

Chapter 6

Guangdong Pilot ETS Allowances Allocation Mechanism



6.1 Foreign and Chinese Emission Allowance Allocation Criteria

The “cap-and-trade”-based ETS follows two principles for free allowance allocation: “Grandfathering” and “Benchmarking”, which apply to different conditions and objects [1]. Grandfathering is a free allocation based on average historical emissions of covered enterprises. It is applicable to the companies (e.g., in chemical and electronics sectors) that have a complex process, multiple categories of technologies, and a great variety of products. And, it costs much to gather their emission data. In the case of Benchmarking Allocation, the allowances are the production/value of a working procedure or a product, which is multiplied by unit emissions.

The above basic approaches give rise to several mixed allocation approaches, e.g., “Historical Benchmarking” and “Correction Benchmarking”; the former calculates the companies’ allowances based on their historical production/value and unit emissions; the latter differs from the former in a procedure for compliance period accounting, i.e., when the allowances for each compliance period are about to be settled, the competent departments will reverify the year’s allowances by taking account of the companies’ actual production/value, and following the principle of “any excess payment shall be refunded and deficiency shall be repaid.”

During the prior two trading phases of EU ETS, most Member States adopted the Grandfathering Allocation, which was replaced by the Historical Benchmarking during the third trading phase after the carbon trading system was improved and more data were accumulated. Such benchmarks are made up of product benchmark, heat benchmark, fuel mix benchmark, and process emissions benchmark (listed in order of priority). The product benchmark involves the benchmark value for 52 products in 21 sectors. The CAL ETS also applies the Historical Benchmarking, which incorporates product benchmark and energy benchmark. The product benchmark involves 28 products in 18 subsectors. With respect to China’s seven

carbon markets, they adopt Grandfathering, Historical Benchmarking, and Correction Benchmarking in light of their respective characteristics.

Grandfathering is a common allocation approach and fairly practicable, yet it seems unfair for the companies with low emissions or already enforced emission reduction measures, thus giving rise to the so-called “whipping the fast and hard-working”. Moreover, once the base year for the Grandfathering Allocation is defined, it should not be altered; otherwise, the covered enterprises may lose motivation for cutting emissions, leaving the carbon market to exist in name only. In order to incentivize the emitters to reduce emissions, the depreciation factor shall be introduced in reference to base year’s emissions, and gradually lower the emission allowances to the companies.

The definition of a base year is fairly important for both Grandfathering and Historical Benchmarking, because different base years may diversify allowance quantity and emission reduction effect, which calls for comprehensive data about the companies’ historical emissions and operation. Since these two approaches adopt static historical data, whenever there are economic fluctuations, the covered enterprises’ production and emissions may deviate greatly from their historical records, which will then cause serious surplus or deficiency of emission allowances, drastic carbon price swings, and finally impede smooth operation of the carbon market.

The Correction Benchmarking is able to avert such problem, and the companies will exempt from meeting the total allowances through reducing production based on Grandfathering. The benchmarks could be emissions from unit production and emissions from unit value.

Emissions from unit production equal to unit consumption or benchmark value, the value may be industrial benchmarks or average value, global, national, or local, the average value of the covered enterprises (or the companies in the top rank), or historical unit consumption of each company.

In light of the working procedures and diversity of products of different sectors, set a benchmark value of a working procedure (e.g., the clinker working procedure of cement sector and long-flow process in iron and steel sector), or set a benchmark value for a product (e.g., the benchmark value for the 52 products during the third trading period of EU ETS).

If there are overly many differences between companies, or there are no data accumulation about carbon emissions for unit production, emissions for unit value (e.g., the manufacturing companies involved in Shenzhen ETS). Such allocation approach presents higher requirements for carbon verification. As such, Shenzhen Carbon Emission Exchange established accounting audit for carbon verification.

6.2 Foreign and Chinese Allowance Allocation Approaches

(1) Free allocation

Free allocation is at present the most broadly applied by the world carbon emissions trading schemes at the initial phase, i.e., the government will, after setting a cap on the national or local total emissions, compute the emissions space of the covered enterprises in line with certain principles and criteria, and then grant the emissions permit to the covered enterprises for free (usually called emission allowances) to sustain their normal operation and production. It is, in fact, an instrument for directing the participants to realize low-carbon production process.

The rationale behind the free allocation is as follows: if the free allowances fail to cover the companies' actual emissions, they have to pay for additional emission permit; if the companies cut their emissions below the allowances through active reductions, they are entitled to sell the surplus allowances to gain profit. It is a common practice for the world carbon emissions trading schemes to choose free allocation at the infant phase. Take EU ETS—the world largest “cap-and-trade” system—for instance, most of the allowances were allocated for free during its prior two trading periods (2005–2007 and 2008–2012); the percentage of free allowances will go down to approximately 50% during the third period (2013–2020). Free allocation also prevails in other countries and regions, e.g., CAL ETS allocates free allowances to the industrial sector that is exposed to significant risk of carbon leakage, NZ ETS adopts the same attitude toward the forestry, fishery, and industry that are prone to be affected by international competition, as well as China's seven pilot carbon markets.¹

(2) Fixed-price sales

Allowance sales are a supplement to free allocation. The government usually sets a price for emission allowances. In case the free allowances are not enough for the covered enterprises to sustain normal production, they are able to purchase additional allowances from the government at a fixed price.

During the initial operation of EU ETS, the carbon prices experienced marked ups and downs, which is a lesson for its counterparts in other countries. For instance, AU ETS adopts a strategy of “progressive marketization”, i.e., sell the allowances at a fixed price in the first 3 years, allow price fluctuation within a permissible range in the coming 3 years, and ultimately apply market pricing, for the purpose of sending a stable price signal to meet the anticipation of all participants, give them enough time for adjustment and adaptation, or even divert funds and capital to flow into emission reduction projects. Similarly, NZ ETS specially

¹With the exception of Guangdong ETS that also adopts allowance auction, the other six pilot carbon markets mainly rely on free allocation.

arranges a transitional period, where the government sells the additional allowances at a fixed price of 25 NZ\$/t.

(3) Auction

Paid allocation of allowances is mainly realized through auction. There are a sealed auction and dynamic auction based on rounds of biddings. Currently, it is sealed auction that prevails in the current carbon markets. The dynamic auction is applicable to mature traded products, it is unable to incentivize the entrants to the newborn carbon market, because the potential bidders who are less competitive may be deterred from participating; moreover, it is possible to breed conspiracies. Such aftermath will distort the healthy price signal and allocation results.

The sealed auction is made up of uniform-price auction and discriminatory auction. In case of uniform-price auction, bid winners pay for the allowances at the uniform market-clearing price. In case of a discriminatory auction, bid winners pay for the allowances at their own bidding prices, which are diversified and above the uniform market-clearing price [2]. Uniform-price auction is easier to operate, and able to draw more bidders and promote reasonable competition. In contrast, in case of a discriminatory auction, the smaller and unsophisticated bidders are prone to think that it is hard to predict the market-clearing price, so they dare not join in the bidding for fear of false judgment. Particularly at the initial phase of the ETS, the secondary market still lacks mobility, and there are uncertainties in sending a stable price signal. Summing up, uniform-price auction is more appropriate for increasing participating companies; specifically, uniform-price sealed auction is deemed as the best option for initial allowance allocation.

EU ETS distributes more and more allowances via auction during the first three trading periods. The Member States obtain at most 5% of allowances via auction in the first period, such proportion goes up to 10% in the second period, and some sectors may receive allowances solely via auction in the third period. During the three periods, the auction-based allowances granted to different sectors are in various proportions. For instance, EU ETS distributes 100% of the allowances to electricity sector via auction by 2020, such proportion for other sectors goes up year by year to reach 70% by 2020, and ultimately reaches 100% by 2027. The US Regional Greenhouse Gas Initiative (RGGI), which has been implementing allowance auction since it was launched in 2003, is the world's first cap-and-trade system that solely relies on allowance auction.

In contrast to free allocation and fixed-price sales, allowance auction boasts lots of advantages, e.g., simplified procedure, explicit rules, clear-cut targets, fair, and cost-effective, which are fit for exploring authentic prices for emission credits. Allowance auction is able to motivate the companies to cut emissions more actively, create a fairly competitive environment for the new entrants, promote the application of the latest production technologies, and ultimately increase energy-use efficiency and lower emissions. Furthermore, the government may use the gains from allowance auction to sponsor the emission reductions in underdeveloped areas, foster R&D, and

application of clean technologies, or subsidize the carbon-intensive export-oriented companies to tackle with international competition.

The biggest resistance in front of emission credit auction is actually from the ETS-regulated companies, since all of them will suffer mounting emission cost. In order to urge the companies to cut emissions conscientiously, there shall be explicit laws and regulations, the companies shall form strong low-carbon awareness and properly use the income from emission credit auction. Besides, the auction mechanism has intrinsic problems that cannot be ignored. Since different sectors and companies have greatly varied total emissions and reduction potentials, a cover-all auction mechanisms seems unfair for some of them, i.e., the privileged sectors or large companies may monopolize credit trading via auction, thus depriving the vulnerable sectors or small companies of their advantages.

(4) Combined allocations

The above allocation approaches have their respective strengths and shortcomings and the best applicable industries. If an emissions trading scheme involves a large number of sectors and greatly distinguished emitting installations, it usually combines the two allocation approaches to make use of their advantages. Free allocation is usually preferred by a newborn carbon market, allowance auction is then gradually introduced after the market matures. Alternatively, an ETS is able to combine both free allocation and auction at its infant phase.

In its first and second trading periods and early stage of the third period, EU ETS combines free allocation and allowance auction, but gradually increases the auctioned allowances.

CAL ETS learned from the experiences of EU ETS, and then refined the methodologies for allowance-free allocation and auction. The competent department is entitled to auction 10% of the allowances directly, leaving the rest 90% allocated to companies for free; yet it asks the companies of different categories to handle the allowances differently. For instance, the industrial sectors and independent power plants can use the free allowances directly; the Publicly Owned Utilities (POU) may auction their surplus emission credits voluntarily; the Investor Owned Utilities (IOU) shall auction all of their free allowances, and return the income therefrom to electricity consumers.

The ETS operational experiences in Europe and America prove that the partially auctioned allowances are more effective in boosting the companies to cut emissions and energize the carbon market.

6.3 Foreign and Chinese Allowance Allocation Frequency and Effectiveness

For the purpose of making the ETS administration more compatible with the actual situations of an economic society, the allowances are allocated in prescribed time frames, and different allocations are chosen in different time frame, e.g., allocation by year or by stage, different allocation approach decides the validity period of allowances, which also gives rise to the issues of allowance storage and loaning.

The European Commission provides that the EUAs can be either stored or loaned within the same trading period. The EUAs are distributed annually, but every date of issuance is 2 months ahead of the deadline of the previous compliance year, which implies that if a company is short of EUAs in 1 year, it may use next year's allowances. By analogy, if a company has surplus EUAs, they may store them for next year within the same trading period, rather than saving them for the next period. As for China's seven pilot carbon markets, their allowance allocation systems vary from each other. For allocation frequency, Shanghai ETS allocates 3 years' allowances all at once, but the covered enterprises shall fulfill their annual obligations on time; other ETSs allocate the allowances annually and require fulfillment of annual obligations; the allowances in all ETSs are available for storage, rather than loaning; the allocation methodologies are basically uniform for all sectors (these seven markets abide by the Benchmarking Principle for allocating allowances to electricity sector, but set up different allocation criteria).

Allowance banking, on one hand, incentivizes the companies with low reduction cost to further reduction efforts and start earlier, and on the other hand buffers the short-term impact from varying demand and mitigate allowance price fluctuations. But the banking is valid for the same period, cross-period banking is not allowed unless the carbon market becomes fairly mature and stable. The operational experiences of the existing ETSs reveal that the target for capping total emissions seems unreasonable, because of lacking historical data and experiences in projecting emissions. At this point, the main objective of ETS is to obtain accurate emission data and operational experiences, a ban on cross-period allowance banking is a better option. After the ETS becomes more mature, the upper limits on total emissions will be coherent, and cross-period allowance banking may receive a better result.

Allowance borrowing may lure the companies to shift the emission reduction pressure to the last year of a trading period, which is not a good news for either administration of the covered enterprises, or for discovering the problems existing in the carbon market at an early date. Currently, on China's pilot carbon markets, it is government reserved allowances that take charge for easing the situation of short allowances.

6.4 Guangdong ETS Allowance Allocation

6.4.1 *Interpretation of Guangdong ETS Allowance Allocation Plan*

Guangdong Province Development and Reform Commission (GD DRC) takes charge of the overall work of the Guangdong Carbon Emissions Trading Scheme, e.g., allowance administration, monitoring, and guidance. In order to work out a scientific and appropriate allowance allocation plan, GD DRC, in conjunction with the relevant departments, established the Allowance Allocation Assessment Panel and Industrial Allowance Assessment Review Board to evaluate the ETS allocation methodologies, criteria, and rationality, the concrete work may be undertaken by the accredited social organizations or institutions. The development and reform commissions at or above the prefecture level are obliged to coordinate with GD DRC in allowance administration. They are responsible for reviewing the allowance purchase application filed by the new project proponents under their jurisdiction, and urge the covered enterprises under their jurisdiction to fulfill their obligations.

Fairness and efficiency are core elements of an allocation mechanism, but their status may not be equal under different policy goals, which leads to greatly varied allocation plans. Before an allocation plan is determined, the policy goal and guideline for each trading period shall be clarified. A pilot carbon market is obliged to make explorations for the ETS, and compatible with the local emission reduction targets and industrial structure over 2011–2015 (the Five-Year Plan period). If an ETS covers a great variety of sectors, the corresponding allocation plan shall stress allocation efficiency, like what Shenzhen ETS has done; otherwise, a fairer allocation plan is preferred. Guangdong ETS has been following the guideline as “efficiency comes first, balances fairness, promotes emission reduction and safeguards development,” which is interpreted as follows:

- (1) Promote emission reduction and safeguards development: Stick to the overall target for controlling total emissions, and in the meantime leaves appropriate space for continuing steady development of socioeconomy. Guangdong is China’s top developed province; its economic aggregate and growth have been ranking first since China introduced the reform and opening-up policy in 1978. However, it should be noted that the entire Guangdong is unevenly developed, the gap between the developed areas and underdeveloped areas is even wider than such a gap across the nation, i.e., Guangzhou and Shenzhen within Guangdong’s jurisdiction are the top developed cities in China, yet the counties at both the eastern and western wings and in mountainous areas are the nationally designated poor counties. As such, Guangdong ETS shall make effort to fulfill the target for controlling total emissions, and pay attention to safeguard the development of the less developed areas.

- (2) Control existing emissions and restrict emission increments: Motivate the existing covered enterprises to cut emissions step by step, and set strict emission criteria for new project proponents. The existing production facilities can only make limited emission reductions, because massive reduction calls for energy-saving transformation, which takes a long time to finish and incurs higher expenses, it is impossible for most of the existing covered enterprises to upgrade and update all equipment within the pilot period; instead, they rely on administration of energy conservation and consumption of low-carbon materials to cut emissions. Overall, a reasonable allocation plan shall ask the existing covered enterprises to gradually lower their emissions so as to control their current total emissions; while the new projects do not have such technology or equipment lock-in, they shall satisfy stricter allocation criteria to become advanced emitters.
- (3) Efficiency comes first, balances fairness: Take account of both the benchmark emissions by sector and historical emissions by company, support the advanced sectors/companies, and winnow out the outdated ones. Emission allowance allocation is actually a configuration of development space. A proper allocation plan shall take full consideration of the local industrial development policies, take a strict position on the companies “blacklisted” by the government due to high emissions, and high pollution, but incentive those sunrise industries. Different sectors have greatly distinguished emissions, some of them, with fairly low emissions, could be compared to the international advanced level; while some of them have middle-level emissions. Therefore, when developing the allocation criteria by sector, we should take an overall account of the sector’s unit CO₂ emissions, and then come up with a set of allocation criteria that satisfy the emission demand of most companies.
- (4) Paid allocation and implementation step by step. Rely on free allocation with paid allocation as a supplement, and gradually increase the proportion of paid allocation. According to the *Report to the Eighteenth National Congress of the Communist Party of China* delivered by the then China’s president Hu Jintao on 8 November 2012, China shall deepen the resource product price and tax-fee reform, establish the paid use system of resources and eco-compensation system that are able to reflect resource supply–demand pattern, resource scarcity, ecological value and intergenerational compensation. Paid allocation of emission allowances is an irresistible trend. Both EU ETS and RGGI have started paid allocation in an all-round manner, and Guangdong ETS has been making attempts in this regard. However, for the sake of lowering emission cost of companies and reducing ETS operational resistance, Guangdong ETS still relies on free allocation, only a small portion of the allowances are distributed via auction with an aim to send a signal that resource has its price.

6.4.2 Allowance Allocation Methodology

Guangdong Development and Reform Commission (GD DRC) takes charge of drawing up emission allowance allocation plan for Guangdong ETS, by taking full account of the baseline emissions, reduction potentials, and historical emissions by sector. Such plan shall be first reviewed by Guangdong ETS Allowance Assessment Review Board, and then reported to and ratified by Guangdong People's Government. GD DRC had issued three allowance allocation plans respectively for 2013, 2014, and 2015, which define the covered enterprises, new projects, annual total allowances, and percentage of free and paid allowances, allocation principles, methodologies, and procedures, allowance quantity via auction, transaction platform, and rules.

Guangdong ETS allowances are made up of the compliance allowances and reserve allowances; the latter is left for new entrants (to satisfy their emissions demand) and for the government (to regulate carbon market in case of allowances shortage). Guangdong ETS allowances are subject to both free and paid allocation. The allowances for new entrants are estimated in light of their production capacity and the allocation criteria. The allowances for market regulation are determined in certain proportion to the compliance allowances.

(1) Allocation plan

An allowance allocation plan involves main body, schedule, channel, procedure, and price. Generally, the main body for allowance allocation refers to the competent government department. Take Guangdong ETS, for instance, it is under the leadership of Guangdong Development and Reform Commission (GD DRC); its allowances allocation is in line with the Guangdong ETS allowance allocation plans, respectively, for the compliance year as 2013, 2014, and 2015.

Guangdong ETS adopts both free and paid allocation. In order to coordinate the work for free and paid allocation, they are scheduled at different times and through different channels. In principle, GD DRC shall distribute the free allowances to Guangdong ETS Allowance Registration System on every July 1, the covered enterprises shall register an account in this system and apply for 95–97% of these free allowances. Paid allocation is undertaken by an auction platform titled China (Guangzhou) Emissions Exchange in each quarter, both covered enterprises and new entrants can bid for the allowances via this platform at their own emissions demand. Guangdong ETS allowance allocation plan is briefed in Table 6.1.

Owing to a limited pilot period (2013–2020), Guangdong ETS allowances are allocated annually for two aspects of considerations: on one hand, such allocation shall enable the administrator to acquaint with the administration process and gain a thorough understanding of the allocation mechanism; on the other, it shall favor adjustment to the allocation plan, and leave a time window for such adjustment after a period of market observation and feedback.

If the basic data are fairly complete, the allowance allocation shall center on emitting installations to prevent from wrong identification of regulatory boundary.

Table 6.1 Essential elements of Guangdong ETS allowance allocation plan [3–5]

		Free allocation (compliance companies)	Free allocation (compliance companies, new entrants)
Schedule		Each July 1	Each quarter
Channel		Allowance registration system	Guangzhou Emissions Exchange
Approach		Direct distribution	Bidding
Price		Free	Floor price
Quantity	2013	97% of total verified allowances	Purchase 3% of total verified allowances
	2014–2015	95% of total verified allowances for electricity sector; 97% for other sectors	Purchase at their demand

Source The Guangdong ETS allowance allocation plans, respectively, for the compliance year as 2013, 2014, and 2015

At the initial phase of Guangdong ETS, the basic data about covered enterprises are incomplete, since lots of them do not store any emission data about emitting installations, thus making companies become the focus of allowance allocation.

In order to define the regulatory scope or boundary, the covered enterprises shall submit an emissions monitoring plan to the administrator for examination and approval, report their emissions data based on the plan. Later, based on the report and allocation criteria, the administrator shall calculate the allowances to be distributed.

(2) Allocation criteria

After a thorough comparison of the Benchmarking and Grandfathering Principles, Guangdong ETS gives priority to the Benchmarking Principle, and turns to the Grandfathering Principle when the Benchmarking is inappropriate. For instance, the Benchmarking Principle is applicable to the single generating set in the electricity sector, the clinker production and grinding in cement sector, and the long process in iron and steel sector. In contrast, the Grandfathering Principle is applicable to co-generation in electricity sector, mining of cement mine, oil refinery, and ethylene production in petrochemical sector, a short process in iron and steel sector, and other sectors with diverse types of products and sophisticated process.

The allowance allocation criteria of Guangdong ETS are briefed as follows. The years' allowance allocation plans are available for downloading from the website of Guangdong Development and Reform Commission (<http://www.gddrc.gov.cn/was5/web/search>) for the readers that care about Guangdong ETS.

(i) Electricity sector

In light of Guangdong ETS allowance allocation plan, the emission allowances are granted to electricity sector by following the Benchmarking Principle.

The electricity sector that falls under regulation by Guangdong ETS consists of electricity generation companies and electricity–heat co-generation companies. The

generation companies of the same category have different types of generating sets which are made up of those based on coal and natural gas. The coal-fired generating sets are further divided into four subcategories based on the size of installed capacity; the big and small generating sets have greatly varied energy consumption and emissions owing to varied technical parameters. Therefore, the allocation criteria are established on basis of the average energy consumption of the same-category generating sets, which not only reveals the emissions disparity among various generating, but motivates the companies with the same fuels and generating sets to seek energy-efficiency modification or automatic elimination.

a. Electricity generating units

The total allowances granted to covered enterprises are made up of free and paid allowances; the former is computed in light of allocation criteria, while the latter is decided by the companies at their special demand. Therefore, the percentage of paid allowances shall be ignored when setting up the allocation criteria. Formula 6.1 is the allocation criteria for electricity generation companies.

$$EA = \sum_{i=1}^n HP_i \times BM_i \times CF \times (1 - PA) \quad (6.1)$$

EA is free allowances allocated to the companies with generating set i ; HP_i is the electricity output of generating set i ; BM_i is benchmark emissions from generating set i of the same category; CF is annual decline factor; PA is the percentage of paid allowances.

HP_i is electricity output of generating set i (average historical output in 2013 allocation, and actual output in 2014 and 2015 allocation). It is provided that the electricity output for allowance computation may not be larger than the designed capacity of the generating set. BM_i is determined on basis of the unit emissions of all types of generating sets. The allocation criteria are finally determined in reference to the emissions reduction target (total allowances) of the electricity sector. See the benchmark emissions of Guangdong ETS-regulated electricity generation companies in Table 6.2.

b. Heat-electricity generating units and resources comprehensive utilization generating units²

The Grandfathering Principle is applicable to the allowance allocation for the heat–electricity generating units and the resources comprehensive utilization generating unit, because the former has greatly varied heat–electricity ratio and inadequate data accumulation; the latter has low energy use efficiency, fuel grade notably lower than the generating units based on general fossil fuels.

²Resources comprehensive utilization generating units are those mainly rely on coal gangue and oil shale as fuel.

Table 6.2 Benchmark emissions of Guangdong ETS-regulated electricity-generating sets

Category of generating sets			Benchmark emissions (gCO ₂ /kWh)	
			2013	2014 and 2015
Coal-based	1000 MW		770	825
	600 MW	Ultra Super-critical (USC)	815	850
		Super-critical (SC)		865
		Sub-critical (SubC)		880
	300 MW	Non-circulating fluidized bed (NCFB)	865	905
		Circulating fluidized bed (CFB)		927
	<300 MW	Non-circulating fluidized bed (NCFB)	930	965
Circulating fluidized bed (CFB)		988		
Natural gas-based	390 MW		415	390
	<390 MW		482	440

Source The Guangdong ETS allowance allocation plans, respectively, for the compliance year as 2013, 2014, and 2015

$$\text{Companies' allowances} = \text{historical average emissions} \times \text{CF} \times (1 - \text{PA})$$

(ii) Cement sector

The production of cement follows three fundamental stages as quarrying, clinker production, cement grinding, and micro-grinding. The total allowances granted to cement plants are a sum of allowances for the four stages. The Benchmarking Methodology applies to clinker production and cement grinding, while the Grandfathering Methodology applies to quarrying and micro-grinding.

Similar to the calculation formula for the allowances for electricity sector, HP_i is cement production (average historical output in 2013 allocation, and actual output in 2014 and 2015 allocation). Since cement overproduction happens from time to time, it is provided that the cement production for allowance computation may not be 1.3 times more than the designed capacity of the cement kiln. The categorization and value of BM_i are given in Table 6.3.

Table 6.3 Benchmark emissions of Guangdong ETS-regulated cement sector

Benchmark emissions (CO ₂ /t)	Cement clinker production line			Cement grinding
	≥ 4000 t/d	2000 ≤ CO ₂ /t < 4000 t/d	<2000 t/d	
2013	0.874	0.921	0.945	0.0237
2014 and 2015	0.893	0.937	0.950	0.027

Source The Guangdong ETS allowance allocation plans, respectively, for the compliance year as 2013, 2014, and 2015

Clinker production efficiency is in direct proportion to the capacity of the production line. In order to mobilize the initiative of cement producers, Guangdong ETS exercises differentiated allowance allocation criteria toward different clinker production lines. For the production lines at or above 4000 t/d, the BM_i is the unit average emissions from the producers of the same technical group. For the production lines no less than 2000 t/d and less than 4000 t/d, the BM_i is the unit average emissions from the leading 75 producers of the same technical group. For the production lines less than 2000 t/d, the BM_i is the unit average emissions from the leading 50 producers of the same technical group.

(iii) Iron and steel sector

Iron and steel sector is made up of long-flow and short-flow iron and steel companies. In this study, the focus will be placed on long-flow companies. Their coke and lime input (raw materials) and crude steel production (product) are directly related to CO_2 emissions. The Benchmarking Principle is herein feasible.

Similar to the calculation formula to the allowances for electricity sector, HP_i is raw material input or crude steel production i (average historical input/production in 2013 allocation, and actual input/production in 2014 and 2015 allocation). In order to safeguard the fairness of allowance allocation, it is provided that the steel production for allowance computation may not be 1.1 times more than the designed capacity. The categorization and value of BM_i are given in Table 6.4.

The BM_i of the existing long-flow iron and steel companies in Guangdong is defined through weighted calculation. The carbon-bearing substances directly emitted from crude steel production is made up of scraps, slags, steel, pig iron, lime, dolomite, carburant, and coke. For lime roasting, the emissions are from decarbonation and energy consumption. The emissions from coking process are beyond consideration because the exhaust from coking is inflammable gas with high heat value and recyclable, the coking by-products as benzene (solid) and coal tar (liquid) are either solid or liquid, and the coke will be directly filled in the iron-making furnaces.

Summing up, the emissions hereby are from energy consumption during coal preparation, coking, and gas purification, after deducting the energy for self-recycling and for supply to external costumers.

Table 6.4 Benchmark emissions of Guangdong ETS-regulated long process in iron and steel companies

Raw material/Product	Benchmark emissions (CO_2/t)	
	2013	2014 and 2015
Coke (raw material)	0.3307	0.2976
Limestone (raw material)	0.8280	0.5796
Crude steel (product)	2.1274	1.9785

Source The Guangdong ETS allowance allocation plans, respectively, for the compliance year as 2013, 2014, and 2015

(3) Allocation approaches and procedures

There are free and paid allowance allocations. Paid allocation a unique feature of Guangdong ETS, its approaches and procedures will set an example for the ETS in other areas and the nationwide uniform carbon market.

(i) Receivers of allowances and allocation approaches

As soon as the pilot work for Guangdong ETS started in December 2013, the paid allocation was put into effect, catering to both covered enterprises and new entrants. As approaching the end of the first compliance year 2013, a paid allocation system was established and started the smooth trial run. In addition to covered enterprises and new entrants, there were other opt-in entities. Therefore, since the second compliance year 2014, the investment institutions and other market participants are able to join in an auction for paid allowances.

For covered enterprises, the legal persons are entitled to determine the quantity of free allowances, and whether and when to auction for paid allowances based on their emissions demand.

For new entrants, the owners shall, before the projects are completed and subject to acceptance check, purchase adequate verified paid allowances at China (Guangzhou) Emission Exchange (CGEX). After the projects are put into operation for 12 months, the new entrants will access the same allocation methodologies as the covered enterprises.

(ii) Allocation procedures and rules

a. Free allocation

The competent department of Guangdong ETS will, in reference to the basic emissions data supplied by the covered enterprises, calculate their respective free allowances based on allocation criteria, submit the result to the Allowance Allocation Review Board for rectification, and then issue the allowances to the companies' registered account at CGEX.

After these companies have fulfilled current year's obligations, the competent department will issue next year's allowances to their registered account. The allowances used for covering current year's emissions will be revoked, and the surplus allowances are still valid. The benchmark values of these companies will directly affect the quantity of allowances, therefore, when defining the benchmark values, the competent department shall take account of production stability and sustainability of these companies, so the benchmark values for the year 2013 are an average of the verified emissions data over 2010–2012.

The allowances given to the companies with abnormal production are defined in line with the two principles as follows: First, the projects, either newly operated or going through substantial technical revamp, fail to reach the prescribed period of operation. If such projects are operated within 1 or 2 years, or if the technical revamp brings significant changes upon their original categorization, production process, or capacity, their allowances shall be based on the emissions from the period of normal production, for the sake of fairness. The specific rules are given

like this, if the projects fail to reach 12-month operation in a current year, then the allowances shall be based on the average emissions of a full year, or in reference to the average historical emissions from the counterpart companies. Second, special circumstances may take place during the production process within the years for drawing the basic data. Any inappropriate production management, external natural environment, and social environment may lead to abnormal production, which will then bring uncertainties upon allowance determination. When deciding the quantity of allowances, full consideration shall be given to the reasons, duration, and impact of abnormal production. If the abnormal production arises from changes on demand–supply pattern or equity structure, or from technical revamp, all the risks therefrom are due to borne by the companies themselves, so allowance determination shall follow the regular procedure, in other words, there is no special treatment.

Special consideration is given to the following two situations: Any abnormal production arises from force majeure, e.g., typhoon, earthquake, flood, fire, or explosion, and extends over 1 month. Any abnormal production under government mandate (excluding electricity generation dispatching) and extends over 1 month. Under such circumstances, the allowances may be calculated disregard of current year's emissions, or converted based on the emissions from normal production.

a. Paid allocation

From December 2013 to June 2014, China (Guangzhou) Emission Exchange altogether held five rounds of allowance auctions with reserve price determined by the government. Such an auction reserve price in 2013 was set at 60 yuan/tCO₂. This is a sealed auction at uniform price. The companies shall declare their intended purchase quantity and price via the electronic transaction system. Upon closure of the auction, the transaction system shall rank the declarations by price, then rank the same-priced declarations by time. If the total declared quantity is no more than the total issuance quantity, all the transactions will be concluded at declared quantity at the reserve price. If the total declared quantity is above the total issuance quantity, then all the transactions will be concluded at issuance quantity at the minimum offer price.

Starting from the second compliance period of Guangdong ETS, the competent department decided to hold an allowance auction at the last month of each quarter. In the compliance year of 2014 (from September 2014 to June 2015), the auctions were exercising a staircase reserve; such price for the four auctions was, respectively, 25, 30, 35, and 40 yuan/tCO₂. In the compliance year of 2015 (from September 2014 to June 2016), the auction reserve price was 80% of the weighted average transaction price for the listed tradings at CGEX during the 3 calendar months before the Notice Date when the auction price is made to public. The companies shall declare their intended purchase quantity and price via the electronic transaction system. They are allowed to make multiple offers with each one no less than 1000 tCO₂; no offer may be canceled after submission. And, the accumulated offers may not be over 50% of total issuance quantity. The auction is a

uniform-price auction, both the transaction quantity and price shall meet the following conditions: (i) Upon closure of the auction, the transaction system shall rank the declarations by price, then rank the same-priced declarations by time. (ii) If the total declared quantity is no more than the total issuance quantity, all the transactions will be concluded at declared quantity at reserve price. (iii) If the total declared quantity is above the total issuance quantity, then all the transactions will be concluded at issuance quantity at the minimum offer price.

6.4.3 Allocation Correction

The covered enterprises under Guangdong ETS regulation vary from each other in business scale and industry categorization. To safeguard fairness and efficiency of allowance allocation, the competent department of Guangdong ETS, while stitching to established allocation methodologies and approaches, has laid out the following adjustment mechanism to deal with special situations in real economic operations:

(1) Fall-back correction to benchmarking allocation

Since benchmarking allocation is closely related to companies' production scale, it is logic to base on the historical average output of covered enterprises for benchmarking allocation. However, historical output, which is a reflection of the past, varies from a company's present production, particularly the companies that are more sensitive to the changes in national economy. Thus, an allocation plan with historical output as the major parameter tends to differ greatly from the companies' actual demand for allowances. When the national economy takes a downward trend, the allowances based on historical output will exceed the actual demand, then leads to surplus allowances, which will weaken the ETS effect emissions abatement. On the contrary, there will be a tight allowance supply if the allowances are below the actual demand, which will impose great cost pressure on the companies' normal production. Therefore, a fall-back correction to benchmarking allocation will enable scientific management of allowances in light of the companies' real production activities.

(2) Cement, petrochemical, and iron and steel sectors: set a cap on allowances allocation

Benchmarking allocation is available for fall-back correction, yet such correction may not be unrestrained. It is a feasible option to adjust the upper limit of output in light of designed capacity. If the output is above the capacity, then switch the output-based allowances to the capacity-based allowances, and allow the companies to purchase additional allowances to make up for the deficiency. Such approach, on the one hand, satisfies the development demand of companies, and on the other levels the playing field and controls aggregate emissions of a given industry, and

injects vitality into carbon market, which is ought to be accepted by most participants.

(3) Deal with special circumstances

Since the economic practice is always sophisticated, it is natural to see some special circumstances during the pilot period of Guangdong ETS. The citation of some typical circumstances and resolutions are given as follows:

The 2013 allocation is, in principle, based on the verified annual average emissions over 2010–2012 reported by the covered enterprises. But the adoption of historical data may follow some special rules in case of the following exceptional circumstances: (a) If the companies (production lines or generators) are put into operation (or major technical revamp) in any year over 2010–2012, if their normal production fails to reach 12 months in a row in 1 year, then the emissions of next year (12 months) will be defined as the benchmark data. (b) Over 2010–2012, if the companies (production lines or generators) are halting production for over 1 month in any year owing to force majeure, then the emissions data from that year will be put aside. (c) If the companies (production lines or generators) are put into operation in 2013, yet fail to report the emissions data from more than 6 months of stable operation, then they shall abide by the rules that apply to New Entrants in the carbon market. (d) If the companies (production lines or generators) autonomously halt production for over 6 months in any year over 2010–2012, and fail to start up till December 2013, then the allowances for 2013 will be frozen, and subject to reassessment by the competent department after they officially resume operation. (e) If the companies (production lines or generators) are blacklisted for elimination, whether they are closed in a given year over 2010–2012, the allowances are for only valid for that year. If the closure is carried out in advance, their remaining allowances shall be withdrawn.

6.5 Crucial Elements of Guangdong Pilot ETS Allowance Allocation Plan

An overall allowance allocation plan is made up of methodologies, criteria, and distribution cycle, which may implicate detailed aspects of the practical operation. This section, by drawing the experiences from implementation of Guangdong ETS pilot program, sheds light on some crucial elements of the allocation plan.

6.5.1 Objects of Regulation

By drawing the experiences from carrying out the pollutant discharge standards, and other mandatory measures for control over energy consumption, which regulate

emissions from companies and gather their emissions data; and the companies are adapt to reporting wholesale emissions data instead of breaking down to the emissions from installations. Therefore, China's seven ETS pilot programs define companies as objects of regulation and sources of data, in contrast to EU ETS and other foreign cap-and-trade systems that regulate installations. Take Guangdong ETS, for instance, it is the covered enterprises that report emissions data and receives allowances, and their business scope is defined via an exclusive Organization Code; in other words, each Organization Code accesses to a registered account. However, such regulation with companies as centerpiece has the following problems:

- (1) Inexplicit emitting sources. Each company may have different types and quantity of emitting sources. The companies, despite the same industrial property, may have diverse emitting sources, which is a resistance for benchmarking allocation. Therefore, the special emitting sources shall be handled separately, which inflicts difficulties upon allowance administration. Take cement sector, for instance, some cement plants buy minerals directly, while other have self-run quarries, in this case, the CO₂ emissions from extracting quarries are combined into the aggregate emissions of this cement plant; otherwise, additional allowances for emissions from quarrying shall be distributed. Guangdong ETS chooses the second option.

There is an alternative better for clarifying emitting sources: split a company's different emitting sources into working processes (generators or products), develop a specific allocation criterion for each working process (generator or product), and add these allowances into the sum for the companies.

- (2) Changing production activities cause a gap between planned allowances and actual emissions. Any technological modification or product switching is a challenge against the allowance allocation to the companies. This is a non-distinctive issue for the companies with stable raw material or product mix or for the single electricity producers. Yet it is another landscape for petrochemical companies, particularly those small-sized ones. Owing to varied raw material sources and oil demands, petrochemical companies are forced to substitute their large equipment (emitting sources), so the allowances defined before such changes will notably vary from the current actual emissions. Under such circumstance (significant changes on production activities), the Guangdong ETS-regulated companies will revise their emissions monitoring plan within 3 months as of the change takes place, and resubmit the plan to the competent department for recording; then the competent department shall designate experts and verification institutions to conduct on-site verifications to the companies, and then ratify proper adjustments to their previous allowance allocation plan.

6.5.2 Rediscussion on Responsibility Division for Emissions Reduction

In view of energy consumption and CO₂ emissions, the entire electricity system could be divided into the production side and demand side. For both Guangdong and the national uniform carbon market, whether electricity producers—generating and supplying electricity to consumers—shall take charge for the emissions from electricity generation is a foremost issue for developing allowance allocation plans.

Through surveys of electricity companies and other stakeholders, we found three dominant opinions about responsibility division for emissions reduction [6]: (a) The emissions that fall into the ETS regulation stem from electricity consumption by both power plants and consumers. Those who hold such viewpoint believe the power plants take sole responsibility for the emissions from their own electricity use; as for the electricity supplied to consumers, any emissions therefrom shall be compensated by the consumers. Anyway, the consumers will turn to other fossil energy for power in absence of electricity. (b) The emissions shall be compensated by the companies in the places where the emissions are generated. Such viewpoint, which features clear-cut division of responsibility and helps implementation of emissions credit transaction, is widely executed by the world leading emissions trading systems, e.g., EU ETS and RGGI. (c) Both electricity production side and demand side shall be covered by the ETS mandatory regulation.

The electricity pricing in China is relatively fixed, the administration of emissions allowances tends to increase the cost of power plants, yet they are confined to pass the additional cost onto consumers. Though Viewpoint A may somewhat resolve such contradiction, it has pronounced limitations: the electricity consumed by power plants is generally 5% of their total electricity output, implying that the consumption side—all sectors that consume electricity—shall fall into strict regulation and restriction of the emissions trading scheme. However, a high-degree dependence on the cutback efforts of the consumption side is from enough to fulfill the overall emissions reduction target; after all, CO₂ is mostly emitted from electricity producers. Moreover, the emissions restriction upon the consumption side is fairly complicated, since a great number of sectors and entities are involved, and they have disparate emissions reduction technologies. Therefore, Viewpoint A is hardly able to restrict the emissions from such leading emitters as fossil fuel-based power plants, which, of course, weakens the ETS effect and encumbers fulfillment of the overall emissions reduction target.

Viewpoint B holds that the electricity consumption side should not fall under mandatory compliance for cutting emissions; instead, if they can generate any cutbacks from emissions reduction efforts, these cutbacks may be traded for earnings in the form of CERs under the framework of CDM, GS (the Gold Standard) of other global voluntary emissions reduction organizations, or the CCERs stated in China's *Interim Measures for the Administration of Voluntary Greenhouse Gas Emissions Reduction Transactions* (NDRC [2012] No. 1668). But the current emissions trading market across China remains inactive with low carbon prices,

which is hard to motivate the consumption side to save electricity consumption and reduce emissions.

Viewpoint C argues that there is double counting of CO₂ emissions arising from both electricity production and consumption. Under the ETS framework, the allowances to be issued will exceed the needed amount, which may lead to a misconception that the ETS-regulated emissions are more than actual emissions, but in fact it is only a matter of statistics. Such double counting is easily resolved by providing an explanation or taking off the double-counted portion when keeping statistics of the aggregate emissions. This viewpoint, at the production side, appeals the electricity companies to raise the efficiency of generating units and switch to clean energy; while at the consumption side, it calls the energy-intensive companies, particularly cement plants, steel mills and shopping malls, to adopt advanced technologies and raise electricity-use efficiency. The significance of Viewpoint C lies in the equal emphasis on controlling electricity-induced CO₂ emissions (emissions magnate) from upstream and downstream sectors, which is able to maximize the effect of ETS, complete the task of capping on aggregate emissions and fulfill the regional emissions reduction target.

Guangdong ETS is now regulating CO₂ emissions from both electricity production and consumption sides—a core of Viewpoint C as noted.

6.5.3 Problems in Defining Benchmark Value and Resolutions

The accuracy and integrity of companies' benchmark emissions is of great significance for safeguarding the effectiveness of allowances allocation. Yet, the data accuracy is affected by the following factors:

(1) Unstable production of covered enterprises during reference years

Owing to volatile macro-economy or changing supply–demand patterns of certain products, the companies may generate different amount of emissions every year. In order to mitigate the disparity in annual emissions, the benchmark value shall be the companies' annual average emissions in past 3 years or in several given years.

(2) Companies failing to reach prescribed production duration due to newly started operation or major technical revamp

If a company (production line or generator unit) fails to reach 12-month operation in the current year, then the allowances shall be based on its average emissions of the next full year. For a company (production line or generator unit) that is operated in a year or so, the allowances shall be based on the emissions from a normal production period (12 months in a row). If the duration of normal production is shorter than 1 year, then the allowances may be converted on basis of the

emissions during the months of normal production, or in reference to the average historical emissions from the counterpart companies.

(3) Special circumstance during the data-collection period

During the production process within the years for drawing the basic data, any inappropriate production management, changing natural environment or social environment may lead to abnormal production, which will then bring uncertainties upon allowances determination. When deciding the quantity of allowances, full consideration shall be given to the reasons, duration, and impact of abnormal production.

If the abnormal production arises from changes on demand–supply pattern or equity structure, or from technical revamp, all the risks therefrom are due to borne by the companies themselves, so allowance determination shall follow the regular procedure, in other words, there is no special treatment.

Special consideration is given to the following two situations: Any abnormal production arises from force majeure, e.g., typhoon, earthquake, flood, fire, or explosion, and extends over 1 month. Any abnormal production under government mandate (excluding electricity generation dispatching) and extends over 1 month. Under such circumstances, the allowances may be calculated disregard of current year's emissions, or converted based on the emissions from normal production.

6.5.4 Matters Needing Attention When Defining Benchmark Values

In light of the allocation methodologies and benchmarking experiences in the foreign emissions trading systems, the benchmarking value for the same group of products is usually the average value of the ETS-regulated products or the top 10 emitters, or the benchmark value of such products. China is now at the period of economic transition, different regions vary greatly in technological strength, sweeping approach is not recommended. For instance, for some small-sized cement plants that use shaft kilns, they are confined by production scale and production process, their efficiency in cutting CO₂ emissions never catches up those large and advanced companies. For the generating units with different production capacities, uniform benchmark value is, of course, unfair; moreover, some small coal-fired power plants in remote areas, despite of low efficiency, are still a backbone for people's livelihood.

Such a situation calls for fairness. Define benchmark value based on types of production lines or generating units. Take account of the situation of small companies and leave them a buffer zone and gradually integrate into the carbon market. In the meantime, in order to protect the leading companies, the priority shall be given to efficiency, the benchmark value of different production capacity may be defined by different approaches. In order to mobilize the initiative of cement

producers, Guangdong ETS exercises differentiated allowance allocation criteria toward different clinker production lines. For the production lines at or above 4000 t/d, the BM_i is the unit average emissions from the producers of the same technical group. For the production lines no less than 2000 t/d and less than 4000 t/d, the BM_i is the unit average emissions from the leading 75 producers of the same technical group. For the production lines less than 2000 t/d, the BM_i is the unit average emissions from the leading 50 producers of the same technical group. In addition, adjust the range of benchmark value in light of the domestic or global level of the same technologies, so as to guide the companies to step onto a high-efficiency and low-carbon development path.

In sum, the definition of benchmark values shall ensure efficiency and fairness of allowances allocation; in other words, when computing quantity of allowances, both industrial baseline emissions and companies' historical missions shall be taken into account, with an aim to protect the advanced companies and winnow out the outdated ones.

6.5.5 Allowances Correction

The CO₂ emissions from companies vary from time to time amid volatile economy and uneven industry development. As a result, an elaborate allowance allocation plan shall either involve an ex-ante approach that applies to economic ups and downs or fall-back approach that deals with production fluctuations. All the pilot carbon markets in China have established an allowance adjustment mechanism. Nevertheless, with regard to the integrity of an emissions trading scheme, an ex-ante approach that foresees all possibilities is better for ETS steady performance.

In order to ensure stability and continuity of the relevant policies and allocation system, the fall-back approach shall be able to solve the practical problems in line with the established basic principles and allocation methodologies, as well as the guidelines for efficiency and fairness. The fall-back approach is not allowed unless the companies indeed have inadequate allowances, increased production, and higher efficiency.

References

1. Carbon Trading Task Group of CAS Guangzhou Institute of Energy Conversion, *Q&A about Design and Practice of Guangdong Emissions Trading Scheme*, China Environmental Science Press, 2014.
2. JIANG Xiaochuan, *Study on the Initial Distribution System of Carbon Emissions in China - Taking the Allocation Method as the Center*, Jiangxi University of Finance and Economics, 2012.

3. Guangdong Province Development and Reform Commission, *the First Allocation and Work Plan for Carbon Emission Permits* [EB/OL]. http://zwgk.gd.gov.cn/006939756/201401/t20140123_463411.html.
4. Guangdong Province Development and Reform Commission, *the Distribution Plan of Guangdong's Carbon Emission Allowance in 2014* [EB/OL]. http://zwgk.gd.gov.cn/006939756/201504/t20150430_578928.html?keywords=.
5. Guangdong Province Development and Reform Commission, *the Distribution Plan of Guangdong's Carbon Emission Allowance in 2015* [EB/OL] http://www.GDDRC.gov.cn/zwgk/tzgg/zxtz/201507/t20150713_322106.html.
6. LUO Yuejun, LUO Zhigang, ZHAO Daiqing, *Mechanism Study on Carbon Emission Trading of Power Sector* [J]. Environmental Science & Technology, 2014, 37 (6N): 329–333.