



The construction of Shenzhen's carbon emission trading scheme



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HIGHLIGHTS

- The Shenzhen ETS is the first urban-level “cap-and-trade” carbon emission trading scheme operated in China.
- This paper focuses on the construction of Shenzhen carbon emission trading scheme. It is devised as the intensity-based cap, output-based allocation and allowance trade carbon market.
- It has some signatures in the general principles, coverage and scope, cap and allocation and other mechanisms.
- Several challenges and their policy choices are detailed for the development of Shenzhen ETS.

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ABSTRACT

The Shenzhen ETS is the first urban-level “cap-and-trade” carbon emissions trading scheme to operate in China. This paper gives an overview of the economic and emissions situation in Shenzhen and focuses on the development of the Shenzhen ETS regulatory framework. It is devised as an ETS with an intensity-based cap, output-based allocation and a market for trading of allowances. The design of the Shenzhen ETS attaches great importance to coordinate the dynamic relationships between economic growth, industrial transition and emissions control. The cap and its allocation are determined by carbon intensity reduction targets and economic output, with an aim to slow down emissions growth while mitigating shocks from economic fluctuation and industrial adjustment to market stability. The Shenzhen ETS features extensive coverage consisting of three types of regulated entities and four categories of covered emissions, in order to control carbon emissions by both improving energy efficiency and restraining growing energy demand. A competitive game theory method is created for allocation of free allowances to manufacturing enterprises. Mechanisms for carbon offsets and market stabilization are developed to promote active and orderly trading in the carbon market. Moreover, several challenges and their policy choices are detailed for the development of the Shenzhen ETS.

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1. Introduction

China has become the most important GHG emitter in the world, accounting for 24.6% of global GHG emissions. In order to control carbon emissions in a cost-effective way, China has launched several regional pilot carbon emission trading schemes and is attempting to establish a national carbon emissions trading scheme step by step. Shenzhen was authorized as one of the pilot regions and thus explored the development of an ETS adapted to China's situation and Shenzhen's economy in particular. The Shenzhen ETS became operational on 18 June 2013, representing the first practice of a “cap-and-trade” ETS in a developing country.

2. The economic context and GHG emissions of Shenzhen

Shenzhen is located on the southern coast of Guangdong province, adjacent to Hong Kong. It covers an area of 1953 km² and has a population of 10.55 million, with an average income of US\$19,450 per capita in 2012. The industrial structure of Shenzhen is experiencing significant change, as illustrated in Table 1. The proportion of secondary industry has been dropping while that of service industries has increased. Meanwhile, secondary industry in Shenzhen is dominated by light industry, of which the development is characterized by upgrading traditional manufacturing industry and promoting advanced manufacturing industry. According to the city's Twelfth Five-Year Plan (2011–2015), Shenzhen will speed up its economic transformation and promote the steady progress of its modern industrial system.

Energy consumption in Shenzhen is growing along with economic development and high living standards. GHG emissions have

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Table 1
Composition of gross domestic product by three sectors in Shenzhen (%).

Year	Primary industry	Secondary industry	Industry	Service industry
2006	0.1	52.6	49.8	47.3
2007	0.1	50.2	47.6	49.7
2008	0.1	49.6	47.1	50.3
2009	0.1	46.7	43.8	53.2
2010	0.1	47.2	44.2	52.7
2011	0.1	46.4	43.4	53.5
2012	0.1	44.3	41.5	55.7
2015*	0.1*	40.0*	38.0*	60.0*

Data source: Shenzhen Statistical Yearbook, 2012.

* refers to predicted value.

Table 2
Proportion by sector of direct CO₂ emissions from fossil energy consumption in Shenzhen (%).

Category name	2005	2010
Energy industries	35.0	27.3
Mfg. industries and construction	29.0	14.8
Transport	25	46.3
Residential and commercial	10.9	11.5
Other	0.1	0.1

Data source: The GHG Emission Inventory of Shenzhen, 2010.

increased to about 80 MtCO₂e in 2010, with an average annual growth rate of 4.9% during 2005–2010. However the growth of emissions has been gradually slowing down in recent years. Carbon emissions per capita are stable at a level of 6.5 t CO₂e while carbon emissions per unit GDP is continuing to fall. As shown in Table 2, the structure of Shenzhen's emissions is also undergoing a process of dynamic change. There are a small number of large direct emission sources and a large number of small and scattered indirect emissions sources¹. The proportion of indirect emissions from power dispatch has significantly increased. In addition, the proportion of emissions from power, manufacturing and construction sectors is dropping whereas that from the transport, residential and commercial sectors is increasing.

3. The construction of the Shenzhen ETS

Shenzhen has developed and put into operation the first pilot carbon emission trading scheme in China, which is devised as an urban-level “cap-and-trade” scheme. Table 3 gives a summary of key elements of the Shenzhen ETS regulatory design, and several important features and innovations are detailed in the following paragraphs.

3.1. Coverage and scope

The Shenzhen ETS has the broadest coverage amongst the current ETSs, consisting of three types of regulated entities and four categories of CO₂ emissions. Specifically, the former refer to the industry, public building and transport sectors while the latter include direct emissions from energy consumption, industrial processes and production as well as indirect energy emissions. Two innovations can be revealed by this

¹ Direct emissions are emissions from fossil energy consumption, industrial process and product fugitiveness. Indirect emissions are emissions from consumption of purchased electricity, heat or steam, which are calculated by the activity data and emission conversion factor.

coverage: one is the inclusion of the public transport sector and the other is the regulation of direct and indirect emissions from all industrial sectors. Being at the stage of rapid industrialization and urbanization, energy consumption demands of transport, residential and commercial sectors are soaring in Shenzhen. Therefore, the regulatory design of Shenzhen's ETS aims to control GHG emissions by both improving energy efficiency and restraining energy demand. And due to the decentralized structure of industrial emissions, the Shenzhen ETS covers direct and indirect emissions from all industrial sectors, including power and water-supply sectors, manufacturing of electronic products, metallic products, equipment, plastic and rubber, non-metallic minerals, food, drink and others. The amount of potential GHG emissions is the main consideration for the inclusion threshold, being 5000 tCO₂e p/a for industrial sectors and an area of 20,000 m² for buildings, respectively. Besides, some companies or buildings under the threshold but located in the specified areas may be included under the regulation. As a result, 635 business entities and 197 large-scale public buildings are covered, which accounts for almost 40% of Shenzhen's total GHG emissions. Moreover, Shenzhen ETS has been preparing to cover emissions from public transport vehicles, starting from buses and taxis. It is a bold attempt to slow down the increase of urban vehicles and to promote the application of new energy vehicles via an ETS. According to the plan of Shenzhen's ETS, this may be put into practice in 2014 or 2015.

3.2. Cap on emissions

Compared with the ETSs operating in developed economies, the Shenzhen ETS attaches more importance to coordinating dynamic relationships between economic growth, structural transition and emissions control, and takes an innovative approach to setting an intensity-based cap on emissions. It is a reality that Shenzhen's GHG emissions will continue to grow for quite a long period of time. There are two alternatives given this background: set an absolute cap but allow it to increase, or make an intensity-based cap. The former was adopted by the EU ETS to set caps for several member states, such as Lithuania, Latvia and Luxembourg. Due to the shocks of the global financial crisis and European debt crisis, it is difficult to assess the effectiveness of the former model through the EU ETS practice. However some studies have discussed absolute caps and intensity-based caps in theory or by modeling, and suggest that an intensity-based cap may behave better than an absolute cap if uncertainty of output is high or if the marginal cost curve is steeper than the marginal benefit curve (Ellerman and Wing, 2003; Quirion, 2005). The level of output uncertainty is extremely high in Shenzhen with its rapid growth and accelerated structural adjustment. Meanwhile, economic development is still the first priority and the fundamental driving force to improve social welfare for a developing city. As a result of these factors, an intensity-based cap was selected by Shenzhen for its ETS.

China's GHG emissions control target for 2020 is to reduce carbon intensity² by 40%–45% compared with 2005. The national target is decomposed to its provinces and cities and Shenzhen's target is to reduce carbon intensity by 21% during 2010–2015. To achieve the city's goal, the Shenzhen ETS sets intensity reduction targets of 2%, 2% and 25% for its power, water-supply and manufacturing sectors respectively according to the regional reduction target, sector reduction potential as well as cost, industrial competence and development strategy. Then a set of intensity benchmarks is formulated and combined with projected outputs to calculate the intensity-based cap and sector totals. For power and water-supply sectors, carbon

² Carbon intensity can be expressed in two forms, the amount of carbon dioxide emitted per unit GDP or the amount of carbon dioxide emitted per unit product.

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