

Research Report

The Growth of Global Carbon Markets and Opportunities for Hong Kong



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SUMMARY

As the international community takes action to reduce greenhouse gas emissions and limit climate change, emissions trading systems and voluntary carbon markets are rapidly expanding. These market mechanisms, where carbon units in the form of “allowances” or “credits” are traded, increasingly offer not only spot carbon trading but also carbon derivatives which help improve liquidity and price discovery.

In 2005, the European Union established the multinational EU Emissions Trading System (ETS). Since then, an increasing number of national and regional ETSSs have been established around the globe, including national ETSSs in New Zealand and Korea, as well as eight pilot regional carbon trading markets in China and the Regional Greenhouse Gas Initiative (RGGI) and California Cap-and-Trade Program of the US. In 2021, more national ETSSs were set up, including those in the UK and Germany, to further promote emission reductions.

Mandatory carbon markets, in the form of ETSSs, covered approximately 8.9 gigatonnes of global carbon dioxide equivalent (CO₂e) emissions in 2022, with total trading volume on major global ETSSs reaching an estimated 15,773 million tonnes of CO₂e in 2021. Voluntary carbon markets are also developing rapidly, with 304 million tonnes of global carbon offsets issued in the first ten months of 2021 and trading turnover reaching US\$2.0 billion in 2021.

China is becoming increasingly prominent in global carbon markets. Since 2013, regional carbon trading markets have been launched in eight provinces and cities — Shenzhen, Shanghai, Beijing, Guangdong, Tianjin, Hubei, Chongqing and Fujian. In July 2021, China launched a national ETS covering initially the power sector that covered more than 4 billion tonnes of CO₂e emissions, making it the world's largest ETS market by coverage.

China's commitment to achieving peak carbon emissions by 2030, reaching carbon neutrality by 2060 and providing strong policy support for carbon trading opens up many opportunities for Hong Kong. By providing connectivity for international investors to onshore markets, and vice versa, Hong Kong's strong international standing and regulatory regimes could allow it to play a superconnector role linking carbon projects with investors looking to drive the low-carbon transition and allocate capital to green and sustainable finance projects.

HKEX announced the launch of the Hong Kong International Carbon Market Council in July 2022 to explore carbon market opportunities in the region and launched Core Climate, a new international carbon marketplace, in October 2022 to connect capital with climate-related products and opportunities in Hong Kong, Mainland China, Asia and beyond. More market structure developments and products are expected to be launched to further develop Hong Kong as a premier carbon trading hub.

1. INTRODUCTION

The international community is taking action to reduce greenhouse gas (GHG) emissions and address climate change. Since the 1990s, the United Nations (UN) has organised a series of international negotiations and initiatives, such as the United Nations Framework Convention on Climate Change (UNFCCC) (1992), the Kyoto Protocol (1997) and the Paris Agreement (2015), to accelerate action on climate issues.

Carbon dioxide (CO₂) released from the burning of fossil fuels is a primary cause of global warming. To reduce carbon emissions, the Kyoto Protocol established a framework for carbon emissions trading through which the framework quantifies the required reductions in CO₂ emissions that major industrialised countries must make and specifies how carbon emission allowances can be created and traded in the market.

The Kyoto Protocol marked the first contractually binding international agreement on GHG emission reductions. The agreement covered industrialised countries (excluding developing countries) that commit to reduce GHG emissions by 5% on average compared to the 1990 levels during the first commitment period (2008-2012). In the second commitment period (2013-2020), some countries set further emission reduction targets while others withdrew their emission reduction commitments.

The Paris Agreement was passed and adopted in 2015 by 196 parties after negotiations held under the UNFCCC on measures to be taken after the Kyoto Protocol's second commitment period ended in 2020. It established a set of binding procedural commitments by each member to pursue domestic climate goals. Each member sets up their own "Nationally Determined Contribution" on emission reductions based on their own circumstances, in lieu of mandatory emissions reduction targets set under the Kyoto Protocol.

According to Article 6 of the Paris Agreement, countries can achieve their emission reduction targets through market mechanisms. This provides the basis for establishing trading systems to transparently and efficiently achieve global goals for emissions reduction. As a result, emission trading systems (ETSs) and voluntary carbon markets have gradually developed and expanded. In these systems, carbon trading units of major GHG in the form of "allowances" or "offsets" are traded through a market-based mechanism.

Since the world's first ETS was launched in 2005 in the European Union (EU) — the EU Emissions Trading System (EU ETS), an increasing number of ETSs have emerged in different jurisdictions at different levels, ranging from cities (e.g. Tokyo) to countries (e.g. the United States (US), Canada and China) and regions (e.g. the EU). According to the International Carbon Action Partnership (ICAP), global ETSs in aggregate covered 17% of global GHG emissions, and the gross domestic product (GDP) of the covered regions accounted for 55% of global GDP¹ at the end of 2021.

The global carbon market can play a critical role in supporting global initiatives to combat global warming and reduce global GHG emissions. In an ETS, carbon allowances are firstly distributed through free allocation and/or auctions. The allowances can then be sold in the ETS by those with a surplus and bought by those in need of them.

As carbon markets have developed, derivatives, such as carbon futures and options, have been launched on exchange platforms and over-the-counter (OTC) trading venues. These

¹ The data of carbon emissions was latest data with cut-off date of January 2022 and the data of GDP was up to 2019 or 2020. Source: "Emissions trading worldwide: Status report", 2022 issue, published on the website of ICAP.

product innovations have added hedging tools, broadened participation and increased liquidity in the markets by bringing in more participants such as financial institutions.

Take the EU ETS as an example. In 2021, the EU ETS was the largest carbon market in terms of trading value, accounting for 90% of the total value of carbon trading in the world, including spot, auctions and futures².

Futures on carbon allowances in the EU, i.e. European Union Allowances (EUAs)³ have also been actively traded on exchanges. According to the Futures Industry Association (FIA)⁴, the total trading volume of EUA futures on exchanges reached 11.4 million contracts in 2021, making it the most actively traded carbon futures product in the world. On top of stringent regulations and the development of the EU ETS quota system, these carbon derivatives have contributed to the improvement of market mechanisms to reduce carbon emissions.

In Asia, China is building a comprehensive carbon trading system to help manage an orderly reduction of carbon emissions across the country and achieve the goal of transforming to a green and low-carbon economy. Starting from 2013, the government has launched regional pilot carbon trading markets in eight provinces and cities — Shenzhen, Shanghai, Beijing, Guangdong, Tianjin, Hubei, Chongqing and Fujian.

In July 2021, China's national emissions trading scheme (referred to as "China ETS" hereinafter) officially started trading carbon allowances, while the development of relevant derivatives remains in the planning process. As the voluntary trading of emission offsets is regarded as a constructive supplement to the mandatory trading of allowances, the combination of these two trading models may improve the effectiveness of carbon emissions reduction efforts.

The following sections will explore the development of global carbon markets and exchanges, analyse the growth of carbon markets in China and then discuss the potential role for Hong Kong in China's carbon market through the provision of a well-developed platform in line with international practices for carbon spot and derivatives trading.

2. MAJOR GLOBAL CARBON MARKETS AND EXCHANGES

2.1 Types of carbon market⁵

Global carbon markets can be classified into two types: quota-based and project-based. These two market types serve as the basic foundation for global carbon emissions trading.

(1) Quota-based market

The quota-based market is based on the "cap-and-trade" mechanism. Governing authorities will set a cap, or upper limit, on GHG emissions for a defined compliance period.

There are two types of cap: (1) an absolute cap — a fixed quantity of allowed emissions, and (2) an intensity-based cap — a cap on a pre-specified rate of emissions relative to inputs or outputs at the level of jurisdiction. By setting a cap on emissions that then

² See "Carbon market year in review 2021", *Refinitiv*, 31 January 2022.

³ An EUA is defined in Article 3(a) of the EU ETS Directive as being "an allowance to emit one tonne of CO₂ equivalent (CO₂e) during a specified period, which shall be valid only for the purposes of meeting the requirements of this Directive and shall be transferable in accordance with the provisions of this Directive".

⁴ Source: Calculated based on the trading volumes of EUA futures of individual exchanges from FIA's monthly statistics.

⁵ See "Unlocking the potential of carbon markets to achieve global net zero", jointly prepared by the Global Financial Markets Association (GFMA) and Boston Consulting Group (BCG), published on the GFMA's website, October 2021.

declines over time (or across compliance periods), a cap-and-trade system can theoretically guarantee the reduction of carbon emission levels.

After the cap is set, carbon emission allowances are allocated to covered entities either through free allocation or an auction in the primary market. In the secondary market, companies can buy and sell allowances to meet their compliance requirements. The trading units of carbon allowances are usually equivalent to one tonne of carbon dioxide (CO₂e).

(2) Project-based market

The project-based market adopts the principle of “baseline-and-credit”, which is also called an offsetting mechanism. Under this mechanism, there is no explicit cap on emissions for a jurisdiction/company. A company can aim to reduce their GHG emissions to a certain level below the level in a baseline scenario, which is formulated by third-party verifiers and may take into account the sector the company operates in and the technology constraints it faces.

Carbon offsets (also referred to as “carbon credits”) can be generated from either the avoidance/reduction of emissions or removal/sequestration through either direct actions (such as forestation projects) and/or emerging technologies (such as carbon capture).

To verify the effectiveness of a carbon offset project, the project plan or description (sometimes called Project Design Document) is validated by an independent auditor and the implementation is verified by another independent auditor, who will send its report to a standard-setting body (e.g. Verra and Gold Standard) if the criteria are met.

These standard-setting bodies are responsible for verifying projects for avoidance and/or removal of carbon emissions and issuing carbon offset certificates. They also record the historical data of carbon offset projects records within registries until the retirement of carbon offsets.

Carbon offsets can be used in some jurisdictions to offset a company’s carbon emission quota under an ETS or its own voluntary commitments. The trading unit of carbon offsets is usually one tonne of CO₂e.

From a regulatory perspective, carbon markets can be classified into two types: mandatory carbon markets and voluntary carbon markets (VCMs).

(1) Mandatory (or compliance) carbon market

Mandatory (or compliance-based) carbon markets are a kind of quota-based carbon market with legally binding emission reduction requirements from entities covered by the ETS. Covered entities can trade carbon emission allowances (or carbon offsets accepted in some markets) to meet their emission reduction requirements. Mandatory carbon markets are fragmented across jurisdictions. Currently, carbon allowances are restricted for use only within their own jurisdiction and are generally not fungible across mandatory markets⁶.

Given varying carbon emission regulations across jurisdictions, carbon prices differ across ETSs. It is therefore possible for entities to shift the location of their operations (and

⁶ There are some cases of interoperability between mandatory markets, e.g. between ETSs of California and Québec and between ETSs of Switzerland and the EU.

emissions) from one jurisdiction to another that offers more lenient emissions requirements, i.e. where the carbon price is lower.

This is called “carbon leakage”. To address this issue, some ETSs have implemented carbon border adjustment mechanisms (CBAMs), which include tariffs, taxes, and/or rebates on imports and exports, to compensate for differences in carbon pricing across jurisdictions and to ensure that polluting companies do not work around emissions controls and unduly burden developing countries that have comparatively weaker regulatory regimes⁷.

In addition, certain sectors (e.g. emission-intensive and trade-exposed sectors) with higher risk of carbon leakage than others will receive free allowances to cover their carbon emissions⁸. The EU ETS and the United Kingdom Emissions Trading Scheme (UK ETS) have both taken this approach.

(2) Voluntary carbon markets

Voluntary carbon markets (VCMs) are typically established by certain international organisations, countries or enterprises and, unlike ETSs, may not necessarily have legally binding emission reduction commitments.

VCMs mainly handle the purchase of carbon offsets from owners of emission reduction projects for the purpose of voluntarily offsetting their GHG emissions⁹. Similar to mandatory markets, VCMs are fragmented because there are no universal standards to verify the underlying projects. Examples include the Chicago Climate Exchange (CCX) and Japan’s Voluntary Emissions Trading Scheme (JVETS)¹⁰.

The interoperability between mandatory and voluntary carbon markets is limited. It has been reported that¹¹ existing linkages between mandatory and voluntary carbon markets only allow covered entities to use VCM credits to meet 3% to 10% of their compliance obligations. In addition, only a limited number of mandatory market ETSs accept carbon offsets to meet compliance obligations, where the acceptable carbon offsets are usually “high-quality” ones based on a taxonomy for categorisation.

An example is China’s National ETS, which allows the use of China Certified Emission Reductions (CCERs) for offsetting. The covered entities of China’s National ETS can use offsets for up to 5% of their compliance obligations for CCERs generated from verified emission reduction from projects (e.g. in renewable energy and carbon sinks). Prior to the launch of the National ETS, CCERs were used for compliance in China’s regional pilot carbon trading markets (see Section 3.1). Issuance of CCERs has been once suspended after March 2017, but the market expects it could be resumed after the planned launch of a national VCM

⁷ For example, in July 2021, the EU announced a CBAM under which importers will purchase certificates that will correspond to embedded emissions within the goods being imported into the EU. The price of CBAM certificates will mirror the price of carbon within the EU ETS. The importers of goods from jurisdictions with lower carbon prices will surrender a portion of their purchased CBAM certificates to ensure the carbon price embedded in these goods equals the total carbon fee for comparable goods produced under the jurisdiction of the EU ETS.

⁸ See “Allocation” webpage published by ICAP.

⁹ See “Voluntary carbon markets: How they work, how they’re priced and who’s involved”, published on S&P Global’s website, 21 June 2021.

¹⁰ JVETS allows voluntary participation but participating companies are obliged to meet previously set emission targets. See “Japan’s voluntary emissions trading scheme (JVETS)”, published on the website of Japan’s Ministry of the Environment, May 2011; Environmental Defense Fund (EDF), CDC Climate Research and International Emissions Trading Association (IETA), “Japan: An emissions trading case study”, published on the EDF’s website, May 2015.

¹¹ See “Unlocking the potential of carbon markets to achieve global net zero”, jointly prepared by the GFMA and BCG, published on the GFMA’s website, October 2021.

trading platform in Beijing¹². In August 2021, China Beijing Environmental Exchange started the construction of a trading system and a registration system for CCERs¹³.

2.2 Overview of the global carbon market

Around the world, a number of countries are committed to addressing climate change and progressing the low-carbon transition. The EU, the United States (US) and the United Kingdom (UK) have announced carbon neutrality or net-zero emission targets by 2050. In Asia, three major countries — China, Japan and Korea — have also committed to carbon neutrality. In particular, China announced its target of reaching peak carbon emissions by 2030 and achieving carbon neutrality by 2060.

Given these targets, a growing number of local or national governments have established their own mandatory carbon markets to reduce carbon emissions through market mechanisms, using ETSs as a policy tool for energy conservation and emission reduction¹⁴. In 2005, the EU established the multinational EU ETS.

Since then, an increasing number of national and regional ETSs have been established around the globe, including national ETSs in New Zealand and Korea, as well as eight pilot regional carbon trading markets in China and the Regional Greenhouse Gas Initiative (RGGI) and California Cap-and-Trade Program of the US.

In 2021, more national ETSs were set up, including those in the UK and Germany, to further promote emission reductions¹⁵. The ETS in China was launched and commenced trading in July 2021. The US currently has regional ETSs only but no national ETS.

ETSs developed across the world cover sectors with high carbon emissions, such as electricity, industrials, construction, transportation and aviation. In terms of operations, the government sets limits on total carbon emissions and allocates tradeable carbon emission allowances to companies included in the trading system.

Covered companies need sufficient allowances to cover their actual carbon emissions during a compliance period (mostly one year). Where their allocated allowances fall short of their need, they have to buy allowances in the secondary market through an ETS.

On the other hand, other companies may have a surplus of allowances during the period for sale. Covered companies would take into consideration their emission reduction costs and trade their own carbon emission allowances with other entities. In this way, covered entities would be able to meet the emission limits as required at the lowest cost through market mechanisms.

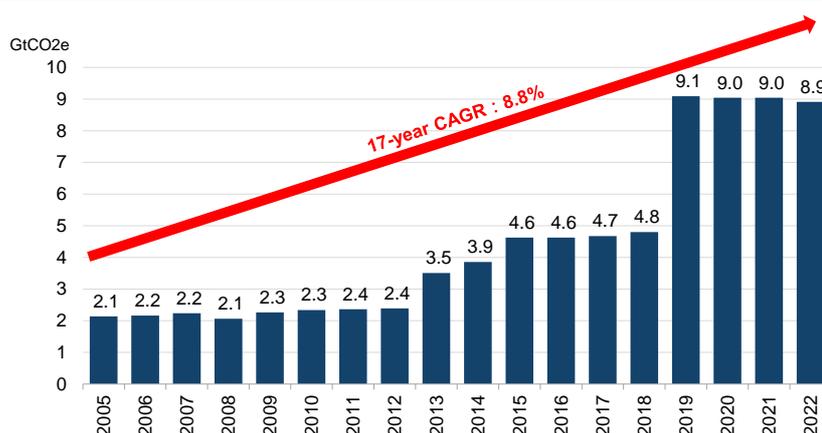
In 2022, the total amount of carbon emissions covered by global ETSs increased to approximately 8.9 gigatonnes of CO₂e from approximately 2.1 gigatonnes of CO₂e in 2005, with a 17-year compound annual growth rate (CAGR) of 8.8% (see Figure 1).

¹² Source: *Announcement of the National Development and Reform Commission of People's Republic of China 2017 (No.2)* (《中華人民共和國國家發展和改革委員會公告 2017 年 第 2 號》), issued by the National Development and Reform Commission, 14 March 2017; *Beijing Municipality Implementation Plan For Building a Modern Environmental Governance System* (《北京市關於構建現代環境治理體系的實施方案》), issued by General Office of the Beijing Municipal Committee of the Communist Party of China and the General Office of the Municipal People's Government of Beijing, 10 March 2021.

¹³ See "Public tender on the registration system and trading system for CCER" (《全國溫室氣體自願減排註冊登記系統和交易系統的公開招標》), *Tanpaifang.com*, 17 August 2022.

¹⁴ See "Climate change and carbon trading: Understanding several basic concepts including carbon emission rights and quotas", published on the website of British Broadcasting Corporation, 17 July 2021.

¹⁵ The UK ETS was established after Brexit and UK's emission reduction targets had been separated from those of the EU since then. The ETS in Germany covers companies that are not covered by the EU ETS.

Figure 1. Total carbon emissions covered by global ETSs (2005 – 2022)

Note: China ETS was launched in 2021 along with the first compliance period and retrospective compliance requirements for 2019 and 2020. The allowances for these carbon emissions are included in the data.

Source: "Emissions trading worldwide: Status report", 2022 issue, published on the website of ICAP.

However, the proportion of local carbon emissions of companies covered by an ETS (i.e. ratio of emissions covered) in each major carbon market varies significantly partly due to policymakers may consider other carbon reduction policies (e.g. carbon taxes) based on their own circumstances and objectives.

As of end-2021, the ratio of emissions covered by global ETSs was 17%, with the highest of 78% for Québec ETS in Canada and the lowest of 10% in Switzerland (see Table 1). The coverage of carbon emission through ETSs may increase over time as more countries planned or considered setting up new ETSs¹⁶ and more sectors or companies are expected to be covered by existing ETSs (e.g. China¹⁷).

Table 1. Major ETSs around the globe

ETS	Nature	Year of establishment	Ratio of emissions covered (2021)
EU ETS	Multi-national	2005	39%
New Zealand	Nationwide	2008	49%
RGGI (US)	Regional	2009	11%
Tokyo (Japan)	Regional	2010	20%
Switzerland	Nationwide	2013	10%
California (US)	Regional	2013	74%
Québec (Canada)	Regional	2013	78%
China regional pilots*	Regional	2013 – 2016	41%
Korea	Nationwide	2015	73%
China ETS	Nationwide	2021	44%
UK ETS	Nationwide	2021	28%
Germany	Nationwide	2021	40%
Global			17%

* Pilot regions in China comprise Beijing, Guangdong, Shanghai, Shenzhen and Tianjin (2013), Chongqing and Hubei (2014) and Fujian (2016).

Source: "Emissions trading worldwide: Status report", 2022 issue, published on the website of ICAP.

¹⁶ See "More Countries Are Pricing Carbon, but Emissions Are Still Too Cheap", IMF Blog published on International Monetary Fund's website, 21 July 2022.

¹⁷ See "Carbon market eyes stability in the long run", published on the Ministry of Ecology and Environment's website, 16 August 2021.

In practice, the government allocates carbon allowances to covered companies through an ETS, either by free distribution and/or auction under the “cap-and-trade” mechanism. Auctions of carbon allowances in the primary market on many ETSs are conducted through exchange platforms, which allow companies, brokers and financial investors to participate so as to increase the price discovery of carbon trading.

For instance, carbon allowance auctions in EU ETS are conducted on the European Energy Exchange (EEX). The results of the auctions are recorded in the registries of ETSs, e.g. the Union Registry of the EU ETS.

Governments tend to use auction revenues from ETSs to fund climate change projects in areas including energy efficiency improvement, low-carbon transportation and renewable energy development and utilisation.

Auction revenues can also be used to support energy-intensive industries, as well as to support vulnerable and low-income groups. Between 2008 and 2021, carbon allowance auctions in the global carbon market raised over US\$161 billion¹⁸ (see Table 2).

Companies can trade their carbon allowances not only bilaterally in the OTC market, but also with other types of market participants on exchanges. These exchanges may provide futures (including spot contracts) and options for carbon allowances and carbon offsets.

Carbon products have developed rapidly in the European and American exchanges. Transactions of carbon allowances on exchanges are also recorded in the registries of ETSs.

Market	Annual revenue from auctions (US\$ mil)					Year of the first auction	Cumulative amount raised up to 2021 (US\$ mil)
	2017	2018	2019	2020	2021		
Europe	6,234.2	16,747.3	16,389.6	21881.5	36,734.4	2009	117,554
California	1,818.8	3,018.0	3,065.3	1,699.3	3,992.4	2013	18,230
China pilot regions	n.a.	n.a.	n.a.	n.a.	n.a.	2013	255
Switzerland	4.8	4.5	8.6	8.3	19.2	2013	64
Québec	445.0	641.5	727.7	521.2	902.2	2013	4,387
Massachusetts	n.a.	n.a.	n.a.	n.a.	n.a.	2018	71
Korea	n.a.	n.a.	199.4	210.4	257.7	2019	668

n.a.: Not available.

Source: “Emissions trading worldwide: Status report”, 2019-2022 issues, published on the website of ICAP.

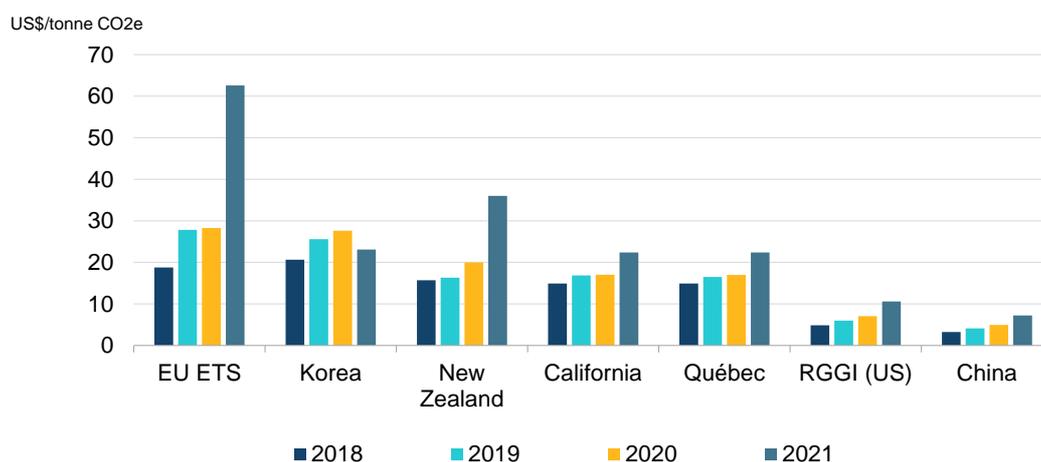
Prices of carbon allowances in the major ETSs in the global market have been on an upward trend in recent years. That said, prices have diverged between jurisdictions, possibly due to different emissions reduction policies between locations (see Figure 2)¹⁹.

¹⁸ Source: “Emissions trading worldwide: Status report”, 2022 issue, published on the website of ICAP.

¹⁹ Major carbon markets have imposed penalties on non-compliance companies for the deficits of carbon allowances, e.g. EUR 100/tonne (about US\$114) for EU ETS, KRW 100,000/tonne (about US\$85) for Korea’s ETS and 3 times the prevailing carbon allowance price respectively for ETSs in New Zealand, California and RGGI in the US and Québec in Canada. The regional ETSs in China’s pilot areas have different penalty rules, ranging from no monetary fine to 5 times the prevailing carbon allowance price, and its National ETS imposes a fixed fine of RMB 20,000 to RMB 30,000 (about US\$3,000 - US\$5,000) for non-compliance. Source: factsheets of respective ETSs, published on the website of ICAP, viewed on 26 July 2021.

According to a World Bank report²⁰, in order to achieve the goal of limiting the temperature increase within 2°C under the Paris Agreement, governments should have well-designed policies adapted to their jurisdictional context, as well as a supportive policy package. In addition, the price of carbon allowances also needs to reach US\$40 to US\$80 per tonne of CO₂e. However, as of 2020, only 3.76% of the carbon emissions covered by global ETSs have reached or exceeded this range²¹.

Figure 2. Annual average prices of carbon allowances in major carbon markets (2018 – 2021)



Note: For data on China, the average price of carbon allowances on pilot schemes was used for each of the years of 2018 to 2020 and that on the national ETS was used for 2021.

Source: “Emissions trading worldwide: Status report”, 2019-2022 issues, published on the website of ICAP.

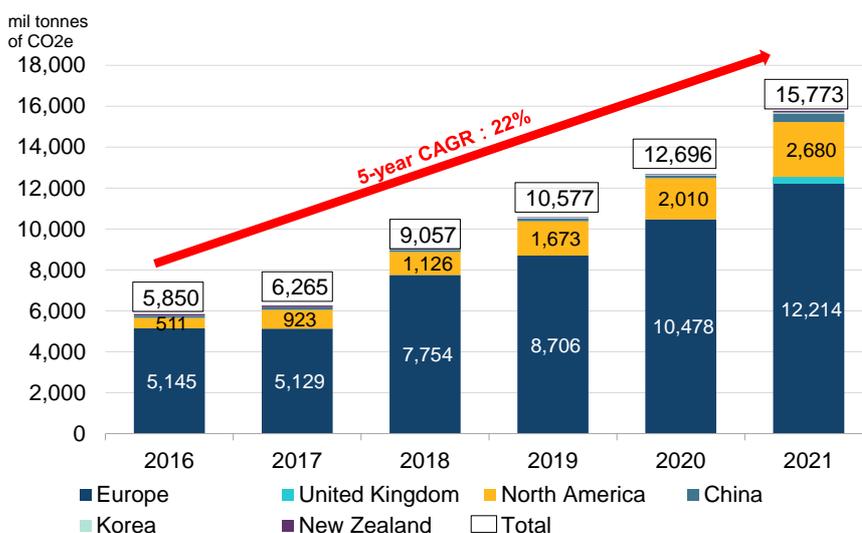
In 2021, the total trading volume on major global ETSs increased to 15,773 million tonnes of CO₂e from 5,850 million tonnes of CO₂e in 2016, with a 5-year CAGR of 22%²² (see Figure 3). The rapid development of carbon trading on these markets and of carbon products on exchanges has gradually made them market mechanisms that may support the world’s transition to a low-carbon economy.

²⁰ “State and trends of carbon pricing 2021”, published on the World Bank’s website, 25 May 2021.

²¹ Source: “State and trends of carbon pricing 2021”, published on the World Bank’s website, 25 May 2021.

²² The figures only include carbon trading on mandatory markets. In comparison, there was only 95 million tonnes of CO₂e traded on voluntary markets (approximately 0.9% of the mandatory market’s volume) in 2020. Source: “Taskforce on Scaling Voluntary Carbon Markets: Final report”, published on the website of the Institute of International Finance, January 2021.

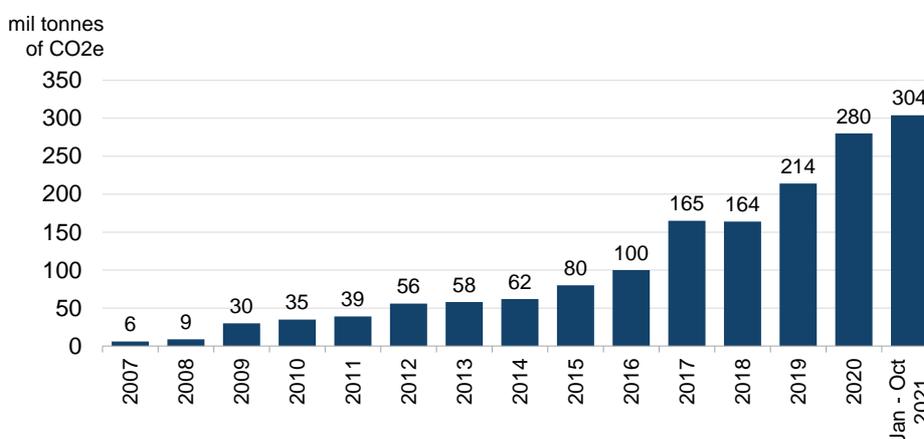
Figure 3. Annual trading volume of carbon allowances in major carbon markets (2016 – 2021)



Note: The statistics do not include the trading volume of options on European carbon allowances.
 Source: Refinitiv, “Carbon market year in review”, 2018 to 2021 issues.

For VCMs, the annual issuance of global carbon offsets rose from 6 million tonnes of CO₂e in 2007 to 304 million tonnes of CO₂e during the first ten months of 2021 (see Figure 4). The trading value of carbon offsets reached US\$2.0 billion in 2021²³ and market analysts estimated that the trading value can reach US\$245 billion to US\$546 billion by 2050²⁴.

Figure 4. Annual issuance of carbon offsets in VCM (2007 – Oct 2021)



Note: Data is up to 12 October 2021.
 Source: “Unlocking the potential of carbon markets to achieve global net zero”, jointly prepared by the GFMA and BCG, published on the GFMA’s website, October 2021.

The average price of carbon offsets has settled at around US\$3 per tonne of CO₂e in recent years (see Figure 5). In contrast to carbon allowances, it is challenging to standardise a carbon offset as they are generated from different types of carbon reduction projects.

²³ Statistics available on the website of ecosystem marketplace, viewed on 3 August 2022.

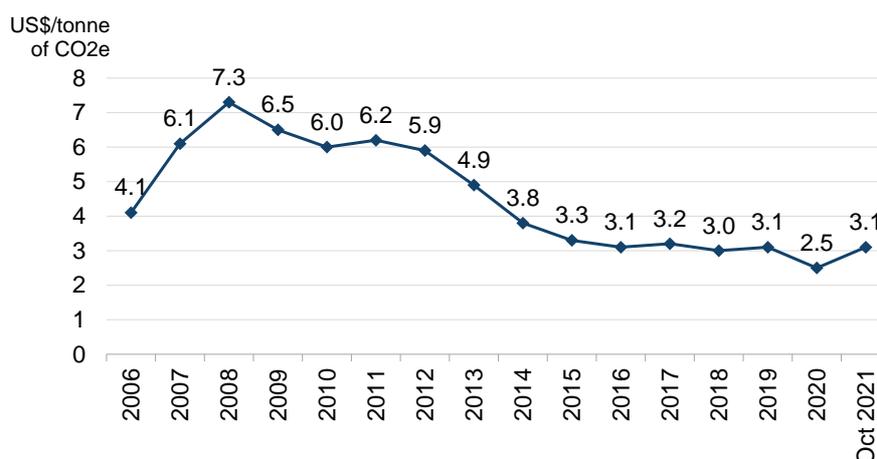
²⁴ Source: “Reform needed to unlock US\$550 billion carbon offsets market”, *Bloomberg*, 21 April 2022.

Potential buyers may have different preferences for these projects, for example, it is reported²⁵ that oil companies have become increasingly interested in nature-based carbon offsets (e.g. those generated from afforestation/reforestation) compared to renewable energy projects.

This may explain why there is a wide disparity of prices across projects — for example, in August 2021, the average price for afforestation/reforestation carbon offsets was US\$8.10 per tonne as compared to US\$1-2 per tonne for renewable energy credits²⁶.

In addition, the average price of carbon offsets was much lower than those of carbon allowances in many major mandatory carbon markets as shown in Figure 5.

Figure 5. Annual average price of carbon offsets in VCM (2006 – Oct 2021)



Note: Data is up to 12 October 2021.

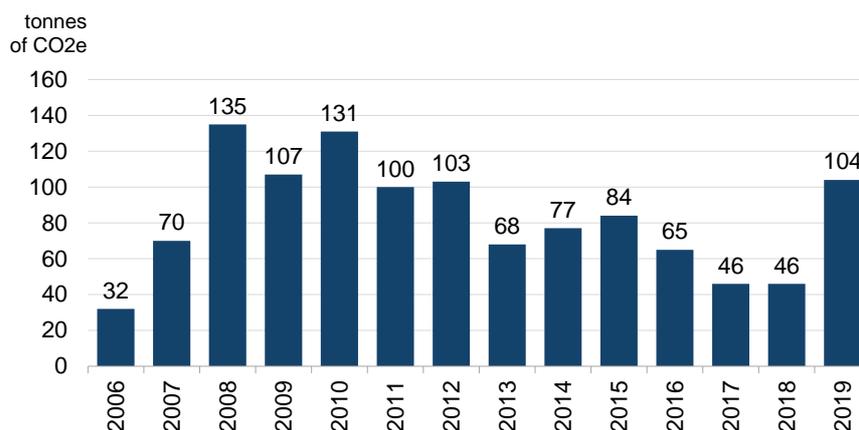
Source: “Unlocking the potential of carbon markets to achieve global net zero”, jointly prepared by the GFMA and BCG, published on the GFMA’s website, October 2021.

Currently, the trading of carbon offsets is mostly conducted in the OTC market. CCX, which was established in 2003, once handled nearly half of the world’s carbon offsets but it ceased operation in 2010²⁷. The annual trading volume of carbon offsets reached 104 tonnes of CO2e in 2019 (see Figure 6).

²⁵ See “Fuel for thought: Carbon offsetting goes mainstream as producers set sights on net-zero”, published on S&P Global’s website, 18 May 2021.

²⁶ Source: “Unlocking the potential of carbon markets to achieve global net zero”, jointly prepared by the GFMA and BCG, published on the GFMA’s website, October 2021.

²⁷ See “Taskforce on Scaling Voluntary Carbon Markets – Phase 1 final report”, published on the Institute of International Finance’s website, January 2021.

Figure 6. Annual trading volume of carbon offsets in VCM (2006 – 2019)

Source: “Taskforce on Scaling Voluntary Carbon Markets – Phase 1 final report”, published on the Institute of International Finance’s website, January 2021.

2.3 EU ETS

The EU ETS, which was officially launched on 1 January 2005, was the world’s first. The trading of carbon allowances on EU ETS is based on the “cap-and-trade” mechanism — where covered entities whose carbon emissions are restricted may obtain EUAs either for free or through auction.

Covered entities which have less carbon emissions than the allocated allowance can sell the extra allowance on the EU ETS and those whose emissions exceed the cap must purchase EUAs. By establishing the market for trading EUAs, the EU ETS transforms the environmental impact from emissions into a measurable cost to help allocate environmental resources effectively.

2.3.1 Four development phases²⁸

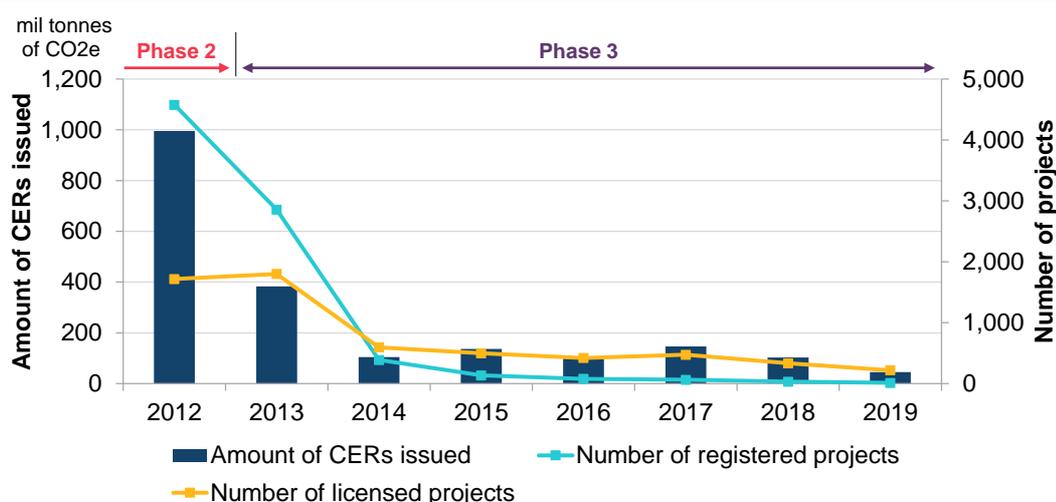
Since 2005, the EU ETS has gone through four reform phases to facilitate the reduction of emissions — Phase 1 (2005-2007), Phase 2 (2008-2012), Phase 3 (2013-2020) and Phase 4 (2021-2030). In 2021, i.e. the first year of Phase 4, the EU proposed to reduce GHG emissions to 55% below 1990 GHG levels by 2030.

Carbon offsets, e.g. Certified Emission Reductions (CERs) achieved by Clean Development Mechanism (CDM)²⁹ projects under the Kyoto Protocol, were accepted for compliance obligations of covered entities of EU ETS during Phases 1 to 3, but are no longer accepted starting from Phase 4. That means the carbon emission quota can only be met by carbon allowance (EUA).

Prior to Phase 4, the use of carbon offsets has already declined significantly in phase 3 (see Figure 7) as the mandatory market in Europe became more developed.

²⁸ See “Unlocking the potential of carbon markets to achieve global net zero”, jointly prepared by the GFMA and BCG, published on the GFMA’s website, October 2021; and the website of EU ETS.

²⁹ CDM is a UN-run carbon offset scheme allowing countries to fund GHG emissions-reducing projects in other countries and claim the saved emissions as part of their own efforts to meet international emissions targets.

Figure 7. The use of CDM projects in EU ETS (2012 – 2019)

Note: The annual registration for acquisition and release of CERs under the CDM is from 1 September of one year to 31 August of the following year. Data recorded in 2012 is the registration data from the beginning of the year to 31 August 2012.

Source: UNFCCC.

Phase 1 was a three-year pilot period of “learning by doing” between 2005 and 2007. This phase only covered CO₂ emissions from power generators and energy-intensive industries and almost all EUAs were given for free.

Phase 1 succeeded in establishing the needed infrastructure and free trading of EUAs across the EU, accumulating experience for the reduction of six GHGs under the “Kyoto Protocol” in Phase 2.

During Phase 1, the EU ETS had a surplus of free allowances and, as a result, the price of EUAs dropped from US\$22 per tonne of CO₂e in 2005 to zero by 2007. The trading volume rose from 321 million EUAs in 2005 to 1.1 billion in 2006 and 2.1 billion in 2007³⁰.

In Phase 2, EU ETS extended its carbon emission restrictions to more GHGs (such as sulphur dioxide, fluorine, etc.) and industries (such as aviation). In 2012, a single EU-wide registry replaced national registries to cover all countries participating in EU ETS.

By the end of Phase 2 in 2012, total emissions in the EU decreased by 19% compared with that in 1980, and energy consumption per unit of GDP decreased by nearly 50%³¹. EUAs were still mostly allocated for free, but the supply of EUAs should be set a level reflecting the economic conditions to avoid downward pressure in prices if the release of EUAs exceeds the actual carbon consumption in weak economic development. Therefore, the cap should be adjusted to the level of emissions allowed to align with the economic activities.

In Phase 2, weak economic activities after the 2008 global financial crisis might have led to a larger reduction in emissions than anticipated. This resulted in a surplus of EUAs and a drop in the price from US\$30 per tonne of CO₂e in 2008 to US\$8 per tonne of CO₂e in 2012, with the trading volume jumping to 7.9 billion EUAs in 2012 from 3.1 billion in 2008³².

³⁰ Source: “Development of EU ETS (2005-2020)” webpage on the EU’s website, viewed on 6 April 2022.

³¹ Source: LAN Hong, “Development of green finance for efficient carbon neutral”, research report of the International Monetary Institute of Renmin University of China, No.2110.

³² Source: “Development of EU ETS (2005-2020)”, webpage on the EU’s website, viewed on 6 April 2022.

In Phase 3, the cap for 2013 was set on the basis of the average total quantity of EUAs issued annually in 2008-2012. The cap on EUAs for stationary installations was set at the level of emissions allowed in 2013, with a plan to decrease annually by a linear reduction factor (LRF) of 1.74% from baseline emissions in 2008-2012.

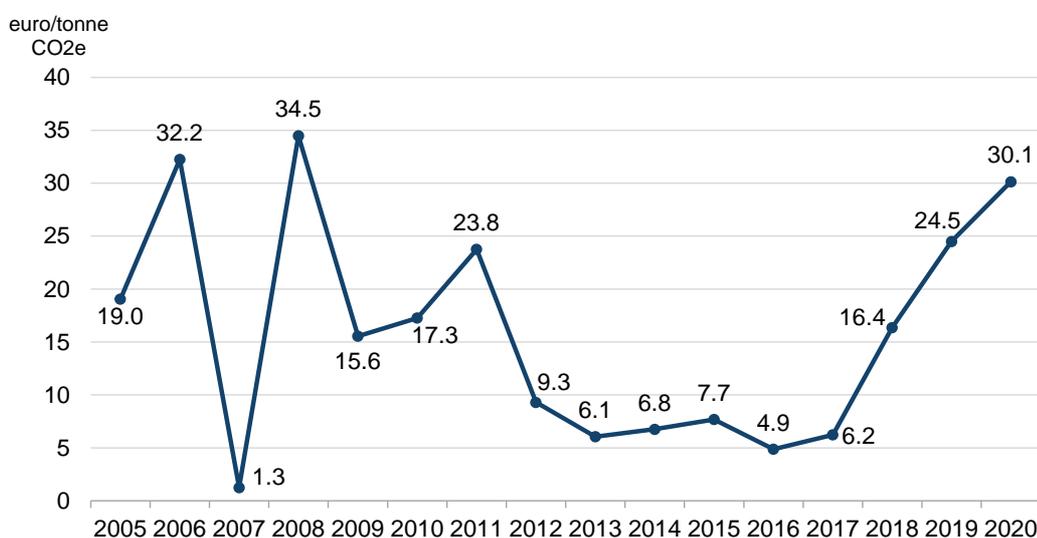
The share of auctioned EUAs increased to 57% while the rest were allocated for free so as to prevent carbon leakage (see Section 2.1 above). The emission reduction target was set so that total emissions in 2020 would be 21% less than in 2005. The EUA price increased from about US\$6.1 per tonne of CO₂e in 2013 to about US\$30.1 per tonne of CO₂e in 2020³³.

In the current Phase 4, a more ambitious cap for stationary installations was set in 2021, with an LRF of 2.2% annually. Around 57% of new carbon allowances in the EU ETS were allocated through auctions and the remaining allowances were freely allocated to companies. However, free allocation for less-exposed sectors will be phased out after 2026 from a maximum level of 30% of the total cap to zero by 2030. In July 2021, the EU proposed in its “Fit for 55” addendum that the cap will implement a one-off reduction of 117 million allowances and decline with an increased LRF of 4.2% annually between 2021 and 2030³⁴.

2.3.2 Market stability measures for carbon prices

Since 2005, demand and supply imbalances have driven significant fluctuations in EUA prices, ranging from a high of EUR 34.5 per tonne in 2008 to a low of EUR 1.3 per tonne of CO₂e in 2007 (see Figure 8).

Figure 8. Annual average price of EUAs on EU ETS (2005 – 2020)



Source: “Carbon pricing dashboard”, webpage on the World Bank’s website, viewed on 6 April 2022.

In Phases 1 and 2, member countries may not have predicted the downside impact of the 2008 global financial crisis and may have also over-estimated capacity expansion, resulting in more EUAs allocated than required.

On the demand side, many enterprises reduced production and therefore demand for EUAs weakened when the global financial crisis broke out in 2008. Moreover, carbon offsets were

³³ Source: “Carbon pricing dashboard”, webpage on the World Bank’s website, viewed on 6 April 2022.

³⁴ See “Increasing the ambition of EU emissions trading”, webpage on the EU’s website.

continuously generated from developing countries, bringing more downside pressure on the price of EUAs.

The EU ETS Management Committee had no effective tools to regulate the EUA estimation and the supply of each country in the first two phases. The EU ETS used National Allocation Plans (NAPs) as the core principle for the allocation of EUAs, which allowed each member in the EU to plan for itself the total amount of EUAs in accordance with the allocation standards and principles determined by the EU, and then report to the EU ETS Management Committee.

The implementation of NAP, to a certain extent, reduced the resistance EU ETS might face to form a unified carbon market in the EU and helped accelerating the pace of EU ETS development at its initial stage, regardless of the large differences in economic conditions and legal environments across member countries. However, a number of fundamental problems — an oversupply of EUAs driving down carbon prices and therefore weakening the incentive to reduce emissions — gradually emerged upon implementation of NAP.

A reform of the EU ETS framework in Phase 3 fundamentally changed the NAP system. A single EU-wide cap on emissions was established in place of the previous system of national caps, and auctions were used as the default means for allocating EUAs; free allocation was required to use the “benchmarking approach” to calculate and allocate EUAs³⁵. The auction mechanism increases the transparency of the EUA allocation, reflecting the principle of “polluter pays” and providing an effective measure to reduce carbon emissions.

In March 2014, the European Commission initiated a back-loading programme as a short-term measure to reduce the amount of EUAs available for auction in the short term while not changing the overall volume of EUAs to be auctioned in Phase 3. In 2019, the Market Stability Reserve (MSR) was set up by the European Commission to absorb the excess and alleviate the shortage of EUAs. The EUAs back-loaded in 2014-2016 were transferred to the reserve rather than auctioned in 2019-2020.

The MSR continues to operate in Phase 4 to address the imbalance between the demand and supply of EUAs. Currently, the EU publishes the total number of allowances in circulation each year. At the same time, the EU also set up some dedicated funding mechanisms, including the Innovation Fund and the Modernisation Fund, to help industrial and electricity industries cope with the challenges of innovation and transformation to a low-carbon economy.

To a certain extent, the above measures contribute to the price management of EUAs³⁶.

2.3.3 EUAs: Spot and futures trading

As the EU ETS launched spot trading of EUAs and CERs in 2005, the futures trading of carbon was also launched around the same time on a number of exchanges. Since then, the EU ETS has accumulated experience in the trading of carbon emission allowances and CERs, and for developing the appropriate linkage mechanism between the spot and futures markets. The futures contracts on carbon allowances traded on EU ETS serve as valuable

³⁵ The number of EUAs freely allocated to an installation of a company is determined by the product benchmark based on the average GHG emissions of the best performing 10% of the installations in the EU. As the requested allocations for all installations in the EU exceeded the total amount available for free allocation, the allocation per installation was reduced for all installations by the cross-sectoral correction factor (increased from about 11% in 2013 to about 22% in 2020). See “Allocation to industrial installations”, webpage on the EU’s website.

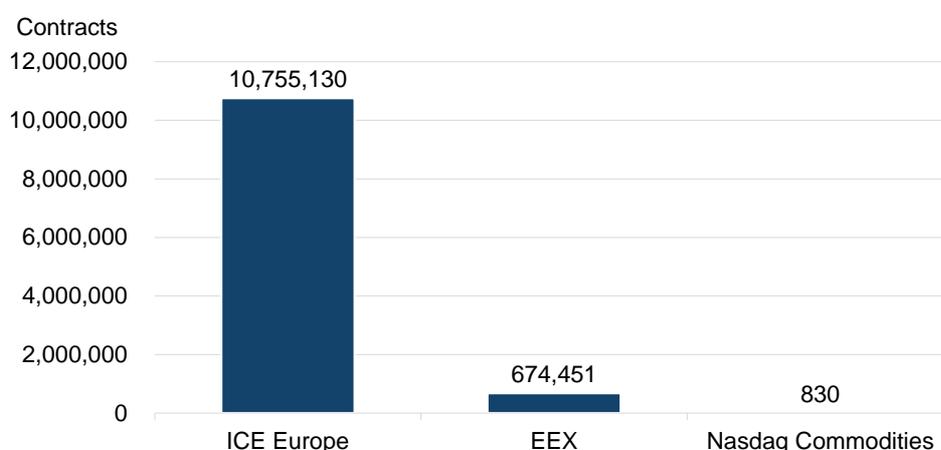
³⁶ Source: “Fact sheet of EU ETS”, available on the website of ICAP, viewed on 23 July 2021.

tools to hedge risk in carbon spot trading, contributing to stabilising spot price volatility and facilitating investors to participate in the EU carbon market.

The European Climate Exchange (ECX) and European Energy Exchange (EEX) had provided futures trading for EUAs and CERs at early days. In 2006, ECX was merged into the Intercontinental Exchange (ICE). ICE combined ECX's carbon trading business into ICE's European futures business (ICE Europe), which has gradually developed itself to become an important energy futures exchange in Europe.

Currently, the futures of EUA (including spot contracts) can be traded on four exchanges — EEX and ICE in Europe, NASDAQ Commodities and Chicago Mercantile Exchange (CME) in the US (see Figure 9).

Figure 9. Trading volume of EUA futures by exchange (2021)



Note: One contract of EUA futures is equivalent to 1,000 tonnes of CO₂e. Data of EUA futures on the CME is not available and is therefore excluded.

Source: FIA's monthly statistics.

2.4 Major carbon markets and exchanges in the US

Despite the development of regional carbon trading markets in the US, no nationwide ETS has been developed. Carbon futures trading has been flourishing in recent years, supported by well-developed financial markets in the US. In 2021, the US re-joined the Paris Agreement after its departure in 2020 and committed to reducing carbon emissions by 2030 by 50%-52% compared to 2005 levels, and to achieve carbon neutrality by 2050³⁷.

2.4.1 Major regional carbon trading markets

Major regional carbon trading markets in the US include RGGI, the Western Climate Initiative (WCI) and California's Cap-and-Trade Program (CCTP).

The RGGI officially commenced in 2009 and was the first mandatory carbon trading market in the US. The market works on the auction mechanism instead of allocating allowances on a free-of-charge basis.

The RGGI covers 225 power stations, each with a capacity of more than 25 megawatts (MW) of thermal power-generating units in eleven participating states. From inception to

³⁷ Source: "President Biden sets 2030 greenhouse gas pollution reduction target aimed at creating good-paying union jobs and securing U.S. leadership on clean energy technologies", Statements and Releases on the website of the White House, US, 22 April 2021.

September 2021, RGGI-covered emissions have dropped by more than 50% and over US\$4 billion has been raised to invest in local communities³⁸. In 2020, carbon trading volume via the RGGI reached 270 million tonnes of CO₂e and total turnover amounted to EUR 1.695 billion (see Table 3).

The WCI was launched in 2007 and was the first cross-border emissions trading market jointly formed by seven states in the US and four provinces in Canada. The WCI covers 90% of the total carbon emissions of the covered states and provinces, and the GHG emissions of the region are to be reduced by 15% by 2020 compared to levels in 2005³⁹. In 2020, trading volume on the WCI reached 1,739 million tonnes of CO₂e and turnover of EUR 24.3 billion (see Table 3).

	Trading volume (Million tonnes of CO ₂ e)					Trading value (EUR millions)				
	2016	2017	2018	2019	2020	2016	2017	2018	2019	2020
WCI	338	628	887	1,380	1,739	4,088	7,351	11,763	20,738	24,333
RGGI	173	185	239	293	270	825	615	1,107	1,627	1,695

Note: Data of WCI covers emission trading of four provinces in Canada.

Source: "Carbon market year in review: Record high value of carbon markets in 2019" and "Carbon market year in review 2020: Blooming carbon markets on raised climate ambition", published on Refinitiv's website, 22 January 2020 and 26 January 2021 respectively.

Through the WCI, CCTP in California is linked with the cap-and-trade system of the Canadian province, Québec. By 2020, the programme targeted overall reductions in GHG emissions to the equivalent of levels produced in 1990, and proposed to set annual emissions reduction targets of around 4% per year from 2021 to 2030. According to these targets, California's total carbon emissions will continue to decline and will have fallen by an estimated 40% in 2030 compared with levels in 1990⁴⁰. In addition, California has also strengthened the monitoring of non-GHG air pollutants through legislation.

2.4.2 US carbon derivatives trading

US exchanges offer standardised futures and options contracts on GHG emission allowances and offsets. The trading volume of these futures and options, including RGGI contracts and CCA contracts⁴¹, totalled 641.1 thousand lots in the second quarter of 2021⁴².

The Chicago Climate Exchange (CCX), which commenced operation in 2003, was the world's first and North America's only contractually binding, rules-based GHG emission allowance trading system.

The main products traded on the CCX are Carbon Financial Instrument (CFI) contracts which represent 100 tonnes of CO₂e and were launched as a cash contract. Futures and options on CFI are also available⁴³.

The Chicago Climate Futures Exchange (CCFE) handles CFI futures and options trading on CCX. The underlying assets of the futures contracts on CCFE include not only CO₂, sulfur dioxide (SO₂) and nitrogen oxides (NO_x), but also other GHG emission credits and

³⁸ Source: "RGGI 101 Factsheet", available on the website of RGGI.

³⁹ Source: "Design for the WCI Regional Program", July 2010, available on the website of WCI.

⁴⁰ Source: "Executive summary of global carbon market progress", 2018 Annual Report, published on the website of ICAP.

⁴¹ CCA (California Carbon Allowance) contracts are futures contracts for allowances issued by the CCTP.

⁴² Source: International Swaps and Derivatives Association (ISDA), "Role of derivatives in carbon markets", September 2021.

⁴³ Source: The *MarketsWiki* website, viewed on 16 March 2022.

CERs. In 2010, CCX and CCFE were acquired by ICE. The trading of CCFE's futures contracts were then closed at the end of 2010.

Another US exchange, the CME, provides a suite of emissions contracts for hedging exposures in US and European carbon markets. CME offers RGGI allowance futures and options, in-delivery-month EUA futures and options, and California low-carbon fuel standard futures. In addition, it recently launched nature-based global emissions offset (N-GEO) futures and global emissions offset (GEO) futures, which help the global market to access standardised and validated instruments for the emerging voluntary emissions market.

N-GEO futures are based on eligible voluntary offsets from agriculture, forestry and other land-use projects with additional climate, community and biodiversity accreditation. GEO futures are based on eligible voluntary carbon offset credits under the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) at three registries — the registry of the Verified Carbon Standard (or Verra Registry), the American Carbon Registry (ACR) and the registry of the Climate Action Reserve (CAR). The launch of these products reflects hedging demand in the voluntary carbon offset market.

The diverse carbon product suite in the US offers broad coverage of cap-and-trade carbon allowances, including EUA, CCA and those on RGGI, as well as offset carbon credits in various markets. This helps improve the overall liquidity on carbon exchanges, thereby enhancing price discovery in the carbon market.

2.5 Carbon trading in a developing country: India

The development of the carbon exchange in India could be a reference for developing countries. As a developing country, India is not included in Annex 1 of the Kyoto Protocol. It takes up differentiated responsibilities in emissions reduction without making a specific commitment to the first phase of the Kyoto Protocol (2008-2012). Hereby, India has no domestic markets that provide trading of carbon emission allowances, but has futures trading of CERs generated from CDM projects.

Since 2005, India has adopted a “single-sided strategy” to store CERs generated from registered CDM projects to reduce emission costs. In this process, Indian financial institutions have played an active role. Banks provide credit to support CDM projects to generate CERs, and the return from the sale of CERs from CDM projects will be used to repay bank loans. Enterprises are willing to bear the costs in the initial phase of CDM projects. The CERs will have a premium on sale relative to the costs input, and this will allow enterprises to gain profits from CDM projects.

Two existing major local exchanges in India — Multi Commodity Exchange of India (MCX) and National Commodity and Derivative Exchange (NCDEX) — offer trading of CER futures.

Founded in November 2003, MCX is the major commodity exchange for futures trading in India. Its products include derivatives on metals, energy, oil, crops, textiles, etc. In 2005, MCX entered into a strategic alliance with the CCX, and started trading CER futures to support the development of domestic CDM projects. NCDEX also launched several CER futures contracts with different maturities since 2008. The CER futures contracts in India were mainly denominated in Rupees.

3. CHINA'S CARBON MARKET DEVELOPMENT AND PRODUCT INNOVATION

China has pledged to reach peak carbon emissions by 2030, achieve carbon neutrality by 2060, and adopt effective policies and measures to support the overall green transformation of the economy. One key dimension of China's plan is the development of the domestic carbon market, starting with pilot regions and then extending to the entire nation.

3.1 Regional pilot carbon trading markets

In order to achieve the dual goals of “carbon peak, carbon-neutrality”, the Chinese government has promoted the development of carbon emission trading systems, as it regards the marketisation of carbon emission allowances as an important tool to reduce GHG emissions and drive the transition to a green and low-carbon economy.

In 2013, Beijing, Shanghai, Tianjin, Chongqing, Hubei, Guangdong and Shenzhen were designated as pilot regions for carbon emissions trading. In 2016, Fujian also launched a pilot carbon emission trading system. Each of these pilot provinces/cities explored different carbon trading models. Based on the experience of these pilot schemes, the China's national ETS began operating in July 2021.

The pilot emission trading systems were intended to help enterprises use market mechanisms to manage environmental risks and environmental costs. The systems were also expected to ensure the credibility of carbon trading by providing standardised trading procedures and transparency, as well as supporting market liquidity with financial innovation. To date, a number of innovative carbon products have been trialled in the pilot emission trading markets, for example:

- (1) In Shanghai, carbon allowances commenced trading on the Shanghai Environment and Energy Exchange (SEEE) on 26 November 2013. In 2017, SEEE launched a forward product on Shanghai carbon allowances with the Shanghai Clearing House serving as the central counterparty for clearing transactions. The launch of carbon forwards is of great significance in improving the liquidity of carbon allowances and easing price fluctuations.
- (2) In Guangdong, the China Guangzhou Emissions Exchange (CEEX Guangzhou) was established in September 2012. In December 2013, carbon emissions allowances in Guangdong were first allocated through the exchange. CEEX Guangzhou then experimented with carbon financial products, including carbon credit mortgage financing, repurchase transactions and forwards. In addition, it launched the China Carbon Market 100 Index in 2017 and recently began providing services to support new energy and green industry asset investment and financing.
- (3) In Beijing, the Beijing Emissions Exchange (renamed Beijing Green Exchange in 2020) is the designated carbon emissions pilot trading platform. It has explored and launched various innovative products, including carbon repurchase financing, OTC swaps and carbon assets pledge financing.
- (4) In Shenzhen, the China Shenzhen Emissions Exchange began trading carbon allowances in June 2013. In addition, the exchange provides a series of services, including carbon assets pledge financing, domestic and overseas carbon repurchase financing, carbon-related bonds, custodian services for carbon allowances, green structured deposits and carbon investment funds.

Table 4. Overview of China's regional pilot carbon trading markets				
Market	Industry coverage	Eligible enterprises	Carbon products	Related innovative financial products/services
Beijing	<p><u>Industrial:</u> Power and heat supply, cement, petrochemical, manufacturing and other industrial sectors</p> <p><u>Non-industrial:</u> Service, public transportation and domestic aviation</p>	Enterprises with annual emissions of 5,000 tonnes or above of CO ₂ e, considering both direct and indirect emissions	Beijing Emission Allowances, CCERs, Forestry Carbon Sequestration (FCERs) and CERs from automobile (PCERs)	Carbon repurchase financing, OTC swaps, carbon assets pledge financing, etc.
Shanghai	<p><u>Industrial:</u> Power and heat supply, water supply, iron and steel, petrochemical, chemical, non-ferrous metals, construction materials, textiles, papermaking, rubber and chemical fibres</p> <p><u>Non-industrial:</u> Domestic aviation, airport, commercial, ports, shipping, hotels, financial and railways</p>	<p><u>For power and industries:</u> Either 20,000 tonnes of CO₂e/year or 10,000 tonnes of coal equivalent/year; and those that already participated in the 2013-2015 phase with 10,000 tonnes of CO₂e/year or 5,000 tonnes of coal equivalent/year</p> <p><u>For transport:</u> Either 10,000 CO₂e/year or 5,000 tonnes of coal equivalent/year (aviation and ports); 100,000 tonnes of CO₂e/year or 50,000 tonnes of coal equivalent/year (shipping)</p> <p><u>For buildings:</u> Either 10,000 tonnes of CO₂e/year or 5,000 tonnes of coal equivalent/year</p>	Shanghai Emission Allowances, CCERs, Shanghai Emission Allowances Forwards (SHEAFs)	Carbon forwards, carbon pledges, carbon trusts, carbon funds and carbon borrowing, etc.
Tianjin	Power and heat supply, iron and steel, chemical, petrochemical, oil and gas exploration, papermaking, aviation and construction materials	Enterprises with annual emissions of more than 20,000 tonnes of CO ₂ e, considering both direct and indirect emissions	Tianjin Emission Allowances, CCERs, Tianjin Regional Forestry Offsets (TFCER)	Comprehensive services for carbon neutralisation, carbon asset development, energy conservation and emission reduction, etc.

Table 4. Overview of China's regional pilot carbon trading markets				
Market	Industry coverage	Eligible enterprises	Carbon products	Related innovative financial products/services
Shenzhen	<p><u>Industrial:</u> Power, gas, water supply and manufacturing;</p> <p><u>Non-industrial:</u> Public buildings and public transportation</p>	Enterprises with annual emissions of 3,000 tonnes or above of CO ₂ e or large public buildings and government buildings larger than 10,000m ²	Shenzhen Emission Allowances and CCERs	Carbon assets pledge financing, domestic and overseas carbon repurchase financing, carbon-related bonds, custody of carbon allowances, green structured deposits, carbon investment funds, etc.
Guangdong	Power, cement, iron and steel, petrochemical, papermaking and aviation	Enterprises with annual emissions of 10,000 tonnes or above of CO ₂ e or annual energy consumption of 5,000 tonnes or above of coal equivalent	Guangdong Emission Allowances, CCERs, Pu Hui Certified Emission Reductions (PHCERs), Eco-compensation Certified Emission Reductions (STCERs)	Credit mortgage financing, repurchase transactions and forwards, China Carbon Market 100 Index, new energy asset investment and financing, and green industry investment, etc.
Chongqing	Power, iron and steel, electrolytic aluminum, ferroalloys, chemical and cement, etc.	Enterprises with annual emissions of 20,000 tonnes or above of CO ₂ e or annual energy consumption of 10,000 tonnes or above of coal equivalent	Chongqing Emission Allowances, CCERs, Chongqing Certified Emission Reductions (CQCERs)	Integrated services for carbon neutralisation and for integrated contract-based energy management, etc.
Hubei	Power and heat supply, cement, iron and steel, nonferrous metals, petrochemical, chemicals, textile, glass and other building materials, pulp and paper, ceramics, automobile and equipment manufacturing, food and beverage, medicine producers and water supply	Enterprises with annual comprehensive energy consumption of 10,000 tonnes or above of coal equivalent in any year between 2016 and 2018, applying to all energy and industrial sectors	Hubei Emissions Allowances and CCERs, spot and forward	Carbon investment funds, carbon asset pledge financing, carbon bonds, carbon asset custody, carbon finance structured deposits and carbon emission allowance repurchase financing
Fujian	Petrochemical, chemical, construction materials, iron and steel, non-ferrous metal, paper, electricity, aviation and ceramics	Enterprises with annual comprehensive energy consumption of 5,000 tonnes or above of coal equivalent in any year between 2013 to 2020	Fujian Emission Allowances, Forestry Certified Emission Reduction credits (FFCER) and CCERs	Providing innovative products and services

Note: Information collected from the websites of each regional pilot carbon ETS and www.china5e.com.

3.2 The national carbon market

The China ETS commenced trading of carbon emission allowances (CEAs) on 16 July 2021. In the initial phase, only the power sector was covered. The first batch of emitting entities

covered by the system accounted for more than 4 billion tonnes of CO₂, making it the world's largest ETS market by volume⁴⁴. While trading is conducted on the SEEE, the national registry, registration and settlement systems for CEAs are located in Wuhan.

The China ETS aims to reduce CO₂ emissions by requiring covered entities to pay for at least some permits to emit their emissions, encouraging them to invest in technologies that will enhance fuel efficiency and reduce pollution. Covered entities are incentivised to cut emissions as they would be able to sell spare carbon allowances in the carbon market.

According to the *Administrative Measures for Carbon Emission Trading (Trial Implementation)* which was issued on 31 December 2020 and became effective on 1 February 2021, enterprises in the key carbon emission industries will move to the national carbon market and will not participate in the regional carbon pilot trading markets. The first batch of enterprises covered by the national carbon market are only power plants. During the 14th Five-Year Plan period, more industries such as iron and steel, petrochemicals, and construction materials will join the national carbon market.

During the transition period for enterprises to move from regional carbon trading markets to the national carbon market, the regional pilot trading markets would need to accelerate reform and innovation, especially in developing carbon finance through vehicles such as carbon futures, swaps, forwards, investment funds, trusts and other products.

As disclosed by the China Securities Regulatory Commission (CSRC) in June 2021⁴⁵, carbon futures were being developed at the Guangzhou Futures Exchange and will be launched once market conditions are ready. From international experience, the development of the carbon futures market will improve the efficiency of carbon pricing, provide risk management tools for market entities, and improve the overall liquidity of the carbon spot market⁴⁶.

Table 5 presents an overview of the current status and prospects of the China ETS.

	Current status	Prospects
Industry inclusion	First batch: 2,162 power plants	<ul style="list-style-type: none"> During the "14th Five-Year Plan" period, it will expand from power industry to steel, petrochemical, construction materials and other key industries. Ultimately, it will cover eight key industries including electrical power, petrochemical, chemical industry, construction materials, iron and steel, non-ferrous metal, papermaking and aviation
Relevant rules	<ul style="list-style-type: none"> Administrative Measures for Carbon Emission Trading (Trial Implementation) (effective 1 February 2021) Interim Regulations on the Management of Carbon Emission Trading (Draft Revision) (Draft for Comments) (30 March 2021) 	

⁴⁴ Source: "Explainer: How will China's new national carbon emissions trading scheme (ETS) work?", *Reuters*, 14 July 2021.

⁴⁵ Source: "CSRC: will study and launch futures related to carbon emission allowances" (《證監會：將研究推出碳排放權相關期貨品種》), *people.cn* (《人民網》), 18 June 2021.

⁴⁶ See ISDA, "Role of derivatives in carbon market", September 2021.

Table 5. Overview of China's national carbon market — China ETS		
	Current status	Prospects
Supporting systems	<ul style="list-style-type: none"> The national registry, registration and settlement systems are established in Wuhan. SEEE provides trading system. 	<ul style="list-style-type: none"> The exchange for carbon derivatives trading is under planning.
Transitional arrangements	<ul style="list-style-type: none"> Enterprises that are not included in the national carbon market may continue to participate in the regional pilot carbon markets. 	<ul style="list-style-type: none"> Enterprises in the eight key industries currently covered in the regional pilot trading markets will be gradually transferred to the national carbon market. Regional pilot trading systems currently coexist with the national carbon market.
Turnover and price	<ul style="list-style-type: none"> Carbon emission allowances closed at RMB 54.22 (US\$8.52) per tonne of CO₂e at the end of 2021, up 13% compared to the opening price on the commencement day of 16 July 2021. Including both listed and off-exchange trades, the weighted average price of allowances in 2021 was RMB 43.85 (US\$6.89) per tonne of CO₂e. A total of 179 million tonnes of allowances changed hands during 114 trading days in 2021. 	<ul style="list-style-type: none"> The launch of futures and relevant derivatives will further significantly increase the trading volume.

Source: The data of industry inclusion, turnover and price is from the website of the Ministry of Ecology and Environment of China.

3.3 Co-existence of CCERs

In 2012, the *Interim Measures for the Administration of Voluntary Greenhouse Gas Emissions Reduction Transactions* were issued, allowing Chinese entities to file and register voluntary emissions reduction projects, including renewable energy projects, carbon sink projects, methane utilisation projects, which substitute, neutralise or reduce GHG emissions. The reduced emissions as a result of these projects are recognised as CCERs, which can be sold to entities with high emissions for offsetting a certain percentage of their emissions beyond the allowances that they are allocated.

In general, allowances under the mandatory regulatory regime account for the majority of the trading volume in the carbon market. Nevertheless, the voluntary trading of CCERs is regarded as a constructive supplement to the mandatory trading of allowances. Currently, the Mainland regulatory regime allows companies to cover up to 5% of their mandatory obligations with CCERs. The combination of these two trading models would greatly improve the effectiveness of carbon emissions reduction efforts.

The market looks forward to the resumption of the issuance and registry of CCERs in the near future, which has been suspended since March 2017. It is expected that, with the further alignment of China's standards and methodologies with global markets, more international buyers will be interested in purchasing CCERs, especially high-quality CCERs.

3.4 Development outlook and opportunities of carbon market in the Mainland

In the Mainland, the coverage and access of both the China ETS and the VCM are expected to expand over time. In addition to electricity generation, all eight key industries will be covered by the national China ETS during the 14th Five Year Plan.

It is expected that the coverage of the China ETS will increase to 60% of total emissions and the cumulative trading value will reach RMB100 billion by 2030⁴⁷. The development of market infrastructure for trading and registration of CCERs is in progress and may facilitate the resumption of issuance of CCERs. From the experience of the EU ETS, the investor base may be expanded through the innovation of carbon products, such as derivatives products.

Policy measures and support may also help develop the carbon market in the Mainland. Market experts suggested⁴⁸ imposing carbon taxes in China and subsidising the sectors to facilitate the transition to a low-carbon economy.

While the global carbon market is still fragmented and carbon prices vary across jurisdictions, cross-border cooperation in policy coordination (e.g. international carbon price floor⁴⁹) and market connectivity may help facilitate price discovery and the provision of liquidity in carbon markets in Mainland China and across the globe.

4. ELEVATING HONG KONG'S POSITION AS A GREEN FINANCE HUB AND REGIONAL CARBON TRADING CENTRE

China's commitment to achieve carbon neutrality by 2060 provides Hong Kong with huge opportunities to develop into a green finance hub and regional carbon trading centre.

As an international financial centre with a world-class regulatory framework, Hong Kong can provide an effective institutional setting for cross-border flows of green and sustainable funds, and step up with bigger efforts to contribute to attaining China's goal of achieving carbon neutrality before 2060.

Firstly, given China's commitment to achieving peak carbon emissions by 2030 and carbon neutrality by 2060 — and with strong policy support for carbon trading — the Mainland carbon market is expected to undergo rapid development.

However, international investors have limited access to the Mainland carbon market. Hong Kong could possibly fill the gap, offering easy and convenient access to carbon markets in Mainland China, especially to the national China ETS and those in the Greater Bay Area (GBA).

Hong Kong's regulatory standards are in line with international practices, so international entities could make use of Hong Kong's financial and professional services to access Mainland sustainable investment and carbon trading markets.

Secondly, Hong Kong's internationally reputable green certification services and deep knowledge of both international and Mainland markets could help connect Chinese and global investors and carbon projects via a carbon trading platform.

Thirdly, Hong Kong could explore the potential of developing itself into a regional carbon trading centre and an offshore risk management centre to support the development of carbon markets on the Mainland.

⁴⁷ See Center for Energy and Environmental Policy Research (CEEP) of Beijing Institute of Technology (BIT), "Review and outlook of China's carbon market" (〈中國碳市場回顧與展望 (2022)〉), *Forecasting and Prospects Research Report*, 9 January 2022.

⁴⁸ See "Carbon tax coming? Central government clarified four directions of 'dual carbon' fiscal policy support" (〈碳稅將至? 中央明確"雙碳"財稅政策四大支持方向〉), *China Business News*, 27 October 2021; "Li Daokui: China should introduce carbon tax as soon as possible to establish a unified large carbon market" (〈李稻葵: 中國應該儘早推出碳稅·來建立統一的碳排放大市場〉), *Sina.com*, 28 June 2022;

⁴⁹ See "Why countries must cooperate on carbon prices", IMF Blog published on IMF's website, 19 May 2022.

In July 2022, HKEX announced the launch of the Hong Kong International Carbon Market Council, towards the target of developing an international carbon market that leverages Hong Kong's position as a leading global financial centre, contributing to the realisation of carbon neutrality goals and the development of the green and sustainable finance ecosystem in Hong Kong, Mainland China and beyond.

In October 2022, HKEX launched Core Climate, a new international carbon marketplace that seeks to connect capital with climate-related products and opportunities in Hong Kong, Mainland China, Asia and beyond. This platform contributes to building an integrated ecosystem and international carbon market in Hong Kong and providing a one-stop solution for trading, custody and settlement. Core Climate recorded more than 40 trades in less than a month between 28 October and 24 November, 2022, representing a total volume of around 400,000 tonnes of carbon credits⁵⁰.

More market structure and products are expected to be launched to further develop Hong Kong as a premier carbon hub in Asia and beyond.

5. CONCLUSION

As the international community takes action to reduce GHG emissions and limit climate change, emissions trading systems and voluntary carbon markets are rapidly expanding.

China is increasingly prominent in global carbon markets and Hong Kong can leverage its unique advantages as an international financial centre to actively participate in the development of China's carbon market and support China's national strategy in combating climate change.

By providing connectivity for international investors to onshore markets, and vice versa, Hong Kong could play a superconnector role linking carbon projects with investors looking to drive the low-carbon transition and allocate capital to green and sustainable finance projects. The development of a carbon market would also inject new vitality to the development of green finance in Hong Kong.

⁵⁰ Source: "Early momentum for Core Climate, Hong Kong's new international carbon marketplace", news release on HKEX's website, 24 November 2022.

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