Chapter 3
Overview of Chinese Pilots ETS and Characteristics

For the purpose of fulfilling China's carbon emissions reduction targets by 2020 through a cost-efficient market mechanism, and expediting transformation of economic growth pattern and upgrading industrial structure, China's State Council, at the end of 2011, issued the *Work Plan for Greenhouse Gas Emissions Control during the 12th Five-Year Plan Period*, which requires to "explore and establish a national unified carbon emissions trading market." In response to the State Council's plan, the NDRC, in October 2011, initiated a carbon emissions trading pilot program in seven regions, including five municipalities as Beijing, Tianjin, Shanghai, Chongqing and Shenzhen, and two provinces as Hubei and Guangdong, the earliest pilot ETS which open its carbon market is Shenzhen ETS in June 2013, and the latest launched is Chongqing ETS in June 2014. According to NDRC's statistics, more than 1900 emitters (companies and institutions) are covered in this pilot ETS, receiving total emission allowances at around 1200 $MmtCO_{2e}$. During the pilot period, the seven pilots ETS have completed the whole procedures, i.e., data collection, a stipulation of rules, compliance mechanism, offset rules, etc. Each pilot ETS designed its proposal according to the local situation, which is the basis of Chinese national ETS. The structure and characteristics of these pilots ETS are described as follows:

3.1 Construction and Operation of China's Pilots ETS

China's seven pilots ETS which are distributed in the eastern, central and western regions, involve three administrative levels (province, municipality, and city). The basic framework of China's pilots ETS is similar to that of other countries, but distinguishes between regions in details, such as coverage scale, allowance cap, coverage standard, etc. (see Table 3.1).

In reference to the *Interim Measures for the Administration of Carbon Emission Permit Trading* and relevant policy schemes, the pilots ETS are distinguished in

D. Zhao et al., *A Brief Overview of China's ETS Pilots*,
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Table 3.1 Comparison among Chinese pilots ETS

Location	Start date	Criteria for coverage scope	Coverage percentage in total emissions	Allocation plan	Compliance rule	Trading administration
Beijing	Nov 28, 2013	The fixed installations (e.g., iron and steel, cement, petrochemical) that directly or indirectly emitted an annual average of 10,000 $mtCO_{2e}$ or more in 2009–2011	–	The annual total emission allowances are allocated to both established and newly operated facilities and also for adjustment; 5% are reserved for competent department	The compliance rate reached 97.1% in 2013 and 100% in 2014. The percentage of carbon offsets is no more than 5% of the year's total allowances, and that of local CCER is no less than 50%	Restrict overly stocking up allowances; set up price early-warning system; the government maintains the stability of carbon market through allowances auction or buyback
Shanghai	Nov 26, 2013	The industrial sectors that emitted 20,000 $mtCO_{2e}$ or more (e.g., iron and steel, petrochemical, chemical, nonferrous, electricity) or nonindustrial sectors that emitted 10,000 $mtCO_{2e}$ or more in any year in 2009–2011	In 2013: about 57% of Shanghai total emissions	The allowances are allocated for free. Three years' allowances are allocated to covered enterprises in a one-time manner with the benchmarking approach	The compliance rate was the same as 100% in 2013 and 2014. CCER, though accepted for compliance, should be no more than 5% of the year's total allowances	Shanghai Environment and Energy Exchange, which trades three categories of allowance products (SHEA13, SHEA14, and SHEA15), mainly relies on listed transaction and sometimes exercises negotiating transfer, with competitive bidding playing a supplementary role. A price rise or drop by no more than 30% is tolerated. A risk management system is established

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Table 3.1 (continued)

Location	Start date	Criteria for coverage scope	Coverage percentage in total emissions	Allocation plan	Compliance rule	Trading administration
Tianjin	Dec 26, 2013	The major emitting sectors (e.g., iron and steel, chemical, electricity, heat, petrochemical, oil and gas exploitation) or civil construction field that emitted an annual average of 20,000 $mtCO_{2e}$ or more since 2009	Holding 50–60% of Tianjin total emissions	The allowances are allocated for free. The allowances granted to electricity and heat sectors are based on benchmarking allocation and subject to post-correction, while the allowances to industrial sectors are based on grandfathering allocation and adjusted in light of pre-phase reduction effect and targets. Different allocation approaches apply to established and newly operated facilities	The compliance rate reached 96.5% in 2013 and 99.1% in 2014. CCER, though accepted for compliance, should be no more than 10% of the year's total allowances	The allowances transaction is realized through online spot trading, trade by agreement, or auction trading. A price rise or drop by no more than 10% is tolerated. A risk warning system (setting a cap on the quantity of allowances) and an auditing system are established
Chongqing	June 19, 2014	Metallurgy, electricity, chemical, building materials, and machinery sectors, and light industrial sectors	About 60% of Chongqing total emissions	The allowances are allocated for free. Three years' allowances are allocated to covered enterprises in a one-time manner. The companies shall compete for allowances and the government shall set a cap on total allowances; in other words, the government may review and adjust the allowances applied by the companies	The compliance rate in 2014 reached 70% (as of July 14, 2015). The covered enterprises shall not use carbon offsets unless there is short of allowances, and the percentage of offsets may not be above 8% of the allocated allowances during the compliance period	Emission allowances and CCER are two tradable products. The covered enterprises are imposed by certain restrictions, i.e., the allowances to be sold may not be above 50% of their annual total allowances. A price rise or drop by no more than 20% is tolerated

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Table 3.1 (continued)

Location	Start date	Criteria for coverage scope	Coverage percentage in total emissions	Allocation plan	Compliance rule	Trading administration
Guangdong	2013.12.19	The industrial sectors that emitted 20,000 mtCO_{2e} or more (or consumed energy in 10,000 tons of coal equivalent) in any year in 2010–2012, e.g., electricity, cement, petrochemical and iron and steel	In 2013: about 54% of Guangdong total emissions	The 2014 allowance allocation altered greatly from the 2013 version, i.e., only a certain proportion of allowances were allocated to the covered enterprises for free based on their verified quantity of allowances; the established and newly operated covered enterprises shall meet different allocation criteria; both the grandfathering and benchmarking allocations are applicable	The compliance rate reached 98.9% in 2013 and 100% in 2014. CCER, though accepted for compliance, should be no more than 10% of the year's total allowances	The covered enterprises, before their actual annual emissions are verified by GD DRC, may not transfer over 50% of the year's free allowances in their registered account into their transaction account for trading. Neither an investment institution nor individual may hold allowances more than 3 Mmt CO_{2e}. A price rise or drop by no more than 20% is tolerated. And a price stabilizing and reserving mechanism is established
Hubei	2014.04.02	The 12 industrial sectors that consumed energy in no less than 60,000 tons of coal equivalent in any year in 2010–2012, e.g., iron and steel, chemical, and cement	In 2013: about 35% of Hubei total emissions	The allowances are calculated with the grandfathering approach and allocated for free (the allowances granted to electricity sector are based on the benchmarking principle). A review and accreditation mechanism for allowance allocation is established	During the first compliance period (ending in July 2015), Hubei-based covered enterprises fulfilled 100% compliance. CCER, though accepted for compliance, should be no more than 10% of the year's total allowances	An emission allowances trust system is built. The government reserves 8% of total allowances for guarding against market risks. No more than 30% of the allowances reserved by government are used for Price Discovery

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Table 3.1 (continued)

Location	Start date	Criteria for coverage scope	Coverage percentage in total emissions	Allocation plan	Compliance rule	Trading administration
Shenzhen	2013.06.18	Top 800 companies in rank list of industrial added value, top 4,000 electricity-consuming companies, major oil-burning companies and boiler-operating companies. These covered enterprises are defined through cross comparison guided by four principles	In 2013–2015: about 38% of Shenzhen total emissions	The allowances are allocated for free. The covered enterprises will, through competition, receive 3 years' allowances in a one-time manner	The compliance rate reached 99.2% in 2013 and 99.7% in 2014. CCER, though accepted for compliance, should not be above 10% of the companies' actual emissions in the previous compliance period	Carry out the systems for full-amount trading, restricting price rise/drop and maximum allowances holding, big emitters' reporting, mandatory reduction of allowances holding, supervising block trade, monitoring abnormal conditions, risk warning, risk disposal fund, and important customer information disclosure

Source 1. *Interim Measures for the Administration of Carbon Emission Permit Trading*, *Carbon Emissions Trading Implementation Plan* and other relevant policies and documents issued by local governments, or posted on the websites of local carbon emissions exchanges

2. Pang et al. [1]

3. Wang et al. [2]

five aspects[1]: coverage scope, allowances cap, allocation plan, transaction administration, and compliance mechanism.

With respect to coverage scope, China (Shenzhen) Emission Exchange (CEEX) has the widest coverage scope. In addition to the industrial and construction sectors, CEEX has taken the public transportation into its ETS. In terms of total allowances, Guangdong ranks first among seven pilots in 2013 and 2014, respectively, reaching 388 and 408 Million ton CO_2, accounting for around 50% of the aggregated allowances of all pilots ETS. Moreover, Guangdong exerted the policy of auction to distribute the allowances first. In terms of carbon market vitality, China Hubei Emission Exchange is a pioneer in carbon financing innovation and allowances transaction. As of October 30, 2015, Hubei Emission Exchange had traded 23.71 MmtCO_{2e}, receiving turnover of 570 mln yuan; its carbon market trading scale has ranked the first among seven pilots ETS in both trading volume and turnover; moreover, new breakthroughs were made in carbon asset pledging and inviting overseas investment.[2] While speaking of the administration of carbon emissions trading, Shanghai Environment and Energy Exchange (SEEX) and Shenzhen Emission Exchange (CEEX) are prominent examples. SEEX took the lead in coming up with an emissions accounting guideline and accounting methodology for the covered enterprises. Shenzhen—a special economic zone vested with legislative power—was the first in enacting a local decree for carbon emissions trading, which was known as the *Provisions of Carbon Emissions Administration of the Shenzhen Special Economic Zone*.

Overall, the above analysis provides us a visualized comparison between the seven carbon markets: they have the same architectural mechanism, but vary in specific rules, which may result from their different locations and policy orientations. For instance, in a region in which its economy heavily relies on the secondary industry, its ETS coverage focuses on industrial companies. A region with the sound market economy basis and mature financial environment, its ETS works hard on more elaborate administration rules. For the ETS that cares more about carbon emission reduction cost, carbon financing innovation is emphasized. In a word, each pilots ETS has its own characteristics.

[1]Currently, China's carbon trading schemes remain in the pilot period, the concerned areas have been slow in the legislation work. Despite of Shenzhen, the other six areas have been working on their *Temporary Measures for Guangdong Carbon Emissions Management*. All areas have stipulated elaborate technical specifications on Monitoring, Reporting, and Verification (MRV) of the covered enterprises. MRV is an independent factor for building the ETS, and the ETS in different areas have diversified coverage scope, so it is of limited meaning in comparing local MRV in either horizontal or vertical manner.

[2]China Hubei Emission Exchange. Hubei Carbon Market Watch (Oct. 2017) [EB/OL]. http://www.hbets.cn/jbXwzx/2332.htm.

3.2 The Pilot ETS in Five Municipalities

China authorized seven provinces/municipalities to carry out the ETS pilot program. Owing to different administrative levels, the municipal and provincial ETS take account of different factors in system design. They are introduced successively in Sects. 3.2 and 3.3.

3.2.1 Beijing Pilot ETS

Beijing Pilot Carbon Emissions Trading Scheme (briefed as "Beijing pilot ETS") covered CO_2 emissions from all fixed installations within the administrative jurisdiction of this municipality.

(1) Content and procedures of administration

During the pilot period, Beijing pilot ETS constraints covered the following emitters within the administrative jurisdiction of Beijing Municipality: direct CO_2 emissions from the fossil fuel combustion of fixed installations, industrial production process, waste disposal, etc., as well as indirect CO_2 emissions from electricity consumption of fixed installations [3]. Two categories of companies fall into the regulation of Beijing pilot ETS: covered enterprises and reporting companies. The covered enterprises refer to the key emitters with annual total CO_2 emissions (direct and indirect) at or above 10,000 tons; they are obliged to control their CO_2 emissions during the compliance period, which is called as the covered enterprises. The reporting companies, with annual comprehensive energy consumption at or above 2000 tons of standard coal equivalent but below 10,000 tons, voluntarily receive ETS regulation (in reference to the regulation upon key emitters) and report their emissions during the compliance period to the ETS administrator.

The covered enterprises shall, before each April 5 during the pilot period, submit a hard-copy emissions report and verification report to the ETS municipal administrator, which will carry out review and spot check of the two reports. The administrator shall also introduce measures for the administration of the verifier, lay down requirements for the verifier's recording conditions and monitoring duties, and exercise dynamic administration of the verifier through an on-site inspection or irregular spot check.

On September 1, 2014, Beijing Municipal Government released the *Beijing Carbon Emissions Offset Administration Measures* (*for trial*), which authorizes the covered enterprises use CCERs, emission reductions from energy-saving projects and from forestry carbon sequestration projects to offset part of their CO_2 emissions. According to the measures, 1 ton of verified emission reductions in carbon dioxide equivalent is able to offset 1 ton of CO_2 emissions; and the offsets may not be above 5% of the year's allocated allowances. There are elaborate provisions on the proportion of the offsets from CCERs, emission reductions from energy-saving

projects and from forestry carbon sequestration projects. For instance, the CCERs from any offset project outside Beijing may not be more than 2.5% of the year's allocated allowances; the CCERs from Beijing-based offset projects shall be over 50%; and the western region-based offset projects are the first choice when looking for nonlocal offsets.

The reporting companies shall deliver the reports on their last year's emissions to the Beijing ETS administrator in the first quarter (no later than March 20) of each year since 2014. The covered enterprises shall fulfill their compliance in the second quarter (no later than end of June) of each year since 2014: specifically, the covered enterprises shall deliver a verification report, apply for additional allowances for last year's newly added facilities and for allowances adjustment before April 5; their application will be approved before April 30; the current year's allowances to the established facilities shall be allocated before June 30; the covered enterprises shall fulfill their compliance (paying off last year's allowances) before June 15.

(2) Reward and penalty mechanism

In accordance with Beijing municipal laws, any covered enterprises that fail to perform their obligations as reporting, monitoring, or verification will be punished. Beijing imposes harsher punishments upon the violators, i.e., a fine that is 3–5 times more than the market average carbon price will be imposed on the overdue emission part of allowances. In order to ensure administrative enforcement of law, Beijing specially provided for the *Provisions on Standardizing Administrative Penalty Discretion over Carbon Emissions Trading* (No. 1 [2014] BJ DRC), which was the first one in doing so among the seven pilot carbon markets.

In order to guard against any potential market manipulation, Beijing pilot ETS is equipped with two firewalls as control of emission allowances inventory and trading price.

(i) Restrict overly stocking up

For the covered enterprises, their maximum allowances inventory may not be over the sum of its annual allowances and 1 million tCO_{2e}. For the reporting companies, their maximum allowances inventory may not be over 1 million tCO_{2e}. For any natural person that intends to join in emission allowances trading, their maximum allowances inventory may not be over 50,000 tCO_{2e}.

(ii) Price early warning

In order to regulate market activity, Beijing Development and Reform Commission (BJ DRC) conducts open market operation through allowances auction mechanism or buyback. No more than 5% of the year's total allowances are reserved for auction. If the daily weighted average price for the allowances is above 150 yuan/tCO_{2e} for 10 consecutive days, BJ DRC will organize interim allowances auction to keep down carbon prices. In case such price is below 20 yuan/tCO_{2e} for 10 days in a row, BJ DRC shall, through negotiations with the municipal finance department and financial supervision administration, decide whether to buyback the

allowances, and the buyback quantity, price, and approach, and then send the repurchase instruction to Beijing Climate Change Research Center (BCRC).

(3) Cross-regional cooperation mechanism

In mid-December 2014, Beijing Municipal Development and Reform Commission, in collaboration with Hebei Provincial Development and Reform Commission and Chengde[3] Municipal Government, released the *Notice on the Matters about Promoting Cross-regional Pilot ETS Program* (No. 2645 [2014] BJ DRC), marking an official start of the Beijing–Hebei joint carbon market. As a result, both the offsets projects in Beijing and Hebei are recognized by Beijing ETS.

The Beijing–Hebei joint carbon market is the first cross-regional emission reduction endeavor in China. The covered enterprises in Chengde City of Hebei province will be treated equally by Beijing ETS. Other qualified institutions and natural persons in Chengde are allowed to trade in Beijing ETS. Chengde-based offset projects as valid as those in Beijing. Moreover, Beijing–Hebei joint carbon market gives priority to developing forestry carbon sink. On September 24, 2014, Shunyi Forestry Carbon Sequestration Project (Phase 1) was listed on the website for trading in CBEEX. It is part of the plain forestation project launched by Beijing Shunyi District Landscape and Forestry Bureau. The project, which covers an afforested area of 9452.2 mu (630 ha)[4] within Shunyi District, pre-issued offsets of 1995 tCO_2. On December 30, Chengde City Fengning County Qiansongba Forestry Carbon Sequestration Project (phase 1)—the first offset project that crosses Beijing and Hebei—was listed for trading in CBEEX; it sold offsets of 3450 tCO_2 and received turnover of 131,000 yuan on the same day. As of January 16, 2015, this project had accumulatively sold offsets of 15,000 tCO_2, and earned a total turnover of more than 570,000 yuan (averaging at 38 yuan/t), proving that Beijing and Hebei achieved success in cross-regional eco-compensation through a market-oriented approach.

3.2.2 Tianjin ETS

In 2013, Tianjin Municipal Government issued the *Implementation Plan for Carrying out the Work for Tianjin Pilot Carbon Emissions Trading Scheme* and the *Temporary Measures for Tianjin Carbon Emissions Administration*, which lay out specific instructions for carrying out the ETS pilot work in Tianjin [4]. These two documents explicitly announce that Tianjin will establish the Cap-and-Trade (CAT) system and the CAT-based emissions trading scheme, key CO_2 emitting sources reporting system and emissions verification system. On December 24,

[3]Chengde is one of the cities in Hebei Province and a northeastern city in China. Chengde borders on Beijing at the southwest.

[4]1 ha = 15 mu.

2013, Tianjin Development and Reform Commission (TJ DRC) released the *Notice on Carrying out the Work of Carbon Emission Trading Pilot Program*, which requires the relevant institutions to do a good job in emissions monitoring, report delivery, emissions, and allowances administration, together with such appendixes as the industrial emissions accounting and reporting instruction, allowances allocation plan and registration system operations guide.

(1) Content and procedures of administration

In light of China's *Standard Industrial Classification* (SIC) and the statistics about the key energy consumers since 2009, Tianjin ETS regulates five major emitting industrial sectors as iron and steel, chemical, electricity and heat, petrochemical, oil and gas recovery, as well as the civilian construction companies with annual emissions above 20,000 tCO_2. Based on the emissions verification results, Tianjin selected 114 companies as the covered enterprises among the above five sectors, their combined annual emissions account for 50–60% of Tianjin total, which also proves that Tianjin GHGs emissions are relatively concentrated. During the pilot period, the GHG regulated by Tianjin ETS will be carbon dioxide.

In light of the *Temporary Measures for Tianjin Carbon Emissions Administration*, Tianjin ETS will mainly rely on free allowances allocation, which is supplemented by allowances transaction (auction or sales at a fixed price). The funds that are generated from allowances trading will be spent for special purposes, like the work for controlling GHGs emissions.

(i) Allowances administration

In December 2013, Tianjin made public the *Allowances Allocation Plan for the covered enterprises under Tianjin Carbon Emissions Trading Scheme (for trial)*, which proposes to allocate allowances by following the Grandfathering and Benchmarking principles, and take account of the companies' annual emissions reduction targets, competitiveness, energy-use efficiency, reduction efforts before joining the ETS, and industrial baseline emissions.

According to the provisions of Tianjin pilot ETS, the covered enterprises may transfer their annual allowances into the following year of compliance until May 31, 2016. If the covered enterprises dissolve, close down, or move out of Tianjin, they shall clear the allowances that are equal to their actual CO_2 emissions during their operation in the year of compliance, and turn over the year's remaining free

allowances. In case any company is incorporated into the covered enterprises, the former shall inherit the latter's allowances and corresponding rights and duties. In case a regulated company is divided, it shall draw up a plan for dividing its allowances and obligations, and submit the plan to Tianjin Development and Reform Commission, and then re-register for amended allowances.

In case any change occurs in the covered enterprises' organizational structure owing to incorporation, division, or dissolution, they shall submit the relevant materials and documents to the competent department to explain such change, the department shall study the reasons for such change and then decide to either transfer or recover the allowances granted to these companies.

In terms of the validity period of the allowances, the covered enterprises may carry forward their non-canceled allowances to the following year of compliance until May 31, 2016. After that, the validity period of the allowances is subject to the relevant state regulations.

Tianjin Climate Exchange (TCE) trades emission allowances by means of online trade, contractual trade, and auction-based trade. In online trade, the object of the transaction is the emission allowances coded as TJEA; the transaction volume is in a unit of 10 tons or an integral multiple of 10 tons, and the minimum offer price is in the unit price of RMB (yuan)/tCO_2, with the minimum price movement at 0.01 yuan/tCO_2. The trading system acts in accordance with the principle of "price-time priority". Besides, in order to control trading risks, TCE has established the full-amount settlement system, price limit system, large trader reporting system, position limit system, risk early-warning system, risk reserve system, and auditing system. The price fluctuation rate may not be above 10%. TCE has specially set a risk control division to improve the internal administration, safeguard the interests of investors, and ensure safe and steady performance the of carbon market.

(2) Carbon offsetting

The covered enterprises under Tianjin ETS are allowed to use a prescribed proportion of CCERs to offset their emissions, i.e., the offsets may not be more than 10% of their actual emissions in the year. One CCER is to offset 1 ton of CO_2 emission, and the CCERs may come from any project, any area, or region. On March 24, 2015, Tianjin Tianfeng Steel Co., Ltd. and China Carbon Futures (Beijing) Asset Management Co., Ltd. made the first deal to purchase 60,000 tons of CCERs through TCE online trading.

(3) Characteristics of Tianjin ETS

As compared with other pilot schemes, Tianjin ETS registration takes on two characteristics: (i) it recommends three options for allowances clarify, i.e., compliance clear, voluntary clear, and mandatory clear. The compliance clarify is an action for the covered enterprises to fulfill their emissions reduction commitment. The voluntary cancelation is an option limited to nongovernment users. In terms of mandatory clarification, the competent department may cancel the allowances account of the covered enterprises if it fails to fulfill the reduction commitment,

until its allowance account is empty. Both compliance and voluntary clarify are carried out by the covered enterprises on their own, while the mandatory clarify is operated by the ETS system administrator authorized by the government.

(ii) The allowances shall be transferred from register account to transaction account before the transaction. Such design is to mitigate risks from misoperation.

3.2.3 Shanghai ETS

After the NDRC announced to carry out the pilot ETS pilot program, Shanghai Municipal Government spent some time on preparation, and then issued its ETS implementation plan and opinions [5], which explicitly clarify the guiding principles, crucial factors, job schedule, and so on.

(1) Content and procedures of administration

When choosing the industries that covered by the ETS regulation, each pilot area takes account of the local economic development level and the demand for industry transition in the future. Take Shanghai for instance, since it is now at the transitional stage of post industrialization, it not only regulates the CO_2 emissions from industrial sectors (iron and steel, petrochemical, chemical, nonferrous, electricity, building materials, textile, paper, rubber and chemical fiber, etc.), but from non-industrial sectors (aviation, port, airport, commerce, hotel, finance, etc.).

With respect to the ETS participants, Shanghai Environment and Energy Exchange (SEEX) only allowed the covered enterprises to join in the trade at the opening stage. Since September 2014, after SEEX issued the *Measures for the Carbon Trading Market to Implement the Institutional Investor Eligibility System (for trial)*, and the *Account Opening Guide for Institutional Investors*, Shanghai ETS was officially open to common institutional investors.

As for allowances calculation, most pilot areas comply with the Grandfathering Principle (in reference to local industrial characteristics and historical emissions), which is supplemented by the Benchmarking Principle. Shanghai ETS adopts the Benchmarking Principle widely in such sectors as electricity, aviation, port, and airport. Hubei chooses the Grandfathering Principle, but switches to the Benchmarking Principle for computing additional allowances to electricity companies.

As for allowances allocation, Shanghai allocates most of the allowances for free, but the government usually reserves a certain proportion of allowances for auction in order to help companies' compliance or tackle with abnormal market phenomena.

Table 3.2 Shanghai ETS reward and penalty rules

Allowances adjustment	Review the validation mechanism and the provisions for the covered enterprises' closure or removal
Risk control	Establish the price limit system (the price fluctuation rate be no more than 30%), position limit system and risk reserve system
Default penalty	Urge the covered enterprises to pay off their allowances, and concurrently impose a fine of no less than 50,000 yuan but no more than 100,000 yuan

(2) Carbon offsetting

The covered enterprises under Shanghai ETS may use the CCERs to offset 5% of their total allowances or trade such as CCERs on the trading administration platform. The trading administration platform is made up of the registration system, transaction platform, and MRV platform. All trading activities are held in Shanghai Environment and Energy Exchange (SEEX). As for the policy documents, SEEX has unveiled not only elaborate transaction rules, but detailed requirements for member administration, transaction settlement, information management, etc.

(3) Reward and penalty mechanism

SEEX has set several supplementary mechanisms like allowances adjustment, risk control, and default penalty, in an aim to handle any special or abnormal market phenomena (Table 3.2).

3.2.4 Chongqing ETS

The emitting sources in Chongqing are unevenly distributed, i.e., the emissions from the central urban area are relatively higher, while the emissions from the county area are much lower. Such factor shall be taken into account for building the ETS in Chongqing.

(1) Content and procedures of administration

Chongqing ETS is the only one of the reducing GHG emissions in total but not the intensity reduction differed from the rest six pilots ETS, with the benchmarking allocation as a supplement. Both emissions offsetting and banking are acceptable.

When choosing the covered enterprises for Chongqing ETS, several key conditions are taken into account, i.e., energy-use efficiency, large-sized companies with emissions reduction potentials or large-sized companies in rectification industries. Chongqing ETS regulates the industrial companies with annual CO_2 emissions above 20,000 tCO_{2e} in any year in 2008–2012 (based on the energy consumption of more than 10,000 tce), including such sectors as electricity, metallurgy, chemical, and building materials. Six types of GHGs (CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6) are subject to the regulation [6].

The competent department allocates free allowances to the covered enterprises, but the amount of allowances for the existing emitter differs from that for newly emitter, time boundary point is on December 31, 2010. In the case of carbon emissions from the existing emitter, the baseline allowances are the maximum annual emissions over 2008–2010, then decrease year by year since 2011. In case of the newly emitter, the baseline allowances are the maximum annual emissions of the past 3 years before joining the ETS, then decrease year by year. All the annual allowances before 2015 are allocated all at once.

Chongqing ETS has two types of the allowance allocation, the allowances granted to the existing emitter are different from the newly emitter. For the covered enterprises with existing emitter, Chongqing ETS sets a strict cap based on their history emissions; for the covered enterprises with newly emitter, the allocation proposal is in line with their baseline emissions.

Chongqing ETS market trades allowances, CCERs, and other eligible products authorized by the Chinese central government, which are quantified in the unit of tCO_{2e} and priced in the unit of yuan/tCO_{2e}. The difference between Chongqing ETS and other pilot areas is that the former limits the amount of annual tradable allowances, which may not be more than 50% of the annual free allocated allowances.

(2) Carbon offsetting

Chongqing ETS recognizes such flexible mechanisms as offsetting and banking. The covered enterprises may use the emissions reductions from local offset projects (e.g., carbon sequestration), which are outside of the coverage scope for offsetting part of their emissions, and the offsets may not be more than 8% of the total allowances for each compliance period. The offset projects shall start operation after December 31, 2010 (excluding carbon sequestration projects) and fall into one of the following categories: energy saving and higher energy-use efficiency, using clean energy and non-hydro renewable energy, carbon sequestration, energy-based activities, industrial production process, agriculture, and waste disposal. The allowances are available for banking, i.e., the covered enterprises may transfer the surplus allowances in the current compliance period to the next period.

In contrast to other pilot areas, Chongqing ETS has its own requirements for the offsetting mechanism: (i) the acceptable CCER offsets are no more than 8%, which lies at the middle level among the seven pilot areas. (ii) Nonlocal offset projects are also recognized. (iii) Chongqing set restrictions on the operation time, project type, and location of the projects that contribute CCERs. The above requirements reflect that Chongqing ETS competent department pays great attention to CCER, which could be interpreted as a stance to motivate more and more local companies to join in clean energy industries.

Chongqing is the only pilot area that permits offsets can be used just in the condition of existing allowances gap, which implies that if the total allowances and allowances allocation remain unchanged, there is no allowances gap, the usage of CCER will not be allowed. It should be noted that Chongqing does not recognize

hydropower projects as CCER sources. The above regulations will enable Chongqing carbon market to become a de facto single allowances market.

(3) Reward and penalty mechanism

In order to incentivize the covered enterprises to fulfill their emissions reduction targets, Chongqing gives priority to supporting these companies to improve emissions administration; support them undertake such projects subsidized by the Central Government budget, e.g., the comprehensive demonstration of fiscal policies to promote energy conservation and emissions reduction, as well as resource saving and environmental protection; the municipal special funds for energy conservation and emissions reduction shall be first diverted to the covered enterprises; encourage financial agencies to provide green financing services to the covered enterprises.

In terms of penalty, the *Decisions on the Matters about Carbon Emissions Administration of Chongqing Municipality (Exposure Draft)* state that if any covered enterprises failed to deliver emissions report or rejects verification according to the ETS regulation rules, the competent department shall order it to make corrections within a definite time; otherwise, it shall be fined by 20,000–50,000 yuan. In case any regulated company refuse to pay off the allowances or underperforms such obligation, the competent department shall, in reference to the emissions that are beyond the allowances, impose a fine that is three times more than the average allowances trading price in the month ahead of the compliance deadline. If a third-party verification agency is found to issue a false verification report, the competent department shall impose a fine of 30,000–50,000 yuan to the unqualified agency.

3.2.5 Shenzhen ETS

The economy of Shenzhen relies on the tertiary industry, the major CO_2 emitters refer to the industrial, construction, and transportation sectors, Shenzhen ETS covered 635 industrial companies and 194 public buildings, they can be divided into three categories in light of their industrial property: (i) there are 13 public institutions which produce and supply of water, natural gas, and electricity. (ii) There are 15 large-scale enterprise groups with high output value, e.g., Huawei Technologies, Zhongxing Telecommunication Equipment (ZTE), and Foxconn. (iii) Other manufacturing companies. The covered enterprises in the construction sector are made up of the government office administrations, public buildings with sole proprietorship, and property management companies [7 and 8].

(1) Content and procedures of administration

In light of the *Implementation Plan for Carrying out the Work for Shenzhen Pilot Carbon Emissions Trade Scheme* issued by Shenzhen Government, the

industries/institutions that are covered by Shenzhen ETS shall satisfy the following criteria: (i) The companies/public institutions with annual emissions above 5000 tCO_{2e}. (ii) The large public buildings with a floor area above 20,000 m^2 or the government office buildings with a floor area above 10,000 m^2. (iii) Other companies, public institutions, or buildings that apply to join in the ETS voluntarily and receive approval by the competent department. The covered emission of Shenzhen ETS accounted for 38% of Shenzhen's total emissions in 2010.

(i) Allowances setting

Shenzhen ETS adopts the combination approaches of the top-down and bottom-up method to set the total amount of allowances in reference to Shenzhen's emissions reduction targets, GDP growth predictions, and emissions reduction potentials of industrial sectors.

Shenzhen sets a cap based the consideration both of total amount of emission control and on emissions intensity. To set the allowances for the covered enterprises in light of the expecting emission intensity reduction targets and anticipated output, it is favorable for adjusting the allowances to deal with any drastic economic fluctuation. However, such an approach complicates the operation of the carbon trading system, and increases management cost upon the competent department and the covered enterprises.

(ii) Allowances allocation [9]

Shenzhen ETS allowances are based on free allocation and paid allocation, the latter is achieved through auction or fixed-price sales.

With respect to the allowances allocation system, Shenzhen ETS prefers pre-allocation that computes and adjusts the allowances based on the IAV of the covered enterprises. In order to guarantee the fairness and rationality of allowances allocation, Shenzhen ETS pre-allocates the allowances to the industrial sectors that abide by the Benchmarking Allocation, i.e., in light of the allocation criteria, allocate the free allowances to the covered enterprises in advance, when the companies' actual emissions have been verified, the competent department shall, in reference to the verification results

With respect to the allocation methodology, Shenzhen ETS allocates the allowances based on the Benchmarking Principle. For a sector with a single product, the pre-allocated allowances are the companies' carbon intensity target multiplied by their anticipated output. For a sector with nonsingle product, the pre-allocated allowances are the companies' carbon intensity target multiplied by IAV.

In order to define the carbon intensity target of an individual company, Shenzhen proposes an allowances allocation mechanism based on the theory of Bounded Rationality in Repeated Games, i.e., categorize the companies with similar industry type, product type, and business scale into the same group, the government sets a cap on the total allowances granted to different groups, then ask the companies of the same group to report their 2013–2015 emissions and IAV targets concurrently

via a game software; the allowances will be auto computed and pre-allocated to them based on default rules. If the companies refuse to accept the outcome, they may repeat the above process again and again until they cease altering the emissions and IAV data for reporting. At that time, multiply the emissions by IAV (ultimately accepted by the companies), the outcome will be the companies' carbon intensity target. Such methodology increases proactivity of the companies in allowances allocation, improves administration efficiency, introduces human intervention in allowances allocation which may guard against such malpractice as power rent-seeking. However, such methodology is quite complicated, the categorization of the company calls for massive basic data, the loss or inaccuracy of the basic data (e.g., IAV) will hold back application of such methodology.

(iii) Allowances administration

Under the framework of Shenzhen ETS, each compliance period for the covered enterprises is 1 calendar year; the allowances surplus in the previous year may be banked for use in the coming year. Shenzhen ETS grants the allowances for 3 years at one time, so it especially provides that the allowances issued for the coming year may not be used for the previous year's compliance (Table 3.3).

(2) Carbon offsetting

Shenzhen ETS allows the covered enterprises to use the CCERs to offset no more than 10% of their emissions. See, Shenzhen ETS provisions on the offset proportion and project type in Table 3.4.

Table 3.3 Characteristics of Shenzhen ETS allowances administration

Allowances banking	The allowances left from the previous year are banked for use in the coming year
Allowances loaning	The allowances issued for the coming year may not be used for previous year's compliance
Allowances shortage	Make up the shortage before May 30 each year
Allowances surplus	When the covered enterprises move out, announce bankruptcy or dissolution, if the pre-allocated allowances are more than 50% of their fulfilled compliance obligation, such allowances shall be recovered by the competent department; otherwise, the surplus allowances are disposed of by the covered enterprises
Allowances buyback	The allowances bought back by the competent department every year may not be more than 10% of the year's valid allowances
Allowances use	The covered enterprises are entitled to assign or pledge their allowances in accordance with law
Allowances adjustment	Based on the covered enterprises' actual output (the sector with the single product) or IAV (manufacturing sector) in the previous year, confirm their actual allowances, then supplement or deduct the pre-allocated allowances
Allowances settlement	Each calendar year

Table 3.4 Shenzhen ETS carbon offsetting mechanism

General guideline	If the CCERs are generated by the covered enterprises/institutions within their permissible emissions scope, such CCERs may not offset their emissions
Acceptable CCER proportion	The CCER offsets may not be higher than 10% of the covered company's actual emissions in the previous year
Valid CCER offset projects	The valid offset projects for Shenzhen carbon market fall into five categories: renewable energy and new energy (wind power, solar energy generation, waste incineration power generation, rural household biogas, and biomass power generation), clean transportation, marine ecosystem carbon sequestration, forestry sequestration, agricultural emissions reduction

Table 3.5 Shenzhen ETS reward and penalty mechanism

Reward for compliance	The covered enterprises shall strictly abide by the administration rules; any company that achieves greater reduction results will be commended or rewarded by Shenzhen Municipal Government
Fines for noncompliance	The concerned company will be imposed a fine that is three times more than the average market price for the portion of extra emissions; with financial subsidy abolished and in ccessible to any municipal financial assistance within 5 years
Bad credit rating	Access to the social credit management system and make public the noncompliance companies
Implementation	Four noncompliance companies were strictly sanctioned in 2013

(3) Reward and penalty mechanism

Shenzhen ETS has worked out strict and elaborate rules to punish any violation or noncompliance of the covered enterprises and institutions by a heavy fine and a bad credit rating. In contrast to other ETS pilot areas, Shenzhen stresses financial penalties which are fairly deterrent, if the concerned companies will be fined for extra emissions, their financial assistance will be ceased. For instance, four covered enterprises failed to fulfill their obligations on time during the 2013 compliance period, the competent department, in light of the *Interim Measures for the Administration of Shenzhen Carbon Emissions Trading*, report their noncompliance to the corporate social credit administration and the financial credit management agency, made public the names of these companies in line with relevant regulations, and reported their noncompliance to the financial department which ceased their financial assistance (Table 3.5).

3.3 Introduction to the Pilot ETS in Two Provinces

Hubei and Guangdong are the only provinces of ETS among the seven ETS pilot areas. Hubei lies in central China, while Guangdong is located in the south. They are different from each other in economic development level, industrial structure,

CO_2 emissions level, and social low-carbon awareness. Meanwhile, they share such common features as uneven local economic growth, arduous emissions reduction task, complete industrial structure, and great disparity in emissions structure. In a word, the ETS pilot work in Hubei and Guangdong is fairly representative.

3.3.1 Hubei ETS

Hubei is a major province in central China, covering an area of 185,900 km^2. It contributed a GDP of 2.95 trillion yuan in 2015, the permanent population reached 58.52 million at 2015 end, and the year's energy consumption totaled 164.04 Mtce [10]. Hubei is now at the fast-growth track. After the NDRC announced to involve Hubei in the ETS pilot program, the province specially made some preparations, and then the Provincial Government issued the *Implementation Plan for Carrying out the Work for Hubei Pilot Carbon Emissions Trade Scheme*, which explicitly provides for the main principles, essential elements, and work progress for carbon trading. Before the carbon market was officially open to business, a government directive was issued to introduce the interim measures for carbon trading administration, which will support the implementation of the ETS pilot program.

(1) Content and procedures of administration

Regulated industrial sectors: Hubei is now at the phase of rapid industrialization, the major emitters under the ETS regulation are mostly the industrial sectors.

Allowances calculation: Most pilot areas adopt the Grandfathering Principle that relies on the characteristics and historical emissions of industrial sectors, the Benchmark calculation is only a supplement. Hubei ETS also gives priority to the Grandfathering Principle, while the new electricity plants abide by the Benchmark principles. Most of the allowances are allocated for free, yet the competent department may reserve a certain proportion of allowances for auction (to assist companies in their compliance) or deal with any abnormal market situations. In light of the *Hubei ETS Allowances Allocation Plan*, the allowances reserved by the government shall be no more than 8% of the total allowances; no more than 30% of the allowances reserved by the government are used for carbon price discovery; any non-tradable allowances surplus or reserved allowances surplus shall be revoked.

Carbon market participants: The covered enterprises, and the legal person institutions, other organizations and individuals that join in the ETS voluntarily (Table 3.6).

(2) Carbon market performance

By the end of March 2015, China Hubei Emission Exchange (CHEX) had been in operation for almost 1 year, finishing more than 230 dealing days. Its total trading volume occupied about 43% of the aggregate trading volume of the seven

Table 3.6 Characteristics of Hubei ETS design

Start date	April 2, 2014
Criteria for covered enterprises	The industrial companies with comprehensive energy consumption at or above 60,000 tce in either 2010 or 2011
Regulated industrial sectors	Twelve industrial sectors, e.g., electricity, iron & steel, cement, chemical
Allowances calculation	Both Grandfathering and Benchmarking Principles are applicable to electricity sector. The Grandfathering Principle is followed by all the other sectors
Allocation approach	Free allocation. The initial allowances for a compliance period are allocated to the covered enterprises (after registration) at one time
Allowances administration	The total allowances are made up of the allowances to established companies, the allowances to newly operated companies and those reserved by government The allowances reserved by government shall be no more than 8% of the total allowances. No more than 30% of the allowances reserved by government are used for price discovery
Deadline of compliance period	The last workday of each May
Main body	The covered enterprises, and the legal person institutions, other organizations and individuals that join in the ETS voluntarily
CCER	10%

pilot carbon markets, and the total turnover was about 30% of the gross turnover of the seven markets.

In contrast to Shanghai Environment and Energy Exchange, CHEX encountered robust transactions shortly after it was open to business, then the trading activities gradually cooled down and become stable, but showed drastic fluctuations as approaching the end of 2014. In reference to such characteristic developments, the operation of CHEX could be split into three phases: (i) Phase 1: from April to July 2014. (ii) Phase 2: from August to November 2014. (iii) Phase 3: from December 2014 to March 2015. The trading share in these three phases accounted for 59.4, 14.9 and 25.6% of CHEX total trading volume, respectively.

The strike price in CHEX has been lower than the other six carbon markets. From the opening in April 2014 to the end of March 2015, CHEX reported an average striking price at 24 yuan/tce, which was fluctuating moderately from 22 to 26 yuan/tce.

(3) Reward and penalty mechanism

China Hubei Emission Exchange has set several supplementary mechanisms like allowances adjustment, risk control, and default penalty, in an aim to handle any special or abnormal market phenomena (Table 3.7).

Table 3.7 Hubei ETS reward and penalty rules

Allowances adjustment	Review the validation mechanism and the provisions for covered enterprises' closure or removal
Risk control	The government reserves 8% of the total allowances
Default penalty	Impose a fine that is 1–3 times (no more than 150,000 yuan) on the current year's average carbon price upon the extra emissions. Double quota deduction for the part of over emission in the next year's allowances

3.3.2 Guangdong ETS

Guangdong is located at the southernmost tip of China's mainland, covering an area of 179,700 km^2. Guangdong is China's most developed province, it contributed a GDP of 7.28 trillion yuan in 2015, the permanent population reached 108 million at 2015 end, and the year's final energy consumption totaled 256.62 Mtce. Guangdong is now at the mid-to-late phase of industrialization, the tertiary industry accounted for 50% of the provincial GDP; it is an example for the other developed regions in China.

In terms of Guangdong ETS, its system design and operational experiences are worthy of learning and popularizing, its institutional organization and administrative accountability have offered inspirations and references for carbon emissions reduction. Therefore, an all-round interpretation of Guangdong ETS and the pilot program in other areas is of far-reaching impact on pressing ahead with the construction of a nationwide unified carbon market.

(1) Content and procedures of administration

The CO_2 emissions in Guangdong mainly come from industry and manufacturing, therefore, industrial sectors become the foremost regulated objects. The electricity, cement, iron, and steel and petrochemical sectors came under Guangdong ETS regulation in the first compliance period.

In light of the *Implementation Plan for Carrying out the Work for Guangdong Pilot Carbon Emissions Trade Scheme* issued in 2012 [11], all the industrial companies, which are located within the administrative areas of Guangdong, emitted CO_2 at or above 10,000 t (or consumed comprehensive energy at 5000 tce) in any year over 2011–2014 are defined as "reporting companies", i.e., they do not take allowances administration or join in allowances trading, but report their emissions to the government every year. The industrial companies, which are located within the administrative areas of Guangdong, emitted CO_2 at or above 20,000 t (or consumed comprehensive energy at 10,000 tce) in any year over 2011–2014 are "covered enterprises", which are distributed in electricity, cement, iron and steel, ceramics, petrochemical, textile, plastics, paper sectors, etc. In 2013, the electricity, cement, iron and steel, and petrochemical sectors were first came into the

ETS regulation, their CO_2 emissions in the year accounted for around 60% in Guangdong total emissions.

With respect to the allowances allocation system, Guangdong ETS integrates both free allocation and paid allocation; the latter is achieved through auction or fixed-price sales. Guangdong ETS prefers pre-allocation that computes and adjusts the allowances based on the actual production of the covered enterprises. In order to guarantee the fairness and rationality of allowances allocation, Guangdong ETS pre-allocates the allowances to the industrial sectors that abide by the Benchmarking Allocation, i.e., in light of the allocation criteria, allocate the free allowances to the account of the covered enterprises, when the companies' actual emissions have been verified, the competent department shall withdraw or give more allowance according to the allocation standard.

With respect to the allocation methodology, Guangdong ETS allocates the allowances based on the Benchmarking Principle; make the average emissions intensity of industries as the baseline, then raise the baseline year by year through the annual reduction factor, so as to tighten up total allowances and drive companies to cut emissions. Since Guangdong ETS total amount of allowances and allocation plan are open and transparent, such methodology may provide an explicit and stable anticipation to the companies.

Under the framework of Guangdong ETS, each compliance period for the covered enterprises is 1 calendar year; the allowances surplus in the previous year may be banked for use in the coming year (Table 3.8).

Table 3.8 Characteristics of Guangdong ETS allowances administration [12–14]

Allowances banking	The allowances left from the previous year are banked for use in the coming year
Allowances loaning	N/A
Allowances shortage	Make up the shortage before June 30 each year
Allowances surplus	If the covered enterprises intend to shut down or move out, they shall, before completing the relevant formalities, settle the allowances based on their actual and verified emissions in the year; the free allocations for the non-production months (the operation rate in the month is below 50%) will be recovered by the GD DRC. The allowances surplus are disposed by the covered enterprises
Allowances purchase	The newly comer enterprises shall purchase full-amount allowances according to the estimated emission at the bidding platform
Allowances use	Before the GD DRC verifies their annual emissions, the covered enterprises may not transfer over 50% of the year's free allowances in their registered account into their transaction account for trading
Allowances adjustment	The actual allowances based on the covered enterprises' actual output in the previous year, then supplement or deduct the pre-allocated allowances. The companies whose production is above their capacity by no more than 30% are recognized according to the relevant regulations
Allowances settlement	Each calendar year

(2) Carbon offsetting

Guangdong ETS allows the covered enterprises to use CCERS (no more than 10% of the year's total allowances) to offset their emissions. See the characteristics of Guangdong carbon offsetting mechanism in Table 3.9.

(3) Reward and penalty mechanism

Guangdong ETS has worked out elaborate provisions on reward and penalty of the covered enterprises and verification institutions. Guangdong ETS usually executes the penalty by imposing fines and lowering credit rating (Table 3.10).

Table 3.9 Guangdong ETS carbon offsetting mechanism

General guideline	If the CCERs are generated by the covered enterprises/institutions within their permissible emissions scope, such CCERs may not offset their emissions
Acceptable CCER proportion	The CCER offsets may not be higher than 10% of the compliance company's actual emissions in the previous year; no less than 70 of 10%, of the CCERs shall come from the local VER projects
Valid CCER offset projects	Non-hydro electricity generation, non-fossil fuel electricity generation and heat supply (not based on coal, petroleum, or natural gas, but CBM is unconstrained), waste energy (heat, pressure, and gas) utilization Exclude the CDM projects that have generated reductions before registration at the UN CDM Executive Board
Others	The offsets from the CO_2 and CH_4 emissions reduction projects are valid, and CO_2 and CH_4 reductions shall account for more than 50% of all GHG emissions from these projects

Table 3.10 Guangdong ETS reward and penalty mechanism

Reward for compliance	The covered enterprises that, which have fulfilled their obligations, shall take the precedence to declare the government-subsided projects (incl. low-carbon emissions, energy conservation and emissions reduction, renewable energy, circular economy); shall take the precedence to government financial support
Fines for noncompliance	The unsettled allowances for the next year shall be fined by 2 times, a fine of 50,000 yuan is concurrently imposed
Penalty on credit	The noncompliance is reported to the credit management system of financial institutions and Guangdong social credit system; keep the public informed
Penalty on project	No qualify to apply new projects during the period of ETS trial

3.4 Summary

A unified China carbon market is still at the infant phase. The seven ETS pilot schemes share common ideas, but vary in details (e.g., general design, coverage scope, allowances amount, allowances allocation, offsetting, compliance mechanism, and MRV), owing to diversified political conditions, economic growth, stage of development, and industrial structure. Their similarities and existing problems are concluded as follows:

(1) Select the covered enterprises or institutions mainly based on their energy consumption;
(2) Compute total amount of allowances by combining the "top-down" and "bottom-up" methodologies;
(3) Allocate the allowances to electricity sector based on the "Benchmarking Principle";
(4) All of them have built an effective MRV system and carbon trading platform;
(5) All of them set a cap on proportion of offsets (10%), but the sources of the offsets vary among the ETS pilot areas.

Some problems exist in the current ETS pilot mechanisms:

(1) There are great uncertainties in setting the allowances cap. In terms of the "top-down" approach, it takes account of the GDP growth of the pilot area, it is an uncertain factor and not always the same with the GDP growth of the ETS regulated industries, thus injecting uncertainties into the allowances cap based on the "top-down" computation. In terms of the "bottom-up" approach, it relies on the historical emissions and reduction potentials of the covered enterprises. However, such approach is neither 100% reliable if the pilot area has a fast-developing economy and robust GDP growth, local companies are expanding their capacity year by year, and multiple new companies come into being to generate a rigid increase in emissions.
(2) An extensive coverage scope may lower the economic efficiency of the ETS pilot scheme. Different pilot areas have their own coverage scope, either big or small, some only involve large-sized companies with high emissions and high energy consumption, e.g., iron and steel, electricity, heat, metallurgy, cement, and petrochemical sectors. In contrast, other may regulate as many as 20–30 industrial sectors, including service, large public buildings, and public institutions (colleges and government agencies). During the current pilot period, the ETS coverage scope should not be too extensive, otherwise, it will inevitably increase the difficulties and costs in allowances allocation, MRV execution, and companies' compliance.
(3) The allowances allocation based on the Grandfathering Principle does not fit the ETS mechanism in the rapidly developing areas. The grandfathering allocation is based on the historical emissions of the covered enterprises, which may conflict with the demand for sustainable economic growth; and the industry prosperity cycle may alter the emissions structure, which will result in

a gap between allowances supply and demand. Take Beijing for instance, in around the base year, the iron and steel and cement sectors were sluggish, many companies halted production; but the electricity generation plants were operating at a full load, implying that more allowances shall be granted to the electricity sector. However, after the economy entered into the New Normal phase, the allowances supply–demand pattern in these sectors reversed, thus altering the production cost of the covered companies.

(4) The way of linkage between the current pilots ETS and the future national ETS shall be considered. Pilots ETS vary from each other in allowance setting, MRV rules, allocation approaches, it is hard to homogenize under the different value of allowances.

(5) The carbon market functions are fairly weak. As compared with other mature capital markets, e.g., the securities market, China's pilot carbon markets are not strongly functional, particularly weak in mobility, since it is still young and trading newborn product.

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