development and Reform Commission (NDRC), could be beneficial to ensure the system's financing is aligned with China's overall long-term decarbonisation pathway. Concretely, different ministries could be enlisted to participate in a management committee that decides on the administrative and investment rules of the fund. China already has experience with setting up such cross-ministerial funds with the China Clean Development Mechanism Fund: its Guidance Committee is co-chaired by MEE, MOF and the NDRC (China Clean Development Mechanism Fund, 2022).

Auction proceeds could be earmarked for clean energy R&D and deployment, energy efficiency or the promotion of a people-centred energy transition. Earmarking auction proceeds would ensure that the funds are used according to pre-defined rules, increasing the transparency of the emissions trading system and building public trust. This does not mean all revenues must be restricted for a single purpose: they could be divided to support multiple policy goals. For example, clean energy research and development, clean energy deployment in the power sector, energy efficiency investments for covered sectors, and people-centred transition measures for fossil fuel-dependent provinces. Support for technological innovation can help to lower the long-term costs of decarbonisation and thereby moderate carbon price increases. Funding for clean energy deployment in the Chinese power sector could be provided through consignment auctions, whereby power utilities would receive the proceeds of the auctions back from the regulator but they would be earmarked for purposes such as deployment of wind and solar power as well as CCUS. This would be especially useful while China's power market remains regulated and

utilities are not yet able to pass on carbon costs to their customers. Another share of the proceeds could be set aside to support provinces that are especially fossil fuel-dependent, since they are more likely to face economic and social impacts from the clean energy transition. International best practice shows that comprehensive stakeholder engagement is key to achieving a consensual and collective commitment to a clear timeline for the phasing down of coal (IEA, 2022b). Auction proceeds could help finance a people-centred transition by covering some of the costs of supporting workers (through training, re-skilling and early retirement), promoting industry development and economic diversification in fossil fuel-dependent provinces as well as investing in environmental rehabilitation and community cohesion.

As China's power market reform progresses, direct support to electricity-intensive industries and/or low-income households might also become necessary. If wholesale and industrial power markets are deregulated, direct support – funded by auction proceeds – to electricity-intensive industries will be required as utilities pass on their higher carbon costs by raising electricity rates for industrial customers. This is particularly important, since electrification is one of the main routes to decarbonisation for China's industrial sector (IEA, 2021b). For low-income households, direct support (e.g. lump-sum payments) towards electricity bills would be one way to managing excessive cost increases that could result from deregulation.

General annex

Auction and free allowance share

Table A.1 Defining auctioning and free allowance shares by sector

ETS	Power sector	Fuel supply	EITE* industries	Non-EITE industries	Other sectors
European Union	Since 2013, 100% auctioning. Exceptions amounting to around 6% for heat production and power from waste gases as well as some limited free allowances for energy modernisation**	N/A	100% free allowances up to a benchmark level	Phase 3 (2013-2020): Auctioning increasing from 20% to 70% by 2020 Phase 4 (2021-2030): Auctioning increasing to 100% by 2030	Aviation: Since 2013, 15% auctioning
Korea	Phase 2 (2018-2020): 3% auctioning Phase 3 (2021-2025): 10% auctioning	N/A	100% free allowances	Phase 2 (2018-2020): 3% auctioning Phase 3 (2021-2025): 10% auctioning	Buildings, transport and waste sectors: • Phase 2 (2018-2020): 3% auctioning • Phase 3 (2021-2025): 10% auctioning 100% free allowances for public institutions
California	Consignment auctions for electricity utilities: • Investor-owned utilities: 100% • Public-owned utilities: shares determined by entity Free allowances for legacy contract generators	Consignment auctions for natural gas suppliers: Increasing from 25% in 2015 to 100% by 2030 100% auctioning for transport fuel suppliers	**Assistance factor**: 100% free allowances until 2030 **Cap adjustment factor**: Free allowances decline each year in proportion to the overall cap decline (4% p.a. in 2020-2030)	100% auctioning	100% free allowances to public water utilities, universities, public service facilities, and waste-to-energy facilities
RGGI	> 90% auctioning***	N/A	N/A	N/A	N/A
Quebec	100% auctioning Free allowances for legacy contract generators: 100% free allowances in 2013-2020, 60% for 2021-2023	100% auctioning	**Assistance factor**: Phase 1-3 (2013-2020): 100% free allowances for all EITE sectors Phase 4 (2021-2023): assistance factor (free allocation)	100% auctioning	N/A

ETS	Power sector	Fuel supply	EITE* industries	Non-EITE industries	Other sectors
			depends on tiered leakage risk level: • 100% for high-risk sectors • 95% for medium-risk sectors • 90% for low-risk sectors		
New Zealand	100% auctioning	100% auctioning	**Assistance factor**: • High EITE sectors: 90% free allowances • Moderate EITE: 60% free allowances **Annual declining factor for free allowances**, minimum: • 1% for 2021-2030; • 2% for 2031-2040; • 3% after 2041	100% auctioning	One-off free allowances to owners of fishing quota and pre-1990 forests**** Allowances awarded for emissions removed by registered post-1990 forest land

Notes: * EITE = emissions-intensive trade-exposed.

** Limited to 40% of the regular allowances that the Member State will auction. In EU ETS Phase 4 (2021-2030), only three of the ten eligible member states plan to provide free allowances under this rule, allocating 12% of the allowed amount.

*** Share varies by RGGI state. Other allocation methods include distribution from state-specific set-aside accounts and allowances sold at a fixed price.

**** One-off allocations to compensate for impacts of New Zealand's ETS on fishing and forestry assets, concerning effect of increased fuel costs on fishing quota value, and reduced flexibility on how pre-1990 forest land can be used.

Price or supply adjustment measures

Table A.2 Price or supply adjustment measures design by system

ETS	Price or supply adjustment measures
European Union	**Auction reserve price** A confidential reserve price to avoid auction clearing price to be significantly under the price on the secondary market during and immediately before the bidding window. The methodology considers the short-term volatility of the price of allowances over a defined period preceding the auction. **Quantity-based measures** Market Stability Reserve (MSR): automatically absorbs allowance surplus or releases allowances from the reserve based on pre-defined thresholds of Total Number of Allowances in Circulation (TNAC): If TNAC > 833 million, 12% (24% until 2023) of TNAC is withheld from auctions and placed in the MSR; if TNAC < 400 million, 100 million allowances (200 million until 2023) are released from the MSR to auctions. Adjustments to auction volume are spread out in the subsequent calendar year. From 2023, allowances held in the MSR above the previous year's auction volume will be invalidated.
Korea	**Auction reserve price** Reserve price = $\frac{\text{average price over the previous 3 months} + \text{average price of last month} + \text{average price over the previous 3 days}}{3}$ **Discretionary measures** The Allocation Committee may intervene in the market and adopt measures including releasing allowances from reserve, modifying rules on allowance holding, borrowing and offsets, and adopting a price ceiling or floor.

ETS	Price or supply adjustment measures
California	**Auction reserve price** Started with USD 10 for 2013 allowances, increasing annually by 5% plus inflation. Joint auctions with Quebec use the higher auction reserve price among the two jurisdictions. **Cost containment reserve** • Reserve = 1% of cap (2013-2014), 4% of cap (2015-2017), 7% of cap (2018-2020), pre-defined amount for 2021-2030, being around 4% of cap in 2021 and 1% of cap in 2030 • 2013-2020: Three reserve tiers with trigger prices of USD 40, USD 45 and USD 50 in 2013, increasing annually by 5% plus inflation • 2021-2030: Two reserve tiers with trigger prices of USD 41 and USD 53 in 2021, increasing annually by 5% plus inflation • Joint auctions with Quebec use the higher trigger price among the two jurisdictions for each tier **Price ceiling** 2021-2030: Annual price ceiling sale possible for covered entities to purchase allowances for compliance obligations. Price ceiling = USD 65 in 2021, increasing annually by 5% plus inflation.
RGGI	**Auction reserve price** Around USD 2 per allowance **Cost containment reserve** Reserve = 10% of cap. Trigger price: USD 4 in 2014 increasing to USD 10 by 2017, and increasing annually by 2.5% until 2020; since 2021: USD 13, increasing annually by 7%. **Emissions containment reserve** Since 2021: removes allowances up to 10% of state cap from circulation if price falls below trigger price. Trigger price: USD 6 in 2021, increasing annually by 7%.
Quebec	**Auction reserve price** Started with USD 8 in 2013, increasing annually by 5% plus inflation. Joint auctions with California use the higher auction reserve price among the two jurisdictions. **Cost containment reserve** • Reserve = 1% of cap (2013-2014), 4% of cap (2015-2017), 7% of cap (2018-2020), 4% of cap (since 2021) • 2013-2020: Three reserve tiers with trigger prices of USD 31, USD 35 and USD 39 in 2013, increasing annually by 5% plus inflation • 2021-2030: Three reserve tiers with trigger prices of USD 31, USD 40 and USD 48 • Joint auctions with California use the higher trigger price among the two jurisdictions for each tier
New Zealand	**Auction reserve price** 2021: USD 14, with 2% annual increase 2022-2026: USD 21, rising to around USD 28 by 2026. **Confidential reserve price** A reserve price determined using a confidential methodology referencing prices from the secondary market, which becomes the reserve price for the specific auction if it is higher than the standard auction reserve price. **Cost containment reserve** • Introduced in 2021 with the introduction of auctions, replacing fixed price option which previously acted as a price ceiling • Reserve = 7 million allowances for 2021-2024, reduced to 6.7 million in 2026, comprised of 5.4 million withheld from auctions and 5% of cap (~1.6 million) backed by government procured removals • 2021: Trigger price at USD 35 in 2021, with 2% annual increase • 2022-2026: Trigger price USD 50 in 2022, rising to around USD 78 by 2026

Overview of design elements for allowance auctioning

Table A.3 Key design elements for introducing allowance auctioning

Design element	Key considerations	Methods	Main evaluation methods	Coordination with other key elements
Sectoral coverage and auctioning share	• Carbon leakage exposure • Cost pass-through capacity • Alignment with long-term decarbonisation planning/ETS cap trajectory • Availability of low-carbon solutions	• Define coverage and share based on identified criteria and threshold • Visibility on medium/long-term evolution	EITE assessment	• Coordination with choice of auction method • Impacts volume of potential revenue
Auction method	• Environmental effectiveness • Political & administrative feasibility (e.g. for revenue governance, stakeholder engagement)	• Conventional auctions vs. • Consignment auctions		Management of auction revenue use
Auctioning administration	• Transparency • Implications for market liquidity & competition • Administrative feasibility & simplicity • Price alignment between primary and secondary markets			• Adjustment in relation to auction scope and share • Coordination with choice of auction method
Revenue use	• Governance structure & stakeholders • Environmental effectiveness • Equity & political acceptability: e.g. addressing concerns on distributional effects, affordability and competitiveness	• Revenue earmarking vs. general budget • Dedicated fund(s)	• Regular monitoring and reporting on use of auction proceeds	• Coordination with choice of auction method • Evolution of revenue use as scope and share of auctioning evolves

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Abbreviations and acronyms

CARB	California Air Resources Board
CBAM	Carbon Border Adjustment Mechanism
CO_2	carbon dioxide
CCUS	carbon capture, utilisation and storage
EITE	emissions-intensive and trade-exposed
ETS	emissions trading system
EU	European Union
GDP	gross domestic product
GHG	greenhouse gas
MEE	Ministry of Ecology and Environment
MOF	Ministry of Finance
MSR	Market Stability Reserve
NDRC	National Development and Reform Commission
R&D	research and development
RGGI	Regional Greenhouse Gas Initiative
RPS	renewable portfolio standard
PV	photovoltaic
UK	United Kingdom
US	United States

Glossary

CAD	Canadian Dollar
CNY	Chinese Yuan Renminbi
EUR	Euro
Gt	gigatonne
GW	gigawatt
Mt	million tonne
NZD	New Zealand Dollar
USD	United States Dollar

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