Another Learning-by-doing Process:  
The Development and Prospect  
of Carbon Trade in China  

by  

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Abstract

In order to promote marketization at a national level, the Chinese government established special economic zones in some coastal cities at the early stage of the Chinese Economic Reform. This learning-by-doing process helped the Chinese government to gain fruitful experience in designing market-based economic policies that are adaptable to China’s political and economic institutions. Thanks to the market reforms, China has enjoyed rapid economic growth and social development since 1980s. However, this economic achievement greatly contributes to some serious environmental issues, including climate change. As the world’s largest developing country, China has surpassed the United States and become the largest greenhouse gas (GHG) emitter. Facing increasing pressure on carbon reduction from both international and domestic levels, the Chinese government finally decided to conduct a market-based instrument to control CO₂ emissions with another learning-by-doing process. This thesis aims to examine China’s recent experiment on carbon trade, in preparation for the framework design of a national emission trading system (ETS). After explaining China’s preference to emissions trade rather than carbon taxes at the current stage, this thesis compares and discusses the seven pilot ETS programs, the key features and market performances of which are further evaluated. Finally, this thesis provides institutional recommendations on the evolution from the experimental emissions trading systems to a national ETS program.
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Introduction

According to the Intergovernmental Panel on Climate Change (IPCC) *Climate Change 2014 Synthesis Report*, “it is extremely likely that more than half of the observed increase in global average surface temperature from 1951 to 2010 was caused by the anthropogenic increase in GHG concentrations and other anthropogenic forcings together.”¹ Given the excess greenhouse gas (GHG) emissions generated by human activities, climate change becomes an increasingly urgent issue in the global community due to its serious threats to the planet’s ecology. In order to mitigate the impacts of global warming, many countries have taken or are considering taking actions to address climate change. One of the most direct and common methods of mitigation is to control and decrease carbon emissions caused by the anthropogenic activities.

Aligning with its rapid economic growth, China is now experiencing a crucial period of industrialization and urbanization, which greatly contributes to its excess GHG emissions. As the world’s largest emitter of greenhouse gas since the late 2000s, China has been facing tremendous pressures by the global community on the issue of carbon reduction. This pressure forces the Chinese government to carry out appropriate environmental instruments for the purpose of CO₂ emissions control. Similar to its experience in conducting market-oriented policies in the late 20th century, the Chinese government selected seven pilot regions to operate the emissions trading systems (ETSs). This learning-by-doing process will help the central government to gain

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experience in order to draw up national carbon trade policies, especially as China has promised to establish a nationwide carbon market by 2017.

Given that the carbon trade experiment is approaching the end, this thesis aims to examine the strengths and weaknesses of the seven pilot ETS programs in terms of the design elements and performances. Based on the comparison and evaluation of the regional emissions trading systems, this thesis then comments on the following two questions: How should the Chinese government set up a nationwide carbon market? What kind of framework may be more appropriate for China’s national ETS program?

In order to answer these questions, this thesis is split into three chapters. Chapter One chronicles China’s process in addressing climate change and demonstrates China’s preference for carbon emissions trading among the three common carbon reduction instruments, the command and control regulation, carbon taxes and carbon trade. Chapter Two presents a subtle comparison and evaluation of the seven pilot ETSs, drawn from many primary and secondary sources in Chinese. Chapter Three evaluates the pilot ETS programs, concentrating on several selected elements as well as market performances, and provides some suggestions on China’s future construction of a nationwide carbon market.
Chapter One: Employing the Market Forces in Carbon Reduction

Due to China’s rapid economic development in recent years, its energy consumption has increased by 2.3 times from 1990 to 2013, which has led to a tremendous growth in China’s carbon emissions. Well aware of the necessity in CO₂ reduction, the Chinese government started to apply mandatory administrative measures to achieve its carbon reduction goal in the late 2000s. During China’s Eleventh Five-Year period (2006-2010), 1.25 billion tons of CO₂ reduction were accomplished through mandatory regulations, whereas only 0.035 billion tons were reduced by cause of market-oriented mechanisms. However, this kind of command-and-control regulation is very costly. From a long-term perspective, the Chinese government cannot continue to rely on such administrative measures, which are effective but not efficient. In the Third Plenum of the 18th Central Committee of the Chinese Communist Party (2013), the central government determined to increase the employment of market-oriented instruments by assigning the market to play a crucial role in resources allocation, including CO₂ emissions.

At the Beijing Asia-Pacific Economic Cooperation (APEC) in 2014, China and the United States jointly announced targets to reduce carbon emissions in the post-2020 period, which was the first time China declared a specific target of carbon reduction. The Chinese government

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3 Zhang, Zhongxiao, Carbon Emissions Trading in China: The Evolution from Pilots to a Nationwide Scheme, Australian National University, Crawford School of Public Policy, Center for Climate Economic & Policy, CCEP Working Paper 1503, 2015, 4.
4 Ibid., 2.
committed to reach its peak year of CO₂ emissions no later than 2030.⁵ On September 25, 2015, China and the United States announced a significant step in their efforts to address global warming. According to their agreement, China will set up a national carbon emissions trading system by 2017.⁶ By establishing a price for CO₂ emissions, a carbon emissions trading system (or “carbon market”) is a market-oriented instrument providing incentives for firms to voluntarily reduce their CO₂ emissions. Rather than set a specific price for each unit of carbon emission (“carbon tax”), the regulatory authority puts a cap on the overall quantity of CO₂ emissions, which will yield a price for carbon emissions through the market operation.

With little experience in applying market-based measures to reduce CO₂ emissions, the Chinese government started its carbon trade experiment in China’s seven major cities and provinces. In October, 2011, the National Development and Reform Commission (NDRC) approved seven pilot emissions trading systems (ETBs), conducted in Beijing, Tianjin, Shanghai, Shenzhen, Guangdong, Chongqing, and Hubei.⁷ This learning-by-doing process can help the central government to gain fruitful experience and learn valuable lessons in light of constructing a nationwide carbon market in China.

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⁷ Zhang, Zhongxiao, Carbon Emissions Trading in China: The Evolution from Pilots to a Nationwide Scheme, Australian National University, Crawford School of Public Policy, Center for Climate Economic & Policy, CCEP Working Paper 1503, 2015, 2.
China’s Road to Address Climate Change

The First Stage: from the United Nations Framework Convention on Climate Change in 1992

The United Nations Framework Convention on Climate Change (UNFCCC) is an international environmental treaty negotiated at the United Nations Conference on Environmental Development (UNCED) in June 1992 and implemented in March 1994. The ultimate objective of this Convention is to achieve “stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.” With 172 governments participating, the negotiation at UNCED set the framework of sustainable development at a global level. Even though the Chinese government participated in the discussion of the UNFCCC during the Conference, its role was limited. Nevertheless, the UNCED also established Agenda 21, a comprehensive blueprint of action in respect to sustainable development, which became the guiding document for China to address environmental issues in the early stage of tackling climate change.

Based on the content of Agenda 21, the Chinese government drafted and approved China’s Agenda 21, the White Paper on China’s Population, Environment, and Development in 1994. Unlike an international treaty or a legally binding document, Agenda 21 is a voluntarily

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9 Ibid.
10 Shen, Ying, Environmental Policies Concerning Climate Change in China: A Contemporary and Holistic View, Environmental Law Institute, 2013, 2.
11 Ibid.
implemented action plan without the force of law. Correspondingly, China’s Agenda 21 is also a policy document, functioning as a guideline to set up medium- and long-term plans concerning sustainable development. Specifically, Chapter 18 of China’s Agenda 21 focuses on climate change and air pollution caused by human activities, in which the Chinese government aims to develop a national program to control greenhouse gas (GHG) emissions.

The Second Stage: from mid 1990s to 2002 (The Kyoto Protocol)

After signing off on the UNFCCC, the Chinese government gradually improved its understanding of global warming, which contributed to the country’s conservative attitude in international negotiations concerning climate change. The Chinese government recognized that addressing climate change was not only related to the reduction of greenhouse gases concentrations, but also linked with the economic development of all the participating countries, especially the developing countries. Reducing GHG emissions would have a negative impact on the country’s economic development. This kind of tradeoff became a serious concern for the Chinese government. China started to enjoy rapid economic growth in the 1990s, which the central government did not want to sacrifice for the purpose of tackling global warming. During this period, the Chinese government even suspected that the Western developed countries tried to make use of climate change to restrict the economic growth of the developing countries.

\[\text{12 Ibid., 2-3.}\]
\[\text{13 Ibid., 3.}\]
Adopted in December 1997, the Kyoto Protocol provides specific measures for implementing the objective of the UFCCC to tackle climate change given the principle of “common but differentiated responsibilities.” The principle of “common but differentiated responsibilities” means that as developed countries are historically responsible for the current levels of greenhouse gases, they should be obligated to reduce current GHG emissions. Thereby, even though all the countries have a duty to cooperate for the purpose of global sustainable development, the developing countries do not take the responsibilities of GHG reduction in the current stage. According to the Kyoto Protocol, only developed countries and countries with economies in transition have to fulfill the quantified emissions reduction obligations. Moreover, the developed countries should offer technological and financial supports to the developing countries in addressing and adapting climate change. As the representative of the developing world, the Chinese government played a more significant role during the negotiation of the Kyoto Protocol, the final draft of which greatly embodied the principle of “common but differentiated responsibilities.” In 2002, China ratified the Kyoto Protocol, which symbolized a significant progress of the second stage.

The Third Stage: after 2002 (The Paris Agreement)

After the ratification of Kyoto Protocol, the Chinese government became more active in the United Nations Climate Change Conferences, representing the interests of developing

\[\text{Kyoto Protocol, United Nations Framework Convention on Climate Change,}\]
\[\text{http://unfccc.int/kyoto_protocol/items/2830.php.}\]
\[\text{ibid.}\]
countries and insisting on the principle of “common but differentiated responsibilities.” For the Chinese government, addressing climate change was not only an environmental issue, but also a developmental problem. As many of the developing countries are still experiencing the process of industrialization, economic development may be their primary concern rather than environmental problems. However, since China had surpassed the United States to become the largest carbon emitter in the late 2000s, the international pressure forced the Chinese government to gradually change its attitude towards the climate change issue. Aware of its responsibility in addressing climate change, the Chinese government acknowledged its crucial role in carbon reduction, which resulted in China’s announcement to reach its peak year of carbon emissions no later than 2030.

At the United Nations Climate Change Conference (the “Paris climate conference”) in December 2015, 195 countries successfully approved a landmark agreement, in which they committed to limit the global temperature increase to well below 2 °C, with a more ambitious target of 1.5 °C.\(^\text{17}\) China played a leading role in the accomplishment of the Paris Agreement. Keeping the principle of “common but differentiated responsibilities,” China insisted that the developed countries had to offer funds and technology for the developing world to address climate change.\(^\text{18}\) In the agreement, each party shall communicate a nationally determined contribution every five years, requiring all the participating countries to come back with new emissions

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reduction targets to be evaluated. Due to China’s persistence and efforts, the five-year-reviews remain flexible for the developing countries.

Nevertheless, although the Chinese government evaluates the Paris conference as a victory, in which China has expressed a sense of responsibility as a major country to address climate change, some Chinese scholars only see the agreement as a small step in the long-term process. Professor Haifeng Deng, Associate Professor at Tsinghua University School of Law, emphasized the lack of punitive measures within the Paris Agreement. During a private phone interview with Professor Deng, he argued that the agreement is far less meaningful as there is no mandatory provision to tackle climate change. Specifically, if the countries do not achieve the goal of restricting the temperature increase within 2 °C, no country will need to undertake related legal responsibilities. To some extent, the influence of the Paris Agreement in the future is still debatable. However, as the long term framework has gradually been set up, China in addition to other major powers will continue to figure out an optimal solution to climate change on the basis of the Paris Agreement.

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Three Main Methods of Carbon Reduction in the Global Society

Command and Control Regulation

The command and control regulation is an approach to decrease carbon emissions through the intervention of a central authority, usually a governmental body, by applying mandatory administrative measures. The government has to determine the aggregate emissions target with strict individual quotas adding to the total. Given the information collected by the related departments, the authority will set a fixed emissions goal for each polluter in order to fulfill the overall emissions target. Without deploying incentives, the use of inflexible regulatory tools will hardly encourage firms to innovate in their technology. Because it does not take account of different costs faced by each entity in reducing CO₂ emissions, this command and control method is not cost effective. Moreover, since it is difficult for the government to foresee the clear path of technology trends, its stipulation on technology will probably not help the firms to uncover the new technologies that promote the progress of carbon reduction.

A variant of this approach is the restriction of total energy consumption, which is prevalent in some European countries. In this model, legislation and governmental executive policies play fundamental and dominant roles in controlling the total energy consumption. For example, the European Union (EU) has set the 2020 climate and energy package, a set of binding legislation to ensure that the EU meets its climate and energy targets by 2020. The package includes three key

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targets: 20% cut in greenhouse gas emissions from the 1990 level, 20% of EU energy from renewable sources and 20% improvement in energy efficiency.\textsuperscript{21} Particularly, the EU applies the emissions trading system (ETS) in order to achieve the goal of greenhouse gas emissions reduction, trying to combine cap and trade with administrative measures. However, the ETS only covers around 45% of the EU’s greenhouse emissions, while the other 55% is cut by national emission reduction targets, including agriculture, housing, waste, transport, and other main industries.\textsuperscript{22} Based on their development situations in addition to economic conditions, the EU countries have established binding targets specifically for the years before 2020. For example, Germany has stipulated its reduction targets regarding energy efficiency as 20 percent by 2020 and 50 percent by 2050. Electricity consumption should be reduced by 10 percent in 2020 and 25 percent in 2050.\textsuperscript{23} The targets for the building sector as well as energy productivity are also prescribed in the energy-saving and emission-reduction policies of the German government. Given international experiences, controlling the total energy consumption may be more suitable for the developed countries, which have almost finished their transformation of industrial structures and have less demand on energy consumption.

\textsuperscript{21} Ibid.
\textsuperscript{22} Ibid.
Carbon Taxes

The carbon tax is another pure strategy that decreases carbon emissions through pricing. Designed to internalize the externalities of fuel consumption and thus limit CO\textsubscript{2} emissions, the tax rate will not vary with shocks to fuel prices. Instead, under a carbon tax mechanism, the price of carbon ("the tax rate") is ascertained by the regulatory authority after a precise computation. As a market-oriented instrument, the carbon tax provides incentives for firms to directly reduce their CO\textsubscript{2} emissions based on their cost-benefit analysis. The firms, in this way, will carry out energy-saving measures and increase their investment in green projects.\textsuperscript{24} By causing the prices of carbon-intensive goods to rise relative to other goods, this policy can also influence consumers’ consumption patterns towards less carbon-intensive goods, resulting in lower outputs of carbon-intensive industries and thus promoting industrial restructure.\textsuperscript{25} Moreover, the taxes received by the regulatory authority can be redistributed to invest on low carbon industries, which will indirectly help to achieve carbon emissions reduction.\textsuperscript{26}

For many developed countries, carbon taxes have been used for over 20 years. Sweden and Finland were the first countries to employ carbon taxes, starting in 1990.\textsuperscript{27} Since then, more than ten European countries have adopted carbon taxes in specific industries.\textsuperscript{28} However, due to the

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\textsuperscript{27} Ibid., 7.
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application of the European Union Emissions Trading System (EU ETS), some industries have received double regulation on their CO₂ emissions. As a result, the industries that are covered by the EU ETS no longer adopt carbon taxes. In the United States, there is a wide agreement among American economists regarding emissions pricing, but many of them disagree about whether carbon taxes or carbon trade will be the better climate policy option. Only recently, several U.S. policymakers started to focus on carbon taxes due to the inability to pass federal carbon emissions trading legislation and the necessity of a broader tax reform to reduce budget deficit.

In order to help to implement the carbon tax policy properly, the government has to receive ample information regarding the emissions levels of each taxed entities. As the tax rate must be applied to the individual firms given their CO₂ emissions, the information requirement for carbon taxes is almost the same as that of the command and control method. Based on the emissions level of each firm, the government can then calculate the corresponding tax rate for the purpose of restricting the total carbon emissions. Ideally, a uniform carbon tax can help to achieve the aggregate CO₂ emissions target as the command system. With sufficient information concerning individual carbon emissions, the government can simply set the tax rate that makes each entity choose to emit at the level that, when aggregated, equals to the desired overall target. Compared with the command and control method, the employment of carbon taxes will help to reach the aggregate in a cost effective way. After imposing a uniform carbon tax, firms that find it cheap to

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30 Ibid.
reduce CO$_2$ emissions will probably disburse resources in order to achieve the goal and thereby avoid the tax, whereas firms for whom reduction is expensive will prefer to pay the taxes.

Nevertheless, during the practical operation, as it is difficult for the government to obtain sufficient information of carbon emissions for all the entities, the stipulation of tax rates will become arbitrary to a great extent. Even though based on the current aggregate emissions level, the government can compute an appropriate tax rate that will cut specific quantities of carbon emissions. The impact remains uncertain, since the government cannot control how much CO$_2$ emissions are actually reduced in practice. Moreover, a uniform carbon tax that neglects the significant differences among taxed entities, will probably distort the market competition. For instance, the small firms that cannot sustain the high level carbon tax rate may choose to shut down and leave the industry, while the large firms that identify the tax rate as acceptable will probably pay the taxes rather than diminish CO$_2$ emissions. From an economic perspective, this process is efficient as only firms that can afford the costs remain in the market, which will help to maximize the social utilities. However, some of the small firms are at an early stage of their operation, and should not be given more burdens during this period. With a certain degree of protection, these small firms may evolve into large ones that can reduce carbon emissions more effectively.

**Carbon Emissions Trading (Cap and Trade)**

Carbon emissions trading is a hybrid means that basically allocates rights to firms for CO$_2$ emissions so that the aggregate target can be achieved with the permission of trading excess rights at a market price. Instead of setting a specific price for carbon emissions (“carbon taxes”), the
regulatory authority puts a firm limit on the overall quantity of carbon emissions, which will yield a price of CO$_2$ emissions through the market function. In most of the current emissions trading systems, each firm will initially acquire certain allowances given the evaluation of the regulatory authority. If the firm can reduce its emissions below its allowances level, the firm can sell its quotas to another firm and get revenues, which provides incentives for the firms to improve their production mechanism and voluntarily decrease its CO$_2$ emissions. On the other hand, the firm that is inclined to over emit will also have a motivation to reduce carbon emissions in order to avoid the expenses in buying quotas from other firms. Carbon emissions trading, in this way, encourages all the firms within the system to innovate and thus restrict the aggregate CO$_2$ emissions.

This cap and trade approach was first applied to limit the emissions of SO$_2$ in the United States under the Clean Air Act Amendments of 1990, which could be seen as both innovative and successful. Thanks to the allowances trading program, SO$_2$ emissions from electric power plants decreased 36 percent between 1990 and 2004 in the U.S.\textsuperscript{31} Even though emission trading has gradually become familiar to the public since 1990s, the method was still not prevalent in the international community until the adoption of the Kyoto Protocol in 1997. Under the Kyoto Protocol, most developed countries agreed with legally binding targets for CO$_2$ emissions, as well as five other major greenhouse gases.\textsuperscript{32} In order to fulfill the targets, the Kyoto Protocol offers

three market-based mechanisms, which can help to develop low-carbon technology and thus decrease carbon emissions in a cost-effective way. Among the three mechanisms, international emissions trading allows the countries to sell their excess allowances to other countries.\textsuperscript{33} This method greatly leads many developed countries to start their application of cap and trade at a national level. Especially, based on the framework of the Kyoto Protocol, the European Union Emissions Trading System (EU ETS) provides a platform for the firms of the EU countries to trade their allowances of greenhouse gases within the countries or across the borders, resulting in the reduction of carbon emissions for all the participated countries.

Unlike carbon taxes, cap-and-trade will help to directly achieve the carbon reduction goal. As the first step of carbon emissions trading is to set an aggregate emissions target, every trade within the system will theoretically not increase the aggregate emissions. Consistent with the intention of environmental legislation, imposing cap and trade specifies a quantitative limit on the aggregate carbon emissions, gaining support from many environmental groups.\textsuperscript{34} However, as the overall quantity of carbon emissions is stipulated, the carbon price is left uncertain. Some critics argue that the volatility of emissions prices may become a serious problem for cap-and-trade. Especially, several existing cap-and-trade systems have already displayed significant price volatility of emissions.\textsuperscript{35} For instance, the energy supply crisis in California in 2000 provided power companies the incentive to sell some older power generators online in the Los Angeles area,

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\textsuperscript{35} Ibid., 12.
\end{footnotesize}
resulting in a considerable increase in the demand of NOx emissions allowances under the Regional Clean Air Incentive Market Program. As a result, due to the market mechanism, the price of NOx allowances increased dramatically, from about $400/ton to an average in 2000 of over $40,000/ton.\(^{36}\) This unfairly high level of emissions prices harmed the economic interests of the participants within the emissions trading system from a short term perspective, even though in the medium run, the impact of the supply shock would be counteracted through the market function.

Furthermore, some economists also figure out a typical pattern of high price volatility during the early stage of these emissions trading systems. For the EU ETS, the allowance prices tripled in the first six months, but collapsed by half in a week in April 2006, and declined to near zero in the next twelve months.\(^{37}\) Under the U.S Acid Rain Program, the initial price of SO\(_2\) allowances was $130 in early 1993 and halved to $70 in early 1996.\(^{38}\) The opening price of Northeastern NOx Budget Program also started with a higher price level and then quickly dropped to a much lower one.\(^{39}\) Nevertheless, as people get used to the emissions trading mechanism, and the standard of cap and trade becomes more complete and explicit, firms will adjust themselves to the new information more quickly with smaller price fluctuation.

In addition, according to the investigation of Ellerman and Joskow, the volatility of allowance prices is comparable to that of related energy commodities. Especially, they conclude

\(^{36}\) Ibid.
\(^{38}\) Ibid.
that the volatility of EU allowance prices is no greater than that in the markets of natural gas and electricity, in which participants can hedge their positions if they are willing to protect themselves against unfavorable price levels. Similarly, there are also hedging possibilities in the emissions trading systems, which can partially explain the price fluctuation in these markets. The volatility of prices, moreover, provides chances for the market to discover the optimal price of carbon emissions. By using comparisons and analyzing indicative cost curves, economists can predict the price of the carbon emissions at a more or less acceptable level, but the power of market will enable a more accurate carbon price to be revealed spontaneously. As a result, carbon emissions trading will help to satisfy the interests of most participants and maximize the total surplus in the market.

Besides, cap-and-trade encourages firms to invest in the emissions-reducing technologies. The price level of carbon emissions depends on market transactions rather than the governmental stipulation. In order to benefit from the emissions trade, firms are stimulated to reduce their carbon emissions through technology innovations. As this kind of investment is often a long term one, firms can make a series of investment decisions based on the firms’ cost curves in addition to the price signals in the market. If a firm figures out an earlier carbon reduction project to be much more beneficial, it will probably accelerate the investment process. On the other hand, when the market environment becomes negative, it may instead choose to defer the investment and wait for another opportunity. The issue of price volatility, in this way, may also impact the investment decisions of the firms since they will probably give up a preemptive option in order to hedge against loss.

40 Ibid., 42.
Policy Choices in China: from Both Theoretical and Empirical Perspectives

At China’s sixth National Environmental Protection Conference in 2006, the Chinese government proposed to transform from reliance on command-and-control regulations to a comprehensive application of economic, technological, legal and administrative measures for the purpose of emissions reduction and energy saving.\(^{41}\) In the guideline of China’s eleventh five-year plan (2006-2010), the Chinese government set the target of reducing energy intensity for the first time: Energy consumption per GDP should decrease by twenty percent in 2010, in order to reach the target of controlling the total energy consumption as twenty-seven hundred million tons’ standard coal and maintaining the growth rate of total energy consumption as four percent.\(^{42}\) However, during this period, the Chinese government still greatly relied on administrative measures in order to fulfill the energy reduction target. For instance, a number of provinces were obligated to shut down inefficient power plants and large factories.\(^{43}\) Even though such command-and-control regulations are effective, they are very costly and thus inefficient.

In the guideline of China’s twelve five-year plan (2011-2015), the government further stipulated restrictive targets of carbon emissions per GDP (“carbon intensity”) and energy

\(^{41}\) Zhang, Zhongxiao, Carbon Emissions Trading in China: The Evolution from Pilots to a Nationwide Scheme, Australian National University, Crawford School of Public Policy, Center for Climate Economic & Policy, CCEP Working Paper 1503, 2015, 2.


\(^{43}\) Shen, Ying, Crossing the River by Groping for Stones: China’s Pilot Emissions trading Schemes and the Challenge for a National Scheme, Asian Pacific Journal of Environmental Law (Volume 18), 2015, 2.
consumption per GDP, which should be fulfilled by the end of 2015. Based on the restrictions, the Chinese government purposed a goal of total energy consumption as forty hundred million tons’ standard coal. Although China can continue to solely employ governmental commands to decrease carbon intensity and achieve these goals, this approach may not be the best method for the Chinese government to apply. According to Hayek’s theory, it is almost impossible for a central government to have complete information regarding each firm. Without sufficient information, the Chinese government cannot reduce carbon intensity and promote industrial re-structure in a cost-effective way.

Well-aware of the problems within command-and-control regulations, the Chinese government decided to rely on the market forces to reduce its energy consumption as well as carbon emissions. Carbon taxes and emissions trading are the most common market-based instruments that internalize externality costs in the market prices. Theoretically, in the context of regions with high economic growth, a fixed supply of carbon allowances under an emissions trading system (ETS) will increase the price of allowances with no change in the aggregate emissions, while a fixed carbon tax rate will lead to an increase in the aggregate emissions level with no change in the carbon price. The ETS can help to achieve the carbon reduction target

\[44\] Ibid., 9-10.
\[45\] Zhang, Zhongxiao, Carbon Emissions Trading in China: The Evolution from Pilots to a Nationwide Scheme, Australian National University, Crawford School of Public Policy, Center for Climate Economic & Policy, CCEP Working Paper 1503, 2015, 6.
directly, even though the regulated entities have to bear higher abatement costs given the higher price level of carbon allowances.

Furthermore, the creation of carbon market will enable each firm to voluntarily reveal and exchange its information on how much CO₂ emissions are required for the firm’s production. In a carbon emissions trading system, firms will have incentives to uncover new technology in order to decrease their carbon intensities, and thus achieve the goal of carbon reduction. The accumulation of technology innovation will greatly promote the adjustment of industrial structure, which will provide long term impacts in reducing CO₂ emissions. Although carbon taxes can also encourage firms to innovate in technology and promote changes in industrial structure, the effects may be limited since the mechanism may not restrict the aggregate carbon emissions to the specific target.

From an empirical perspective, the Chinese government tends to choose cap and trade over carbon taxes in the short term. Under China’s Environmental Protection Law, polluting entities only pay charges for excess emissions. However, the imposition of carbon taxes will be lacking a legal basis since such taxes have to be levied on each unit of carbon emissions rather than the emissions exceeding the allowed level only.\(^{47}\) In this way, the existing environmental law in China has to be amended for the introduction of carbon taxes. Moreover, even though the Chinese legislature is now considering to promulgate environmental tax law, the whole legislation process

\(^{47}\) Zhang, Zhongxiao, Carbon Emissions Trading in China: The Evolution from Pilots to a Nationwide Scheme, Australian National University, Crawford School of Public Policy, Center for Climate Economic & Policy, CCEP Working Paper 1503, 2015, 6.
of amending the existing environmental law and promulgating new law concerning environmental taxes will take a long time, which greatly retards the introduction of carbon taxes.\textsuperscript{48}

In addition, the current taxation system in China should also be reformed in order to reconcile the carbon taxes with the existing taxes. Many related categories of taxes may need to be adjusted so as to avoid the issue of overlap taxation. As China’s taxation system is a complicated and nuanced fiscal mechanism, its reform may have significant impacts on the national economy.\textsuperscript{49} Therefore, the Chinese government may become more cautious in this process, resulting in a longer research and decision-making period.

In comparison to carbon taxes, emissions trading is more favorable to the Chinese government. From a legal perspective, carbon trade is permissible in China since the mechanism will only require the regulated entities to pay charges for the amounts of emissions above the allowed level. Also, the Chinese government has already launched seven pilot ETS programs since 2013 and has promised to construct a nationwide carbon market by 2017. This series of actions show China’s preference to carbon trade as the major market-based instrument to control and reduce CO\textsubscript{2} emissions in the near future.

\textsuperscript{48} Ibid.

\textsuperscript{49} Shen, Ying, Crossing the River by Groping for Stones: China’s Pilot Emissions trading Schemes and the Challenge for a National Scheme, Asian Pacific Journal of Environmental Law (Volume 18), 2015, 11.
Chapter Two: China’s Recent Experiment on Carbon Trade

In late October of 2011, China’s National Development and Reform Commission approved the operation of seven pilot carbon markets, including in the cities of Beijing, Tianjin, Shanghai, Chongqing, and Shenzhen, as well as in the provinces of Hubei and Guangdong. This “Two Provinces and Five Cities” carbon trade experiment covers China’s major economic and industrial regions, in which over twenty different industries are involved and more than two thousand enterprises or organizations participate, generating about twelve hundred million quotas of CO₂ each year. On June 18th, 2013, as one of the major Chinese economic cities with low energy consumption per capita, Shenzhen first began its operation of emissions trading system (ETS) after completing the regional carbon trade legislation, developing the relevant techniques, and establishing the carbon market scheme. Following Shenzhen’s successful initiation, the six other pilot ETS programs started to operate successively. Until August 2014, the seven regional carbon markets had completed over 13,000,000 tons of allowances transactions in total, with carbon prices ranging from 26 to 78 dollars per allowance. During the first implementation period of all the pilot ETS programs, whereas the average carbon price of Shenzhen’s emissions trading system

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51 Ibid., 3.
52 Ibid.
was 67.67 yuan per ton as the highest level, the average price rate of Hubei’s carbon market was as low as 24.34 yuan per ton, reflecting the dispersion of prices across regions.\textsuperscript{53}

Nevertheless, this experiment has revealed several problems regarding the promotion of carbon trade in China, which this chapter will analyze separately for each regional ETS program. Following the summary and analysis of the regional carbon markets’ performances, this thesis will conclude and criticize the issues of carbon trade in China from various perspectives, including framework design, legislation, and market performances, in light of the further development of the nationwide emissions trading system in Chapter Three.

**Beijing**

As the capital city of China, Beijing is the political, economic and cultural center of the country, leading China’s reforms in many different aspects. Based on the guideline of China’s twelve five-year (2011-2015) plan, Beijing set its overall controlled quantity of carbon emissions as 119% of those in 2010, which should be fulfilled by the end of 2015.\textsuperscript{54} This specific goal of CO\textsubscript{2} emissions helped to ascertain the overall allowances of carbon trade in the first and second implementation period (2013-2015). According to the “Notice regarding the Experiment of Carbon Trade,” Beijing’s ETS program decided to include two types of enterprises or institutions to


participate into Beijing’s carbon emissions trading system: “Reporting Units” and “Key Emissions Units.”

“Key Emissions Units” refer to the enterprises, or institutions, whose sum of direct and indirect CO₂ emissions are over ten thousand tons per year; denoted as “Reporting Units,” the other kind of enterprises are voluntary participants, the yearly comprehensive energy consumption of which are at least two thousand tons. Given the official data on the website of Beijing Development and Reform Commission, more than four hundred enterprises fulfill the first criteria while over one hundred non-enterprises, such as public institutions, are included in Beijing’s carbon trade system. For the issue of allowances distribution, the Beijing government freely distributes all the CO₂ quotas based on four main factors: the firm’s historical carbon emissions level, the advanced CO₂ emissions level of the firm’s industry, the development trend of the associated industry’s technology, and the impact of the economic structure adjustment.

The institution of Measurement, Reporting, and Verification (MRV) is a crucial element of a well-established carbon emissions trading system, which has been gradually developed in Beijing and other experimental cities or provinces. Both the Reporting Units and the Key Emissions Units are supervised and regulated within Beijing’s MRV system. As the Reporting Units have certain levels of flexibility in respect to carbon trade, they are self-responsible for the

55 Ibid., 66. “Notice regarding the Experiment of Carbon Trade” is the translation of a Chinese official document: 关于开展碳排放权交易试点工作的通知; “Reporting Units” is the translation of a specific Chinese word: 报告单位; “Key Emissions Units” is the translation of a specific Chinese word: 重点排放单位.
56 Ibid.
completeness and accurateness of their yearly emissions reports, which do not have to be verified by third party institutions. However, for the Key Emissions Units, they need to not only submit emissions reports every year, but also entrust third party institutions to check and verify their reports as well.\textsuperscript{59} The verification reports of the third party institutions in addition to the related official documents should be submitted by April 30\textsuperscript{th} every year. The responsible department needs to examine both the emissions reports and the verification reports no latter than May 30\textsuperscript{th} in order to prepare for the quotas distribution in the next implementation period. For the Key Emissions Units that do not pass the examination, they have to revise their emissions and verification reports in alignment with the requirements of the responsible department. Two instances of failure will result in re-verification by another third-party institution designated by the responsible department, the verification report of which will become the final result of the unit.\textsuperscript{60}

Beijing has already set the conditions in addition to the thresholds for the third party verification institutions, revealing a higher and more sophisticated management and supervision level: First, the institution’s registered capital should be more than three million yuan. Second, the institution ought to have a robust accounting system with good reputation in the industry. Third, the verification institution should be approved or recorded by the Clean Development Mechanism (CDM) Executive Council, the National Development and Reform Commission, or other governmental institutions. Also, the institution has to accomplish at least ten related projects in the last three years or own the experiences to undertake associated tasks. Fourth, the institution should

\textsuperscript{59} Ibid.
have a well-established system of internal quality management. Fifth, the institution ought to own at least three professional consultants on verification. These conditions greatly help to standardize the market of verification institutions, which is a crucial step to promote the well-functioning of Beijing’s carbon market.

In Beijing’s ETS program, the main reasoning behind its legal framework is called “1+1+N,” emphasizing the collaboration between various official documents of People’s Congress in Beijing. As China’s legislative branch, People’s Congress are operated at both a national and a local level, the official documents of which have strong legal effects in operation. Beijing People’s Congress has drawn up a “decision” regarding carbon trade, the key legal document of Beijing’s construction on carbon emissions trading system, which is denoted as the first “1” in the legal framework. Unveiled in December 2013, this decision provides a relatively detailed framework of Beijing’s pilot ETS program by demonstrating the rights and responsibilities of the Beijing government, Key Emissions Units and other associate institutions. The second “1” refers to the management measure regarding carbon trade, which further specifies and clarifies the role of governmental institutions. Besides these two official documents written by the local People’s Congress, Beijing Development and Reform Commission has also released several management documents regarding many related aspects of cap and trade, including allowances management,

61 Ibid., 31.
62 Ibid., 26.
64 Ibid.
the submission of carbon emissions reports, and the verification of CO₂ emissions. Even though Beijing has issued some governmental documents regarding the operation of carbon market, only two of them have relatively strong legal effects, in which the punitive measures are not strong enough to effectively restrict the carbon emissions of the participated units.

As the first experimental region publishing the management measure of the carbon emissions counteraction, Beijing’s ETS program normalizes the offset mechanism by detailing the specific rules and responsibilities in various aspects. China Certificated Emission Reductions (CCER) projects can be used to meet certain levels of CO₂ emissions, which are different for each regional carbon market. CCERs refer to a type of carbon credits generated from implementing emissions-reduction projects in China. For Beijing’s ETS program, no more than 5 percent of annual allowances can be met with local CCER projects, and no more than 2.5 percent can be met with non-Beijing projects. This stipulation aims to provoke regional cooperation in respect to environmental protection and economic development. The management measure also provides time limits regarding the generation period of CCER credits, restricts the application of water and electricity projects for offset, and encourages the implementation of energy-saving projects.

During the first implementation period, Beijing’s market manifested a seasonal character, in which the carbon price went up drastically right before the actual compliance day. On the compliance date, the participating units need to report their last year’s carbon emissions, which

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66 Ibid., 24-25.
should be no more than the allowances they have. Technically speaking, this process is called compliance, during which all the units within the ETS program have to surrender their allowances. From the market open date in 2013, the carbon price was relatively steady, around 50 yuan per ton to 55 yuan per ton. The price started to increase significantly in the first quarter of 2014, and intensified its extent of escalation since early April. Several days after Beijing’s actual compliance date of the first implementation period, the carbon price declined dramatically to its original level, approximately to the opening price of this period. Beijing originally set its compliance date on June 15\textsuperscript{th}, 2014 for the first implementation period (2013-2014), but postponed the actual date to June 27\textsuperscript{th}, as a result of a lower percentage of allowances surrendered. Among the 257 units that did not achieve their compliance on the original date, many of them are the governmental institutions or the enterprises controlled and managed by the central government. As many organizations and enterprises faced large gaps between the actual CO\textsubscript{2} emissions and the carbon allowances, it was very difficult for them to buy carbon quotas from the carbon market in the first implementation period, which is a relatively unique phenomenon among the seven experimental carbon emissions trading systems. Also, Beijing’s experience in the first implementation period suggests the potential problem of including non-enterprise units into carbon trade, which provides an important hint for the framework design of a nationwide carbon market.

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\begin{itemize}
\item \textsuperscript{68} Ibid., 74.
\item \textsuperscript{69} Ibid., 72.
\end{itemize}
Tianjin

As one of the four municipalities directly under the Central Government, Tianjin is the largest port city in the North China, owning aerospace, petrochemical, biological medicine and five other advantageous industries. Since 2008, Tianjin has kept a high speed of economic development, with an average GDP growth rate over 10 percent each year. Recorded as China’s highest per-capita GDP, Tianjin’s GDP reached 1.653 trillion yuan in 2015, revealing strong economic strength and potential. Due to its industrial structure and economic conditions, Tianjin decided to include two types of firms or enterprises as the participants of the experimental carbon market. While the key emissions firms (the enterprises or units with yearly CO₂ emissions over twenty thousand tons) are obliged to participate into Tianjin’s carbon emissions trading system, the other type of firms, referred to the voluntary participants, owns a higher level of flexibility and autonomy. Even though Tianjin is one of the major industrial centers in China, its threshold of key emissions firms is relatively high among the seven experimental carbon markets. However, these 114 firms cover around 60 percent of Tianjin’s carbon emissions every year, which may

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provide justification for Tianjin’s threshold setting. Given the principle of overall quantity control, Tianjin’s ETS program determines the total amounts of carbon allowances after its consideration of historical carbon emissions, technology characteristics of specific industries and some other related factors, taking both the reduction of CO₂ emissions per GDP and Tianjin’s economic development into account.

Although Tianjin is among the first group of regions to operate the pilot ETS programs, Tianjin’s ETS program has only published policy documents regarding the operation and management of carbon market, which have restricted legal power. Even if (in Tianjin’s management measure about carbon trade) supervision institutions and legal responsibilities both have been specified, Tianjin’s ETS program does not stipulate any substantive punitive measure, such as fines, which may further decrease firms’ incentives to trade and surrender allowances. As China’s major industrial and economic center, Tianjin’s experiment regarding carbon trade may become an important reference for the construction of a national ETS program. In this way, the discussion regarding the legislation framework of carbon trade, especially the penalty mechanism, will probably be a necessary and crucial topic in designing a nationwide carbon market.

Starting to operate on December 26th, 2013, Tianjin’s carbon market has the issue of excess supply in the initial periods. During the first and second implementation periods (2013-2015), the average carbon prices of Tianjin’s ETS program are both the lowest ones among the seven (six for

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2013) pilot emissions trading systems.\textsuperscript{75} Unlike many other experimental regions, the price trend of Tianjin’s carbon market does not present the seasonal characteristic. Even though the trading volume went up right before the compliance date, the volume was still relatively low compared with other pilot programs.\textsuperscript{76} The excess supply of carbon allowances in addition to the lack of legislation greatly leads to an unsatisfactory outcome of Tianjin’s market performance.

**Shanghai**

Located along the southeast coast of China, Shanghai has been the economic and financial center for the country with a large span of history. Since 1990s, Shanghai’s GDP and GDP per capita escalated drastically, with an annual average growth rate of 15 percent and 12 percent, respectively.\textsuperscript{77} Unlike many other major Chinese cities, Shanghai strongly promotes the development of the service industry by encouraging technology innovation and optimizing industrial structure. In 1999, the portion of service industry was over 50\% for the first time and has continued to increase smoothly since then.\textsuperscript{78} Due to the industrial reconstruction in addition to the rapid economic development, Shanghai’s energy consumption per GDP decreased from 1.78 tons standard coal per ten thousand yuan in 1995 to 0.57 tons standard coal per ten thousand yuan.


\textsuperscript{78} Ibid., 115.
in 2012. To a great extent, operating an experimental carbon market will advance and accelerate Shanghai’s development of the service industry, which will play a supportive role in the industrial transformation.

The task of allowances distribution in Shanghai is slightly different from that in other experimental regions. Among the units that are incorporated into the key emissions enterprises, several enterprises from the aircraft industry are included in Shanghai’s ETS program, which is the only experimental region that takes aerospace industry into account. Also, based on the historical CO$_2$ emissions levels of the firms that participate, Shanghai distributed the carbon quotas for three implementation periods (2013-2014, 2014-2015 and 2015-2016) at one time, which may lead to inflexibility for the management and operation of carbon trade. Other experimental regions, such as Beijing and Tianjin, distribute CO$_2$ quotas once per year in order to examine and adjust for the next year’s distribution. However, because of its unique way of allowances distribution, Shanghai’s ETS program initiated more types of exchange objects to further increase the liquidity in the regional carbon market. Also, Shanghai’s emissions trading system allows allowances transfer within the three years, which makes the application of carbon quotas become more flexible.

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81 Ibid.
82 Ibid.
Like Tianjin, Shanghai has not released legislation regarding carbon trade, but has only published regulatory policies to manage the ETS program, including three types of official documents. The central document of Shanghai’s carbon trade management is “Shanghai’s Trial Management Measure of Carbon Trade,” which was published through the mayor’s order.83 In the management measure, for the emissions controlled enterprises that violate the related provisions, the highest level of fines is 0.3 million yuan.84 This amount is too small in comparison to the production values of the enterprises that participate, resulting in fewer constraints on the employment of penalty rules. The second type of official documents are released by the local administration departments, in charge of allowances distribution and management, the institution of carbon emissions verification, and the requirements of emissions and verification reports. The last category, which is relatively unique among the seven experimental regions, refers to the management documents of carbon finance.85 As one of the financial centers in Asia, Shanghai aims to promote the experimental development of carbon finance through the promotion of various carbon financial products.

The problems within the framework design of Shanghai’s ETS program greatly impact its operation, evident through the price change in the last two periods. During the first and second implementation periods, the average carbon prices were 36.13 yuan and 31.56 yuan, which were

84 Ibid.
relatively low among the seven pilot carbon markets. Due to the lack of strong legislation, many of Shanghai’s key emissions enterprises are not active in carbon emissions trading. Also, the allowances distribution is very imbalanced in Shanghai’s ETS program given the scale of different enterprises: 70 percent of CO₂ quotas are held by a few enterprises, indicating that some market power are owned by these few. As a result, if those large enterprises are afraid of excess emissions and refuse to circulate their allowances in the market, there will be very few carbon quotas for circulation and transaction, which may result in the issue of liquidity and inefficient allocation.

Shenzhen

Before the operation of the seven regional carbon markets, Shenzhen initially issued its legislation of carbon trade, constructing a sophisticated and elaborate legal framework. As China’s first Special Economic Zone, Shenzhen has led various experiments in the areas of economy and finance. In 2012, Shenzhen’s GDP reached 1,295 billion yuan with a growth rate of 10 percent. Since 21st century, Shenzhen has been devoted to industrial reconstruction by the vigorous development of the service industry. Technology, finance, modern physical distribution, and culture have gradually become its four pillar industries, consisting of 60 percent of Shenzhen’s

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88 Ibid., 303.
GDP. Due to its adjustment in industrial structure, Shenzhen started to promote low carbon development in the late 2000s, which could be seen as the forerunner of China. In 2012, Shenzhen’s energy consumption per GDP is 0.451 tons’ standard coal per ten thousand yuan, less than 2/3 of the average national level.  

Based on the Med-Long Term Plan of Shenzhen’s Low Carbon Development (2011-2020), in which Shenzhen aims to decrease its carbon emissions per ten thousand GDP by 21 percent of the 2010 level and by 10 percent of the 2015 level in 2020, Shenzhen determines its yearly CO$_2$ emissions goal in addition to the carbon allowances as 30 million tons per year, considering both Shenzhen’s future economic development and its potential of carbon reduction.  

Besides free distribution, Shenzhen also distributes its carbon quotas by means of auction or purchase, which should be accounted as at least 3 percent of the overall cap.  

Unlike many other experimental regions, Shenzhen introduces an innovative twist to its method of allowances distribution, which provides each participant more flexibility in acquiring initial carbon quotas. First, the emissions cap of a given industrial sector is set. Second, all the regulated units in this sector are informed about the historical and target carbon intensities of the sector. Third, each unit submits its emissions allowances demand in order to compete with other units for free allowances. Fourth, more carbon-intensive units are required to achieve more

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89 Ibid., 304.
91 Ibid.
92 Zhang, Zhongxiao, Carbon Emissions Trading in China: The Evolution from Pilots to a Nationwide Scheme, Australian National University, Crawford School of Public Policy, Center for Climate Economic & Policy, CCEP Working Paper 1503, 2015, 12.
carbon reduction, which is one of the basic rules for the units to adjust their projected emissions allowances. In each round of the game, the units can choose to accept allowances and exit the game. Otherwise, they will continue to compete for allowances in the next round with fewer allowances remained. After finite repeated games, those units that have not accepted allowances can only receive allocation from the remaining allowances in the last round.\(^93\)

For the participants of carbon trade, Shenzhen’s ETS program refines its category of “emissions control units” into three types, including all of the enterprises, public institutions, and buildings that fulfill the standard of carbon reduction.\(^94\) The first type of units, named as mandatory emissions control units, refers to the enterprises or buildings emitting over 3000 tons CO\(_2\) per year, as well as the buildings of public institutions with at least ten thousand square meters. “Specified emissions control units” indicate the enterprises and buildings that the responsible department designates to include into the emissions control list. The last type of units, which is similar to other experimental regions, is the voluntary emissions control units ratified by the responsible department.\(^95\) Depending on the above criteria, Shenzhen’s emissions trading system initially included 835 units to participate in carbon trade, consisting of 635 industrial enterprises and 200 public buildings.\(^96\) Among the seven regional carbon markets, Shenzhen’s ETS program has the

\(^{93}\) Ibid.
\(^{94}\) “Emissions Control Units” is the translation of a specific Chinese word: 控排单位.
highest number of emissions control units, even though Shenzhen is one of the smallest geographic regions.

In the area of legislation, Shenzhen’s ETS program has released the temporary management measure of carbon trade passed by Shenzhen People’s Congress, which has stronger legal effects in carbon trade regulation. Especially, as the official document was issued before the operation of Shenzhen’s carbon market, the activities regarding carbon trade are managed and supervised more specifically and comprehensively from the beginning. According to the theory of liability rules, the well-functioning of a market mechanism greatly depends on its institution of rewards and penalty in order to avoid the free-rider problem. Since Shenzhen’s carbon emissions trading system is more market-oriented, the nuanced design of the rewards and penalty mechanism will impact the carbon market’s operation.

On the one hand, Shenzhen encourages the participated enterprises and buildings to achieve the compliance and thus promotes carbon trade by two major means: project support and financial incentives. For the emissions control emits that accomplish the compliance on time, they will be supported by certain governmental policies in their application and financing of energy-saving projects. Also, these units can receive strong financial support in their future activities regarding emissions reduction. On the other hand, Shenzhen provides relatively harsh penalty to the units that do not fulfill their obligations of compliance through various ways. Shenzhen links the compliance performance with the enterprises’ credit system, and promptly exposes the information

of the defaulting enterprises. Besides the negative impacts on the firms’ credit history, Shenzhen has also released a series of penalty policies, which provide multiple levels of punishment.

However, unlike other experimental carbon markets, Shenzhen does not have enough supportive management policies with respect to carbon trade, which may increase the burden of the emissions control units. For example, Shenzhen has not issued the management measure regarding MRV institutions until the end of the second implementation period. In other words, the MRV market remained in a state of disorderly competition. As it was difficult for the emissions control units to find a reliable MRV institution without relevant standards to rely on, the verification reports of the carbon emissions also needed to be examined closely and cautiously by the responsible department. Thereby, even though Shenzhen has completed legislation regarding the management of carbon trade, the lack of specific policies will still harm the well-functioning of its pilot carbon market, which should be resolved in the short future.

In the first two implementation periods, the carbon prices of Shenzhen’s ETS program revealed a pattern of strong fluctuation. Starting from 28 yuan per ton, the price went up in the first few days and dropped dramatically during September. In October 2013, the carbon price fluctuated up and down hitting the highest level as 130.9 yuan per ton, and falling towards around 80 yuan per ton in April 2014. During the time near the compliance date, the price kept going down with some small fluctuations. Until August 1st, 2014, the carbon price was 56.01 yuan per ton, twofold of the opening price.98 As the threshold of Shenzhen’s emissions control units is

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relatively low, more than 500 enterprises or buildings are included in the carbon emissions trading system, each of which holds a small amount of CO₂ allowances. In this way, the market structure of Shenzhen’s carbon trade is more inclined to perfect competitiveness. During the initial period of conducting a perfect competitive market, price fluctuation is a common and even necessary process. As the participants do not know whether they are actually sellers or buyers in the carbon market, they will need time to explore, during which the price may vary significantly. Also, since the related policies will be issued progressively, the market will gradually become more stable.

**Guangdong**

Located in the South China, Guangdong is the country’s top economic province, whose GDP reached 5.7 thousand billion yuan in 2012. Although Guangdong’s GDP per capita has approached 54 thousand yuan, similar to the level of middle income countries, the economic development within the province is imbalanced.99 As the area sum of South Guangdong, North Guangdong and West Guangdong occupies 79.5% of the province’s total area, the GDP combination of these three regions only takes up 20.9 percent of Guangdong’s GDP in 2012.100 In this way, the issue of wealth inequality is very serious in Guangdong, which may impact the province’s future plan of energy consumption. The underdevelopment situation of many areas in Guangdong retards the province’s industrial transformation, as these areas still have to greatly depend on the development of manufacturing industry to boost their economies. Although

100 Ibid.
Shenzhen is a major city in Guangdong, Shenzhen conducts its own ETS program, as its industrial structure is very different from the remaining areas. If Shenzhen is incorporated into Guangdong’s ETS program, the cap setting for Guangdong will be even less stringent for Shenzhen. Some other elements of Guangdong’s emissions trading system, such as the coverage of industrial sectors, are not applicable for Shenzhen. In general, Guangdong enjoys relatively lower energy efficiency as 0.532ton standard coal per ten thousand yuan, compared with the national level as 0.764ton.

As the major economic regions of Guangdong are all coastal cities, global warming will have greater impacts on Guangdong than the inland provinces. Especially, the Pearl River Delta has enjoyed the highest level of temperature increase among the province with 0.3 °C per ten years, which is much higher than the national level.\(^\text{101}\) As a result, Guangdong may have a strong motivation to control CO\(_2\) emissions. During the period of “Eleven Five-Year (2006-2010),” Guangdong greatly reduced its energy consumption per industrial added value, approaching the country’s advanced level. In the next stage, Guangdong aims to decrease carbon intensity by 19.5 percent and diminish energy intensity by 18 percent in 2015.\(^\text{102}\) However, solely depending on administrative measures will have limited effects on the province’s further CO\(_2\) control, which greatly leads to the conduction of a local carbon emissions trading system.

Guangdong is the first experimental region explicitly determining the carbon emissions quotas with definite classification. In 2013, the total allowances were 0.39 billion tons, including

\(^{101}\) Ibid., 253.

the allowances of emissions control enterprises as 0.35 billion tons, the allowances of additional new enterprises as 0.04 billion tons and the adjustment allowances as 0.02 billion tons. In 2014, the total emission quotas increased to 0.41 billion tons, as most of the new emissions control enterprises are from energy industry, the CO₂ emissions of which are relatively high. Guangdong first included the four major heavy industries into its carbon emissions trading system, comprising cement, electricity, steel and petrochemical. Any enterprise of these four industries that yearly emitted over 20 thousand tons of CO₂ between 2011 and 2012 became the emissions control enterprises. The standard has gradually been applied to more industries in the latter period in order to manage and supervise the CO₂ emissions of more high energy-consumption enterprises.

Unlike other experimental regions, Guangdong’s ETS program requires enterprises to buy certain ratios of allowances. In the first implementation period, the emissions control enterprises had to buy 3% of carbon quotas from the official auction platform in order to get the permission of circulating and surrendering the enterprises’ allowances. In addition, Guangdong reinforces the quotas management with a series of management measures. Specifically, while Guangdong

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105 Ibid., 119.
determines the allowances for three years at one time, it also adjusts the allowances offered each year based on the actual emissions level in the previous year.\textsuperscript{107}

However, since the cap setting is very loose in Guangdong’s carbon emissions trading system, the market performance is lower than expected. In the first implementation period, Guangdong set its reserve price for allowances in the initial auction at 60 yuan per ton, much higher than the actual carbon price in Guangdong’s market. Among the five instances of auctions before August 2014, every transaction was accomplished at 60 yuan per ton, in which the auction mechanism did not play a role in discovering prices.\textsuperscript{108} By mandating the participants of the ETS program to purchase a fixed amount of carbon quotas at the auction prices, the participated units might decide to reduce carbon emissions due to the higher emissions costs. However, the mandatory purchase led to strong objections from many of the regulated entities. While 242 enterprises needed to purchase 10.5 million tons of allowances from auctions in 2013, only 178 enterprises had participated into the primary market, purchasing 9.76 million tons of allowances.\textsuperscript{109} In other words, 64 regulated units did not purchase their allowances in 2013, leaving all their free allowances on hold because of the governmental stipulation. Thereby, these enterprises were unable to participate in the carbon trade, which greatly harmed the liquidity within Guangdong’s

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\textsuperscript{109} Zhang, Zhongxiao, Carbon Emissions Trading in China: The Evolution from Pilots to a Nationwide Scheme, Australian National University, Crawford School of Public Policy, Center for Climate Economic & Policy, CCEP Working Paper 1503, 2015, 12.
\end{flushright}
carbon market.\textsuperscript{110} The West-East Natural Gas Transmission is a national project transmitting natural gas from the western part of China, including Guangdong, to many regions in East China. As Guangdong undertakes the task of power transmission to China’s eastern cities, it is difficult for the province to reduce carbon and energy consumption in a short term, which contributes to the loose setting of total allowances in Guangdong’s carbon market. At the beginning of the second implementation period, Guangdong’s ETS program quickly adjusted its auction method, by which the reserve price for carbon allowances was much lower than 60 yuan per ton, increasing from 25 yuan, to 30 yuan, 35 yuan and 40 yuan per ton in the four consecutive auctions. Nevertheless, if the cap setting is still not restrictive, this kind of minor adjustments will not make big differences to the operation and performance of Guangdong’s carbon market.

\textbf{Chongqing}

As the only experimental region lying in the West China, Chongqing becomes the representative cap and trade model for the other western cities or provinces, which aims to integrate both the demand for carbon reduction and the requirement of economic improvement. Even though Chongqing is one of China’s oldest industrial bases, Chongqing’s economic development level falls behind that of the other experimental regions due to its geographic conditions. While Chongqing’s GDP reached 1145.9 billion in 2012, the city’s GDP per capita was only 39 thousand yuan with large income differences between urban and rural residents.\textsuperscript{111} As the manufacturing

\textsuperscript{110} Ibid.
industry plays an important role in Chongqing’s economic development, which occupies 53.9 percent of total industrial added value, Chongqing’s future advancement will still greatly depend on energy consumption, especially coal resources.\textsuperscript{112}

Unlike other experimental regions, Chongqing considers and includes all six of the greenhouse gases that Kyoto Protocol stipulates into the emissions trading system, aiming to systematically control and diminish the impact of climate change. Nevertheless, the means that Chongqing sets its allowances does not help the city to achieve the goal of emissions control. Quotas management units, which are the main participants of Chongqing’s cap and trade, refer to the industrial enterprises yearly emitting over 20 thousand tons of CO\textsubscript{2} between 2008-2012.\textsuperscript{113}

Similar to Shenzhen’s stipulation, Chongqing distributes the allowances founded on the city’s overall control goal and the enterprises’ historical emissions levels from 2008 and 2012.\textsuperscript{114} However, the crucial difference, which greatly results in the failure of Chongqing’s greenhouse gases (GHG) trade, is that the the participated enterprises are in charge of reporting their data of historical gas emissions.\textsuperscript{115} Without any verification from the local government or a third party institution, the sum of allowances becomes very loose and relaxed in Chongqing’s GHG market. As a result, the enterprises within the emissions trading system do not have incentive to trade as they already gain ample allowances to surrender.

\begin{flushleft}
\textsuperscript{112} Ibid., 166.
\textsuperscript{114} Ibid., 100-101.
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Too some extent, the GHG trade in Chongqing does not truly play any role in addressing climate change, and may provide adverse effects in the long term if the issue of cap setting is not resolved. Until June 28th, 2015, only twelve transactions took place in Chongqing’s emissions trading system. In particular, most of the transactions were completed on June 19, 2014, when the market started to operate.\textsuperscript{116} Since the emissions quotas do not become a kind of scarce good in the economy, few enterprises have the incentive to buy the quotas, which greatly leads to the inactive market performance.

\textbf{Hubei}

Hubei is one of the crucial provinces in China’s central region, the economic development of which greatly depends on the economic advancement of heavy industry. With a rapid growth rate, Hubei’s GDP is located at the middle and upper level in China. From 2000 to 2012, Hubei’s GDP per capita increased from 6293 yuan to 38572 yuan, higher than the average national level.\textsuperscript{117} The GDP ratio of three-sector structure (raw materials, manufacturing and services) is 12.8: 50.3: 36.9, in which the manufacturing industry dominates.\textsuperscript{118} Since most of Hubei’s pillar industries are high energy consumed, it is difficult for the province to adjust its industrial structure given that Hubei’s economic development will continue to greatly rely on the large consumption of resources.


\textsuperscript{118} Ibid.
and CO₂ production. Based on the guidelines of China’s twelve five-year (2011-2015) plan, Hubei sets its GDP growth target as no less than 10%, which is highly related to an increase of carbon emissions. In this way, the consideration of future economic development will greatly impact the construction of Hubei’s carbon emissions trading system. Especially, as Hubei is the only experimental region located in China’s central area, its framework design will become a reference for other neighboring regions.

However, even though Hubei’s industrial structure makes it difficult to promote carbon reduction in the short term, Hubei’s ETS program tries to limit the CO₂ production of the major industrial enterprises with the strictest setting of total carbon allowances among the seven experimental regions, having the government more involved in the carbon emissions trading system. The total CO₂ quotas of Hubei’s ETS program are the sum of the initial distribution quotas in addition to the quotas that the local government reserves. Specifically, the initial distributed quotas are 97 percent of the participated enterprises’ carbon emissions in 2010.\textsuperscript{119} Ten percent of the total CO₂ allowances are reserved to the local government, the role of which is to adjust the market as well as explore the carbon price.\textsuperscript{120} The distribution method that Hubei applies will not only play an important role in promoting carbon reduction, but allow adjustment by the local government to diminish the negative impact on Hubei’s economic development as well.

Since Hubei is a large industrial province, its threshold of the participated enterprises remains the highest among the seven experimental regions. Also, Hubei is the only province that

\textsuperscript{120} Ibid.
takes the energy consumption rather than the CO\textsubscript{2} emissions as the criteria to select the enterprises, which will greatly converge the goal of energy conservation with the objective of CO\textsubscript{2} reduction. Enterprises that had yearly energy consumption over sixty thousand tons’ standard coal between 2010 and 2011 participate into Hubei’s carbon emissions trading system, which covers over ten major industries.\textsuperscript{121}

Like many other experimental regions, Hubei does not have legislation regarding carbon trade, but applies the policy documents to manage and regulate its carbon market. For the enterprises that do not surrender their allowances on time, Hubei stipulates the fines as the excess emissions multiplying one to three times the average market price of allowances. The total fine for one enterprise per year should not be higher than 150,000 yuan. This low level of punishment, thereby, will have minor impacts in restricting enterprises from excess emissions.

However, even though Hubei does not have strong legislation to guarantee the market’s well-function, it has the largest trading volume among the seven experimental regions, demonstrating an unexpectedly good market performance.\textsuperscript{122} Occupying 48 percent of the total transactions in China’s ETS programs, Hubei’s carbon market does not exhibit the seasonal characteristic as do many other experimental regions. With a very low opening price, Hubei’s carbon price trend is relatively stable, which is around 25 yuan per ton.\textsuperscript{123} On the opening date,  

Hubei’s carbon market enjoyed relatively large trading volumes, which was maintained throughout the implementation period. Hubei’s good market performance can be greatly attributed to its nuanced cap setting, restricting its total CO₂ allowances to a relatively acceptable level with the intervention of local government. Although Hubei has one of the largest carbon markets based on the quantity of total allowances, its enforcement of carbon abatement enables the CO₂ emissions to become a kind of scarce good, and thus promote the transactions within the market.
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Chapter Three: The Prospect of China’s Carbon Emissions Trading

As announced by the Chinese government, a nationwide emissions trading system will be established by 2017, drawing lessons from the experiences of the seven regional carbon markets. After almost three years of experiments, all of these emissions trading systems (ETS) are approaching the end of their pilot periods (2013-2015). During the significant transition year, it is crucial to gain experience and learn lessons from the seven pilot programs in order to construct a well-functioning national carbon market. There are two major directions that China can take to evolve into a nationwide carbon trading scheme. One is to gradually expand the current pilot regions with respect to geographical coverage as well as construct new pilots, then integrating all the regional carbon markets into a national linked system; the other is to directly launch a nationwide emissions trading system based on the experiences and lessons gained from the pilot programs. In this chapter, China’s regional ETS programs are discussed and compared primarily regarding selected design elements and their performance in terms of strengths and weaknesses. The aim of this chapter is to examine whether the Chinese government should adopt a national carbon market in an evolutionary or revolutionary manner.

126 Zhang, Zhongxiao, Carbon Emissions Trading in China: The Evolution from Pilots to a Nationwide Scheme, Australian National University, Crawford School of Public Policy, Center for Climate Economic & Policy, CCEP Working Paper 1503, 2015, 22-23.
Comparison and Evaluation of the Seven Experimental ETS programs in China

On the basis of their own framework designs, these seven experimental carbon markets are constructed in relatively different ways, displaying regional differences with some unique innovations. Given the other ETS programs all over the world, China’s pilot emissions trading systems have their own advantages that can be applied to the construction of a nationwide ETS program. Nevertheless, even though these experimental programs provide some invaluable experiences, a variety of defects also became apparent during the pilot period, which needs to be further specified and elaborated in the coming pages. Centering on some selected design elements and the performance, this section will discuss and evaluate the achievements and weaknesses of the seven pilot ETS programs.

Cap’s Coverage

The scope of cap’s coverage, referred to as which emissions types and sources of Green House Gases (GHG) emissions are subjected to the overall cap, should be first specified and ascertained by the policymakers.\(^\text{127}\) In order to have a well-established carbon emissions trading system, the government has to figure out the types and sources of GHG emissions, the reduction of which will greatly help to achieve the ultimate goal of mitigating climate change’s impacts. Even though CO\(_2\) contributes significantly to global warming, some non-CO\(_2\) GHG, including Ozone (O\(_3\)), Methane (CH\(_4\)) and Nitrous Oxide (N\(_2\)O), also have great impacts on climate

change. However, with the exception of the pilot ETS in Chongqing, all the other six experimental emissions trading systems cover only CO$_2$ emissions, which simplifies the operation and function of these markets. Among these pilot ETSs in China, both direct CO$_2$ emissions and indirect CO$_2$ emissions are included in the trading mechanism, which is the first trial in the world. Since some experimental regions, such as Beijing and Shanghai, are dominated by the service industry that have a few industrial emissions sources, CO$_2$ emissions of these regions largely come from the consumption of electricity and heat. More importantly, a considerable amount of the electricity and heat consumed in these experimental regions are purchased from outside areas. For instance, more than 60 percent of the electricity consumed in Beijing are acquired from outside the city, so that indirect CO$_2$ emissions become the dominant source of Beijing’s carbon trade.

Furthermore, the government needs to determine the number and types of industrial sectors and firms that are covered in the emissions trading system. Due to differences in geography and economic development, various types of economic sectors and industries are covered by the pilot ETS programs, ranging from 4 sectors in Guangdong and Chongqing to 26 sectors in Shenzhen. As one of China’s old industrial bases, Chongqing’s economic development still greatly relies on its secondary sector of the economy, both heavy industries and light industries. Among Chongqing’s compulsory participants of carbon trade, only enterprises from industrial sectors

\footnotesize{128} Ibid.
including electricity, metal alloy, chemical engineering, and building materials with annual carbon emissions higher than 20,000 tons are included in the emissions trading system.\textsuperscript{131} Even though only four industrial sectors are covered in Chongqing’s ETS program, they encompass 40% of the city’s total emissions, which is the median level across pilots.\textsuperscript{132} For the more developed experimental regions such as Beijing and Shanghai, their pilot ETS programs not only cover industrial enterprises as compulsory participants, but also include some non-industrial entities as well as large public buildings. Nevertheless, the extending coverage of these developed regions does not lead to a higher share of covered emissions in the total emissions. For instance, Shenzhen’s ETS program covers 38% of the city’s total emissions, which is even slightly lower than that of Chongqing.\textsuperscript{133} In order to construct an effective nationwide carbon market, the differences among various regions should not be ignored. In comparison with the central government, the local governments are more knowledgeable in the concrete economic and industrial circumstances of the localities. Thus, it is considerable for the local government to set cap’s coverage of industrial sectors rather than the central government when the national ETS program is launched.

\textsuperscript{133} Zhang, Zhongxiao, Carbon Emissions Trading in China: The Evolution from Pilots to a Nationwide Scheme, Australian National University, Crawford School of Public Policy, Center for Climate Economic & Policy, CCEP Working Paper 1503, 2015, 11.
Cap Setting

Setting reasonable and feasible carbon emissions targets is a crucial element of a well-established emissions trading system, correlated with defined mitigation levels of climate change impacts. There are two types of emissions caps. One is absolute caps, referred to as an absolute level of emissions during a specific period.\textsuperscript{134} The other is relative caps, which are defined by a certain type of activity, such as emissions per unit of output.\textsuperscript{135} In comparison to absolute caps, relative caps provide more flexibility allowing consideration of both economic development and environmental concerns, but they have less environmental effectiveness in targeting specific mitigation levels.

In China, most of the regional ETS programs assign relative caps without providing specific quantities. Whereas for Beijing, Shanghai, and Shenzhen, the emissions targets are determined by their goals of reducing carbon intensity, the caps for the carbon markets of Tianjin, Hubei, and Chongqing are decided by both the reduction objectives of carbon intensity and the targets of energy consumption per GDP. The former regions are the most developed cities in China, with less pressure on economic development. However, the latter are all industrial regions, the further advancement of which still greatly depends on energy consumption. Thereby, there is a minor discrepancy between these two groups of regional carbon markets regarding cap setting. As a result, for the emissions targets of the national ETS program, the Chinese government can

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\textsuperscript{135} Ibid.
consider providing different criteria for various types of regions given their economic and energy consumption levels. Based on the central government’s instruction, the local government can also have certain level of autonomy in adjusting its cap setting. Moreover, it is worth noting that even though Guangdong’s ETS program also applies relative caps, Guangdong’s policymakers explicitly determine specific quantitative caps with definite classification. In the first year operation of Guangdong’s carbon emissions trading system, the carbon cap was 0.39 billion tons, including allowances for emissions control enterprises of 0.35 billion tons, allowances of additional new project enterprises of 0.04 billion tons, and the adjustment allowances of 0.02 billion tons. This method resolves a major concern of relative caps in that before the release of that year’s GDP data, the number of allowances available in the market would remain uncertain.

Besides the selection between the two types of carbon emissions targets, the policymakers should also consider the mitigation level when setting the specific carbon emissions gaps. Given the concrete circumstances of the experimental regions, each pilot ETS program set its relative cap on the basis of the national targets for emissions reduction. In its Twelve Five-Year Plan (2011-2015), the Chinese government has set targets for reducing carbon intensity and energy consumption per GDP by 16% and 17%, respectively. Given the national objectives, all the experimental regions have set their targets for carbon intensity reduction and/or energy consumption per unit of GDP between 17% and 21%. However, an apparently less ambitious target does not imply a low level of carbon abatement. For instance, due to Hubei’s large potential for

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economic development, the emissions target of its experimental carbon market is to reduce both carbon intensity by 17% and energy consumption per unit of GDP by 16% of 2010 levels by 2015.\textsuperscript{137} Compared with other pilot regions, Hubei has the lowest percentage of carbon reduction goal. Nevertheless, in order to construct a more effective carbon abatement mechanism, Hubei has the strictest cap setting among the seven pilot regions with the help of the government intervention. Whereas initial distributed allowances of Hubei’s ETS program are 97 percent of all the participated enterprises’ carbon emissions in 2010, 10 percent of the total carbon emissions quotas are reserved for the local government, the role of which is to adjust the market as well as explore the carbon price.\textsuperscript{138} This distribution method will not only help Hubei to construct a more effective carbon market, but also diminish the negative impact on Hubei’s economic development with the help of government adjustment.

Compared with the performance of Hubei’s ETS program in its first year of operation, the allowances distribution in Shenzhen’s carbon market greatly undermine the efficiency and effectiveness of the emissions trading system. Even though Shenzhen has the highest level of emissions targets, intending to decrease carbon intensity by 21% of 2010 levels by 2015, Shenzhen’s rapid economic growth restricts the effect of overall control on carbon emissions.\textsuperscript{139} In other words, as Shenzhen’s GDP increases dramatically, Shenzhen’s restrictive emissions target based on carbon intensity results in an escalation of overall distributed allowances in the local

\textsuperscript{138} Ibid.
\textsuperscript{139} Ibid., 108.
carbon market. Given the government report of Shenzhen’s Development and Reform Commission for the first implementation period, the initial allowances are more than nine percent of the actual allowances in 2013, adjusted about one month before the compliance date.\textsuperscript{140} About 10 percent of surplus credits had been circulated in Shenzhen’s carbon market before the adjustment, which provided opportunities for the enterprises to emit more and thus made the ETS program less effective in controlling carbon emissions. In this way, the setting of relative caps should be integrated with the method of quotas allocation in order to avoid the issue that Shenzhen has faced.

**Allowances Distribution**

After determining the carbon emissions cap of an emissions trading system, the policy makers need to specify the distribution of allowances, which will have significant impacts on carbon reduction. Theoretically speaking, there are two ways to distribute carbon emissions quotas that will result in the same emissions costs.\textsuperscript{141} Allowances can be freely distributed without charging any individual or organization; the government can also distribute quotas by auction in the primary market of carbon trade. When a firm receives allowances that are freely distributed, it must decide whether to use the allowances or to decrease carbon emissions and thereby sell the allowances for revenue. On the other hand, when the firm acquires CO\textsubscript{2} emissions quotas in

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auctioning, it can make an investment decision about the quantity of allowances the firm will need, given the firm’s cost benefit analysis. In sum, the choice between auction and free distribution theoretically does not greatly influence firms’ decisions of production and emissions reduction, even though that may have significant impacts on the government’s revenue.\textsuperscript{142}

Nevertheless, at an early stage of constructing a carbon market, it is necessary to distribute allowances through free distribution for the purpose of diminishing the participated firms’ negative sentiment to carbon trading. The majority of the seven pilot ETS programs freely distribute their emissions allowances on the basis of the enterprises’ historical emissions in the past three to five years. Some regional carbon emissions trading systems, such as Guangdong’s carbon market, try to increase the role of auctions in allowances distribution. Specifically, Guangdong’s ETS program integrates the two approaches as the portion of allowances auctioned increases steadily during the pilot period: free allocation of 97% allowances in 2013, 97% for industries and 95% percent for power in 2014, and 90% total allowances in 2015.\textsuperscript{143} This adjustment will generate more revenue for the local government to diminish a climate policy’s economy-wide costs.\textsuperscript{144} For instance, the government can apply the revenue to promote the development of low-carbon technology, and thereby help to decrease the costs of carbon reduction for the enterprises.

\textsuperscript{142} Ibid.
\textsuperscript{143} Shen, Ying, Crossing the River by Groping for Stones: China’s Pilot Emissions trading Schemes and the Challenge for a National Scheme, Asian Pacific Journal of Environmental Law (Volume 18), 2015, 21.
However, many enterprises that participated in Guangdong’s carbon market were unwilling to purchase a fixed amount of allowances from the auction platform in the first implementation period. The Guangdong government stipulated that unless the enterprises had purchased a certain quantity of allowances, they were unable to engage in carbon trade. This stipulation forced the regulated enterprises to purchase carbon allowances from the primary market, aiming to help the enterprises become more familiar and adaptable to auctions. Nevertheless, one of the firms that failed to meet their emissions caps argued that it was unfair for them to purchase the allowances, especially as enterprises in other ETS pilot programs were not obliged to pay for the carbon quotas.\textsuperscript{145} For instance, Hubei’s ETS program only employed auctions for the purpose of price discovery, which did not have any obligation to the controlled entities. Therefore, the negative sentiment to carbon trading scheme will become more acute if the nationwide ETS program does not have a united stipulation regarding allowances distribution. Thus, even though the local and central governments can gain revenue from auctioning a portion of allowances, they should be careful about the negative impacts triggered by the auction mechanism.

\textit{Monitoring, Reporting and Verification (MRV)}

A robust, transparent, and consistent mechanism of monitoring, reporting, and verification (MRV) of carbon emissions is crucial for a well-functioned emissions trading system. For the local government, in order to ascertain each unit’s actual emissions allowances and to assure that these

\textsuperscript{145} Zhang, Zhongxiao, Carbon Emissions Trading in China: The Evolution from Pilots to a Nationwide Scheme, Australian National University, Crawford School of Public Policy, Center for Climate Economic & Policy, CCEP Working Paper 1503, 2015, 20.
allowances have been surrendered on the compliance date each year, data and information regarding actual carbon emissions should be carefully collected. This is the main job of the MRV.\textsuperscript{146}

Among the seven regional carbon markets, the establishment and regulation of MRV systems are relatively incomplete in the major pilot cities. For instance, Chongqing’s pilot ETS program applies a unified verification method of carbon emissions that does not differentiate between industries. Without applying different parameters to calculate CO\textsubscript{2} emissions for various industries, this simple verification method ignores the concrete situation of each industry, and thereby provides data with less accuracy and effectiveness.\textsuperscript{147} Since all the pilot ETS programs establish the regulation documents regarding MRV on their own, many issues are idiosyncratic for a specific carbon market and are not very representative across all the pilot ETS programs. Nevertheless, with a more complex supervision and management mechanism, Beijing’s MRV institution is more mature and complete, which may become a reference for constructing a national ETS program.

Furthermore, several critical features are shared by many of the experimental carbon markets, which can also help to guide the future construction of nationwide carbon trade. First, most pilot ETS programs have established enterprise emissions lists as well as yearly emissions...
reports that specify the emissions circumstances in the experimental regions.\textsuperscript{148} By means of public notification, the carbon reduction enterprises will have incentives to limit carbon emissions in order to maintain their reputation. As many compulsory participants of the regional carbon markets are very large and well-known enterprises in China, this method will play an especially important role in China’s carbon emissions reduction. Furthermore, several pilot emissions trading programs stipulate that enterprises are not allowed to choose the same verification organization to check and certify their emissions reports for three consecutive years.\textsuperscript{149} Even though only Shenzhen and Tianjin have specified and carried out the policy, this method will greatly help the verification mechanism become more transparent and accurate. If both parties maintain a long and stable cooperative relationship, the probability of conspiracy occurring between the enterprises and the verification organizations will significantly increase. Because the implementation plans for most pilot ETS programs only focus on the pilot period (2013-2015), the local governments of many experimental carbon markets do not share long term perspectives on the development of carbon trading, which can partially explain their negligence to this point. Nevertheless, for the future construction of carbon emissions trading program in China, it is necessary for both the central and local governments to determine policies prescribing the cooperation length between enterprises and verification agencies. Finally, none of the regional carbon markets has released legislative documents supporting the work of third party verifiers, which contributes to the fact that many

\textsuperscript{148} Shen, Ying, Crossing the River by Groping for Stones: China’s Pilot Emissions trading Schemes and the Challenge for a National Scheme, Asian Pacific Journal of Environmental Law (Volume 18), 2015, 22.

\textsuperscript{149} Ibid.
enterprises do not allow the verifiers to enter their facilities for inspection. Without a series of regulations and guidelines, MRV actions in China’s regional emissions trading systems will be thwarted, resulting in a less efficient administrative mechanism that does not restrict carbon emissions effectively.

**Allowances Banking and Borrowing (“Cost-Containment” Mechanism)**

The volatility of allowance prices is a major concern to the development and promotion of cap and trade. In response to this consideration, many economists try to investigate and design “cost-containment” mechanisms to diminish cost uncertainty in the emissions trading system, including allowances banking and borrowing, offset mechanisms, and safety-valve provisions. Allowances banking and borrowing is the major means to reduce some of the undesirable consequences in the carbon market by giving firms a certain degree of flexibility and thus shifting their obligations of emissions reduction across implementation periods. Allowances banking permits firms to reduce extra emissions earlier and save unused emissions quotas for use in the future. Theoretically, however, this method would fail if carbon costs remain too high over several

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152 Ibid.
During the early stage of carbon trade, when both the policy makers and firms are exploring the appropriate price level in the carbon market, carbon prices may vary dramatically and unexpectedly, resulting in firms’ unwillingness to bank current allowances. In contrast, allowances borrowing allows firms to use carbon quotas that will be issued in future years, shifting the current deficit to the obligations in ensuing periods. Although this method may be much useful in the early stage of ETS operation, all the seven pilot ETS programs in China have not established a borrowing mechanism, as the pilot period is only three years in total. However, it is considerable for the nationwide emissions trading system to allow the application of allowances borrowing from a long term perspective. Since some enterprises may not be adaptable to emissions control during the early years, the borrowing mechanism can help them to have a transition period, and thus maintain the well-functioning of carbon market.

Except for Hubei’s carbon market, six other experimental emissions trading systems have a banking mechanism that allows enterprises to save their carbon allowances for future use. It is worth noting that among the six pilot ETS programs, allowances banking can only take place during the pilot period (2013-2015), revealing the local governments’ cautiousness and conservativeness towards this mechanism. Especially, allowances banking in Guangdong’s carbon market should be approved by the local development and reform commissions, the local governments.

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154 Ibid., 293.
governmental agency in charge of constructing and developing Guangdong’s ETS program. In this way, even though most pilot carbon markets are allowed to bank allowances, the impact of this cost-containment mechanism is very limited. In order to improve the effectiveness of allowances banking, an extended period for saving and banking is essential, which may be a crucial element of China’s national ETS framework. As Shanghai distributed all the allowances once for three years, the enterprises within Shanghai’s ETS program could adjust their yearly allowances easily, even without the banking mechanism. Because the pilot only lasted for three years, the Shanghai government could distribute all the carbon quotas at once, which cannot be applied to the national framework that will last at least for 5 to 10 years. Thereby, allowances banking/borrowing will play a crucial role in adjusting the application of carbon quotas across the years.

**Offset Mechanism ("Cost-Containment" Mechanism)**

Among the seven regional carbon markets, the most common offset mechanism is to meet annual allocations with China Certified Emissions Reductions (CCERs). Certified Emissions Reductions (CER) are a type of carbon credits that are generated from a clean development mechanism project activity. The Clean Development Mechanism (CDM), defined in the Kyoto Protocol, allows a country with an emission-limitation and/or emission reduction commitment to

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implement emissions-reduction projects in developing countries, which can help the country to earn salable CER credits equivalent to one tonne of carbon emission each.\textsuperscript{157} In the framework of Kyoto Protocol, these CER credits can be counted towards meeting Kyoto targets assigned for each participating country. Following the Kyoto Protocol’s mechanism, the Chinese government initiated CCER to provide another method for the participants of regional carbon markets to meet their annual allowances.

Nevertheless, the role of offset mechanism in China’s carbon trade is relatively small due to the allowances restriction. All the pilot ETS programs have proportion limitations on annual emissions quotas that can be met with CCERs, which vary from 5 percent to 10 percent.\textsuperscript{158} Specifically, many regions, such as Hubei and Beijing, stipulate that a certain portion of the CCERs that are used to meet allowances should be local projects. For instance, in order to promote the development of local CCER projects, Hubei’s ETS program only accepts CCER credits generated in Hubei province and its cooperation regions.\textsuperscript{159} Using CCERs as a kind of incentive, the Hubei government encourages the regulated entities to develop low-carbon technology, which will accelerate Hubei’s carbon reduction process. This kind of local protection may be good for the regions with higher CO\textsubscript{2} emissions. In comparison with Hubei’s emissions trading system, Beijing’s ETS program has a relatively low requirement on the localization of CCERs. On

\textsuperscript{157} Clean Development Mechanism, United Nations Framework Convention on Climate Change, http://unfccc.int/kyoto_protocol/mechanisms/clean_development_mechanism/items/2718.p\textsubscript{p}.


\textsuperscript{159} Ibid., 21.
September 2nd, 2014, Beijing issued “The Management Measure of Carbon Emissions Credits,” in which the local government loosened the restriction on source places by stipulating that at most 50 percent of CCER credits can be generated from the areas outside Beijing.\textsuperscript{160} Especially, for the future development of a united regional carbon market among Beijing, Tianjin and Hebei, this management measure also highlights the priority of Hubei and Tianjin’s CCER projects.\textsuperscript{161} On the other hand, the pilot ETS programs of both Shanghai and Tianjin do not have any geological restraint on the generation of CCER credits. The variation among the seven experimental carbon markets seems to be too large to generate a unified requirement for them to follow.

**Penalty System**

An effective and smooth operation of emissions trading systems depends on a well-constructed penalty system. The extent of punishment for excess emissions greatly influences the firms’ enthusiasm to participate in carbon trade and surrender allowances. However, in China, penalties for non-compliances are relatively low for most pilot emissions trading systems. For instance, Shanghai’s experimental ETS program only stipulates a one-off fine from 50,000 yuan to 100,000 yuan for non-compliance, which largely neglects the specific amount of excess emissions.\textsuperscript{162} To a great extent, this kind of punishment will encourage the participating enterprises

\begin{enumerate}
\item \textsuperscript{160}Ibid. “The Management Measure of Carbon Emissions Credits” is the translation of 碳排放权抵消管理办法.
\item \textsuperscript{161}Ibid., 22.
\item \textsuperscript{162}Shen, Ying, Crossing the River by Groping for Stones: China’s Pilot Emissions trading Schemes and the Challenge for a National Scheme, Asian Pacific Journal of Environmental Law (Volume 18), 2015, 29.
\end{enumerate}
to over pollute. The more excess CO$_2$ that the enterprises emit, the lower abatement costs per unit they have to pay. In other words, the marginal cost per additional carbon emissions will decrease with a uniform fine level. Given the penalty rules, the enterprises are much more likely to emit excess emissions and accept the fines, rather than to invest in low-carbon technology or purchase allowances.$^{163}$

Unlike Shanghai and Guangzhou, which have fixed amounts of fines for different levels of excess carbon emissions, Beijing, Shenzhen, and Hubei have a much more flexible penalty rule. For example, Beijing’s pilot ETS program requires that excess emissions are fined at three to five times the average market price of carbon emissions.$^{164}$ Compared to the penalty mechanism of Shanghai and Guangdong’s carbon markets, this kind of penalty rule will provide incentives for the participating enterprises to restrict their carbon emissions. However, as the fine for each tonne of excess emissions is based on the average market price of CO$_2$, the penalties in these three regions are still not stringent due to the relatively low carbon prices in China’s pilot ETSs, even though from a theoretical perspective, a three to five times the average carbon price seems to be a high level of punishment.$^{165}$

Furthermore, there are two experimental emissions trading systems that do not have established fines except for some restrictions on financial subsidies and/or preferential policies.$^{166}$ The pilot ETS program in Chongqing stipulates that enterprises with excess emissions cannot

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$^{163}$ Ibid.
$^{164}$ Ibid., 23.
$^{165}$ Ibid., 32.
$^{166}$ Ibid.
enjoy financial subsidies regarding energy conservation and environmental protection in the consecutive three years.\textsuperscript{167} Slightly different from Chongqing’s stipulation, Tianjin’s emissions trading system provides that enterprises with excess emissions are not allowed to enjoy preferential policies as well as governmental support policies concerning emissions reduction, energy conservation, and circular economy in the subsequent three years.\textsuperscript{168} Indeed, these kinds of restrictions can have certain levels of impact on enterprises, because in China, support for policies and financial subsidies are very crucial for their future development. Loss of governmental support could be very costly for these enterprises to develop low-carbon technology and promote carbon reduction projects. However, as the ETS programs of both Chongqing and Tianjin have very loose cap settings, the enterprises within these two pilots are distributed with ample allowances, resulting in few instances of excess emissions. Therefore, it is difficult to detect the impacts of their penalty rules from their market performance.

Besides the penalty rules regarding non-compliance, all the pilot ETS programs have stipulations concerning the MRV mechanism. Specifically, if the enterprises do not submit yearly emissions reports to the local governments, they will be fined certain amounts of money according to their local measures. Nevertheless, most of the experimental carbon markets do not have a complete penalty mechanism to support the operation of the MRV system, which may be developed during the establishment of a nationwide carbon emissions trading system.

\textsuperscript{167} Shen, Ying, Crossing the River by Groping for Stones: China’s Pilot Emissions trading Schemes and the Challenge for a National Scheme, Asian Pacific Journal of Environmental Law (Volume 18), 2015, 23. 
\textsuperscript{168} Ibid.
Market Performance

Low carbon prices for allowances and trading volumes are two main characteristics of China’s pilot ETS programs. During the first implementation period (2013-2014), the price levels of carbon allowances differed significantly across the pilot ETS programs. The average carbon prices range from 24.34 yuan/t-CO₂ (USD 3.74/t-CO₂) in Hubei to 67.67 yuan/t-CO₂ (USD10.40/t-CO₂) in Shenzhen, remaining at relatively low price levels.¹⁶⁹ To a great extent, this price variability is linked with the policy difference. At the early stage of Hubei’s carbon market operation, Hubei’s government initially auctioned a portion of government reserved allowances for the purpose of price discovery from 20 yuan/t-CO₂, which successfully became the reference price of Hubei’s emissions trading system.¹⁷⁰ In addition, Hubei’s government tried to control the price fluctuation within 10 percent, jointly resulting in a low but stable price of carbon allowances. With few government intervention, the participants within Shenzhen’s ETS program had to discover the price level of carbon allowances on their own. Also, as the China’s Special Economic Zone, Shenzhen was the first experimental region that allowed foreign investors to participate in carbon trading, which made the market more active. However, this initiation also increased the possibility of speculation. Thus, the price of carbon allowances escalated dramatically at the early period of Shenzhen’s carbon market, which is shown in Graph 1. Even though the price level then

¹⁷⁰ Ibid., 24-25.
went down with small fluctuation, the average price of carbon allowances in Shenzhen was still the highest among the seven pilot ETS programs. Since the second implementation period (2014-2015), the average prices of different ETS programs have gradually converged, which is reflected in Graph 1. Nevertheless, the carbon prices of China’s regional carbon markets are still much lower than those of the EU ETS, partially presenting a less active market performance.

**Graph 1:** Price Trend of Pilot ETS Programs in China

From the perspective of price fluctuation, whereas the price trend of Hubei’s ETS program is relatively stable, Shenzhen and Guangdong’s carbon prices have the largest standard deviations.

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171 Data and graph from: [http://k.tanjiaoyi.com/](http://k.tanjiaoyi.com/).
in the first and second implementation periods, respectively.\textsuperscript{172} Government intervention plays a major role in the regulation of Hubei’s carbon market, which restricts the price yearly fluctuation to within 10 percent. Hubei’s government stipulates specific rules on price bargaining with respect to the highest and lowest bargaining price. At the same time, the local government limits the allowances that the enterprises can circulate in the market at 200 thousand tons or 20 percent of their total carbon quotas.\textsuperscript{173} In this way, Hubei’s ETS program enjoys the lowest standard deviation among the seven regional carbon markets in the implementation period of 2014, which is artificial due to government intervention.

With less government intervention, Shenzhen’s emissions trading system emphasizes the role of market adjustment in its operation. As Shenzhen’s carbon market is a relatively competitive structure, none of the participating enterprises enjoys a dominant market power. At an early period, these enterprises do not know whether they will be buyers or sellers in the carbon market, greatly contributing to the variation of supply and demand. Thereby, the carbon price changes dramatically to reflect this issue. Moreover, Shenzhen’s carbon market attracts many foreign investors, which escalates the probability of speculation, and thus enables the market to become more unstable.\textsuperscript{174} Because Shenzhen’s government does not intervene into the carbon market at the early stage, the carbon price varies significantly, which is a necessary process for the controlled entities to explore prices. In the second implementation period (2014-2015), as the participants have gradually

\textsuperscript{173} Ibid., 25.
\textsuperscript{174} Ibid., 24.
become familiar with carbon trade and thus understood their positions within the market, Shenzhen’s price trend of carbon allowances becomes much more smooth.

By contrast, the large price fluctuation in Guangdong’s ETS program comes from its modification of the auction mechanism. In the first implementation period (2014-2015), Guangdong set its reserve price for allowances in the initial auction at 60 yuan/t-CO₂, much higher than the actual price of carbon allowances in Guangdong’s market. As a result, all the transactions were reached at 60 yuan/ t-CO₂ among the five instances of auctions before August 2014, which greatly contributed to the relatively higher carbon price in Guangdong’s ETS program.¹⁷⁵ The auction mechanism did not help Guangdong to discover an appropriate price rate of carbon allowances, resulting in a policy adjustment at the beginning of the second implementation period (2015-2016). Guangdong’s government changed the reserve price for carbon allowances, increasing from 25 yuan, to 30 yuan, 35 yuan and 40 yuan per t-CO₂ in the four consecutive auctions. As expected, this policy alternation led to a significant drop of carbon prices. Since it became difficult for the controlled entities as well as the investors to form a stable long-term expectation to Guangdong’s carbon market, the price rates of carbon allowances varied dramatically in the second implementation period with the largest standard deviation among the pilot ETS programs.

Compared to other regional carbon markets, Hubei’s emissions trading system has the largest trading volume, which does not show a seasonal characteristic. With the strictest emissions

target, carbon allowances become scare in Hubei’s carbon market so that more transactions will be accomplished continuously. During the first implementation period (2013-2014), the trading volumes of Beijing, Shanghai, Shenzhen, and Guangdong in the last month occupied 65 percent of their total transactions. Many enterprises believed that governments might not pay close attention to the compliance performance, and thus they only took advantage of carbon trade until the last minute.\footnote{Zhang, Zhongxiao, Carbon Emissions Trading in China: The Evolution from Pilots to a Nationwide Scheme, Australian National University, Crawford School of Public Policy, Center for Climate Economic & Policy, CCEP Working Paper 1503, 2015, 21.} In order to surrender allowances on time or bank allowances for future use, the enterprises that participated in these ETS programs became much more active in allowances transactions a month before the actual compliance day, resulting in a seasonal characteristic of trading volumes during the implementation periods. As the only ETS program that authorizes the enterprises to be responsible for reporting their data of historical greenhouse gases (GHG) emissions, Chongqing’s cap setting is very loose. Therefore, only twelve transactions took place in Chongqing’s emissions trading system until June 28\textsuperscript{th}, 2015.\footnote{Qi, Shaosi, Cheng, Si, The Comparative Analysis of China’s Carbon Trade Experiments, Annual Review of Low-Carbon Development in China 2015, Brookings-Tsinghua Center for Public Policy, 2015, 31.} It is more reasonable to treat Chongqing’s case as an anomaly with respect to policy lessons for the national program.
Evolutionary or Revolutionary: How to Implement a National Emissions Trading System

Based on the review and analysis of China’s pilot ETS programs, it is necessary to figure out whether a nationwide carbon market should be established in an evolutionary or revolutionary manner. On the one hand, the Chinese government can fully adopt a national emissions trading system in which all the regions are included. On the other hand, the government can gradually include more carbon-intensive regions into the program and thus implement the nationwide ETS program step by step. In order to achieve the goal of establishing a nationwide carbon market by 2017, the Chinese government needs to first select between these two approaches.

The initiation of China’s seven ETS pilot programs helps China to gain experiences in carbon trade. In aggregate, even though these seven regions account for 18 percent of China’s population and 28 percent of the national GDP, their carbon intensity is below China’s national average level.\(^{178}\) Their carbon and energy consumption is not fully representative of China as a whole. Nevertheless, as China’s operation of an ETS is a learning-by-doing process, the central government would like to choose regions with relatively low learning costs. Especially, during the early stage, due to the negative impact of carbon trade on economic growth, the criteria of selecting pilot regions to conduct ETS programs is not their carbon intensity, but their capacity to bear the high learning costs.\(^{179}\) Other regions, especially the poor ones that can hardly pay for the learning costs, can also benefit from the lessons and experiences of these experimental regions.\(^{180}\)


\(^{179}\) Ibid.

\(^{180}\) Ibid.
Although the pilot ETS project has operated for three years, during which the local and central governments have gained fruitful experiences regarding carbon trade, the experiment period is still not very long. Many regions in China have little contact and knowledge to carbon trade, which may incur high learning costs when implementing a national carbon market instantly without a transition period. For the enterprises within these regions, it may be crucial to help them become more familiar and thus adaptable to carbon trading. This process may, indeed, take time for both the central and local governments. Moreover, since the pilot programs are all operated in China’s low carbon regions, it is difficult to evaluate whether this carbon reduction mechanism can truly work out in China as whole, especially as most non-pilot regions in China are high carbon economies. Thus, the Chinese government may need to consider including more carbon intensive regions in the next stage. This will provide fruitful experiences for the regions relying on high carbon industries, which many of the current ETS programs can hardly contribute. Learning from the experiences and lessons of the pilot emissions trading systems, these carbon intensive regions should develop their own mechanisms given the differences on energy consumption and economic development.

Furthermore, the central government should also help the pilot carbon markets to include more regions nearby in order to set up various segment markets. Given their geographic and industrial similarities, an extended form of the regional ETS program will enable more provinces and cities to participate in carbon trading with less learning costs. Also, since the central government has already promoted economic cooperation in several regions, such as Huabei Region (Beijing, Tianjin and Hubei), expanding the current ETS programs will diminish the issue of compatibility in adopting carbon trade policies. With more units participating into the emissions
trading systems, the scope of carbon markets will be enlarged greatly, which helps to promote the transactions of carbon allowances.

In addition, the central government should also consider the connections between various regional carbon markets. Due to their geological and industrial differences, a carbon allowance in Beijing, for example, is not equivalent to a carbon allowance in Hubei. In other words, if a Beijing’s enterprise wants to purchase an allowance from Hubei’s emissions trading system, due to the local restrictions and rules for trading, it is not permissible for the enterprise to directly buy the carbon allowance at the price within Hubei’s market. Conversion formulas for the inter-regional transactions need to be investigated in order to connect different carbon markets. Thereby, for the future construction of a nationwide carbon market, the Chinese government may need to first promote trans-regional carbon trade as well as cooperation between the pilot ETS programs. Considering these three factors, the Chinese ETS program shall go through a transition period before fully implement a nationwide carbon market.

**A Framework Design of Carbon Trade in China**

*Emissions Coverage*

As the main focus of China’s ETS program is to diminish carbon intensity and thus control carbon emissions, the nationwide emissions trading system may only cover CO₂ emissions rather than all the types of GHG emissions. Especially, since controlling all the GHG emissions would incur high administrative costs for the government of a developing country, the Chinese government may prefer to narrow the scope of cap’s coverage. All seven of the pilot ETS programs
take both direct and indirect carbon emissions into account since a great amount of heat and electricity consumed in these regions are purchased from outside areas. However, when carbon markets are operated in all the regions of China, including indirect CO₂ emissions will lead to the issue of re-calculation, which the Chinese government should consider cautiously. For instance, the indirect carbon emissions from Beijing’s electricity consumption is equal to the direct CO₂ emissions in Hebei, where the electric power is generated and purchased from. Moreover, due to differences in economic development and industrial structure, it is a better idea for the local government, rather than the central government, to ascertain the types of industries and the number of units that are included into the emissions trading system. This kind of autonomy will enable the ETS program to become a more efficient tool in controlling carbon emissions.

**Cap Setting**

All seven of the experimental ETS programs have adopted relative caps instead of absolute caps as their short term targets, resulting in less stringent caps for most of the regional carbon markets. Considering China’s economic development, both the central government and the local governments did not consider setting absolute caps for carbon emissions when the ETS project initiated. However, at the Beijing Asia Pacific Economic Cooperation (APEC) in 2014, the Chinese government declared its target to reduce CO₂ emissions in the post-2020 period, and committed to reach its peak year of carbon emissions around 2030 and as early as possible. This long term objective will force China to gradually phase in absolute caps. Although short-term targets that take stringent action too quickly may sacrifice a high economic growth rate, this kind
of economic loss can be greatly reduced by setting annual emissions targets that increase in stringency step by step, which provide enough time to merge advanced technologies into long-term investments.\textsuperscript{181} Indeed, the relative caps tied to growth will play the same role in diminishing the negative impact to China’s economic growth. However, as shown in the experiences of China’s seven pilot ETS programs, the relative caps have limited effects in restricting carbon emissions due to China’s fast economic advancement. Therefore, by taking both climate change mitigation and economic development into account, a gradually increasing trajectory of emissions control targets is not only reasonable but feasible as well. With less costs incurred, setting long-term emissions targets that are gradually phased in will help the carbon markets become more active and effective, which may have similar effects like Hubei’s action in controlling initial allowances distribution.

\textit{Allowances Distribution}

Among the seven pilot ETS programs, only a few carbon markets apply auctions to allowances distribution. Even at an early stage, though, it is important to freely distribute carbon allowances in order to reduce the negative sentiments within the participated units, which most of the ETS programs have considered. The Chinese government may need to gradually increase the proportion of quotas auctions when constructing and operating a nationwide emissions trading system. In addition to price discovery, auctioning can also help to generate government revenue.

that may reduce economy-wide costs of carbon trade through the support of research and development (R&D) in low carbon technology. Moreover, a gradually increasing proportion of auctions will allow participants to become more familiar with the mechanism, and thus diminish their negative sentiments toward auctions as well as carbon trade.

Nevertheless, although some authors suggest that auctions can become the major means of allowances distribution, the Chinese government may still prefer to freely distribute most of carbon quotas and thus encourage transactions within the carbon market. Shenzhen’s pilot ETS program has designed and adopted a competitive game-based allocation of carbon quotas that provides each controlled entity with more flexibility in obtaining initial allowances, which may be applicable in the national ETS framework. After the emissions caps of given industries are first determined, the regulated enterprises will then compete with other enterprises within their industries so as to acquire free allowances. In each round of the game, the controlled entities can choose to accept the allowances they gain and exit the game. Otherwise, they have to continue to compete for allowances in the next round with fewer remaining carbon quotas. In the last round of the finite games, those entities that have not accepted any allowance can only receive allocation from the allowances remaining.\(^{182}\) This allocation method invites competition among regulated entities, providing fair chances for them to acquire adequate carbon quotas in the initial distribution. Compared with the governmental agency, the enterprises have a better understanding on how much

\(^{182}\) Zhang, Zhongxiao, Carbon Emissions Trading in China: The Evolution from Pilots to a Nationwide Scheme, Australian National University, Crawford School of Public Policy, Center for Climate Economic & Policy, CCEP Working Paper 1503, 2015, 12.
allowances they actually need for a certain year, which will help to diminish transaction costs. Thus, Shenzhen’s innovative allocation approach may be more preferable at the national level.

“Cost-Containment” Mechanisms

The mechanisms that China has already applied in their pilot ETS programs are allowances banking and credits mechanism. From a long term perspective, both allowances banking and borrowing are feasible in China’s nationwide carbon market. Since the pilot period is only three years, the local government finds it difficult to initiate allowances borrowing, which allows firms to under-comply with their current emissions reduction obligations and use the future allowances to compensate. With a long period of operation, the Chinese government can introduce allowances borrowing into its national ETS program in order to increase flexibility for the participants and thus diminish long-term uncertainty. As the enterprises become more adaptable to carbon trade and have gradually mastered the low-carbon technology, they may find it much easier to diminish CO₂ emissions in the long run, even though allowances borrowing may incur future severe obligations for these enterprises.

Furthermore, the central government can continue to promote the development of offsets mechanism, which enables regulated entities to offset some of their emissions with credits gained from outside the ETS’s coverage. By implementing emissions-reduction projects, the regulated

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184 Ibid.
entities can earn CCER credits to meet their annual allowances. Even though the role of credits mechanism is relatively restricted in the pilot ETS programs, as only 5 to 10 percent of annual carbon quotas can be met with CCERs, the Chinese government can enlarge the scope to 10-20 percent for the national ETS program, and thereby encourage the participated firms to invest in clean energy projects. Since the requirements for CCERs generation are very different and localized among the seven experiential emissions trading systems, it makes more sense for the local governments to set their own stipulations rather than have a unified obligation across the country. The central government can, instead, release a national guideline imposing the minimum requirements for each locality. Based on the guideline, the local governments will have the flexibility to adjust the specific requirements.

**Penalty System**

Among the seven pilot ETS programs, penalties for non-compliances are relatively low, which cannot play a significant role in normalizing firms’ trading behaviors. While several experimental carbon markets only have fixed amounts of fines for different levels of excess CO₂ emissions, some other pilot ETS programs, such as Beijing, stipulate that excess emissions should be fined three to five times the average market price in the past six months. Nevertheless, as the market prices in China’s regional carbon markets are relatively low, this kind of penalty rule is still not stringent enough in limiting participants’ behavior of over-emissions. Thus, the Chinese

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government may prefer to set a higher fine level for each tonne of excess emissions in order to guarantee the smooth and effective operation of the national ETS program. In addition, the national ETS program should also consider penalizing the non-compliance enterprises by restricting governmental supports. In Shenzhen, for the regulated entities that surrender their allowances on time, the local government will assist their financing of energy-saving projects and carbon reduction activities.\(^{186}\) In Tianjin and Chongqing, enterprises with excess emissions cannot enjoy preferential policies as well as governmental support policies in respect to emissions reduction and energy conservation.\(^{187}\) Loss of governmental support could make it more costly for these enterprises to develop low-carbon technology and promote carbon reduction projects, which may provide strong incentives for them to limit their CO\(_2\) emissions. Besides considering punishments for excess emissions, the central government should also consider stipulations to manage the MRV mechanism. As most of the experimental carbon markets do not have a complete penalty system to support their operation of MRV mechanism, it becomes necessary to have national legislation concerning MRV regulation when a nationwide carbon market is set up.

*Carbon Trade Management Mechanism*

The construction and operation of a nationwide ETS system depends on effective management institutions at both local and central levels. Good cooperation and linkage among different departments will help to normalize the operation of carbon markets and thus diminish the


\(^{187}\) Ibid.
issue of externality. Especially, a national emissions trading system requires close connections between the central and local governments with a clear division of responsibilities, which the Chinese government may need to consider in framework design.

According to the paper of Fan Zhang and Zuojun Li, the National Development and Reform Commission (NDRC) and the Ministry of Environmental Protection should be responsible for the management on carbon trade at the central level, coordinated with other national ministries and commissions.\(^{188}\) Following the short term and long term goals set up by the State Council, these national departments need to accomplish their own division of work and cooperate with each other. Even though Zhang and Li’s framework design emphasizes the roles of various departments as well as their coordination, it is still a debatable question whether the NDRC would like to give up some of its power in carbon trading regulation. As the leading institution in charge of carbon emissions trading, NDRC may prefer to supervise the operation of MRV, which Zhang and Li attribute to the Ministry of Environmental Protection in their framework. In other words, the Chinese government should also take the competition of distinct departments into account.

Furthermore, Zhang and Li’s framework also suggests the close relationship between the central and local agencies. While the central government can be responsible for setting emissions caps and some other basic elements, the local government may be in charge of stipulating caps’ coverage and the MRV mechanism that need to be incorporated with the local circumstances. A certain degree of autonomy should also be left to the local governments in order to make the carbon

trade policies more adaptable. For instance, the emissions caps stipulated by the central government may be adjusted by the local governments given their economic and industrial circumstances. In the early periods of carbon trade, the developing regions may have less stringent caps depending on the state of local economic development. In contrast, major cities like Beijing and Shanghai may need more stringent caps, taking more responsibility in carbon reduction. Moreover, it is worth noting that a nationwide ETS program does not mean free carbon trade across regional boundaries. The central government may be more inclined to regional carbon trade due to the wide differences of geography and economic development in China. Nevertheless, with the help of conversion formulas, trans-regional transactions of CO$_2$ emissions can also be accomplished within the national carbon market.

_**Legislation**_

At the current stage, no legal document or implementation plan of the seven pilot ETS has identified and specified the legal nature of emissions allowances, which may provide a basic challenge to the legal framework of a nationwide ETS program. Specifically, the scope of emissions entitlements needs to be defined in order to provide transaction security for regulated entities, thereby increasing the liquidity within the carbon market. The major goal of the ETS program is to reduce carbon emissions, often reflected in the form of a decreasing cap over time.$^{189}$ However, this goal will probably lead to a conflict between regulated entities and the responsible

departments when valid allowances are cancelled by the authorities for the purpose of restricting the total cap.\textsuperscript{190} It is debatable whether emissions allowances are a kind of private property or authorization that can be revoked by the government. Although the allowances have already been distributed to the enterprises for a specific year, it does not mean that their future allowances are guaranteed. Without a sense of ownership on their carbon allowances, the participants within the ETS program may be less willing to trade and surrender their allowances, since they know that their allowances will be reallocated in the next year. This will harm the effectiveness and efficiency of the emissions trading system. During the construction of a nationwide carbon market, it seems necessary to first make a specific law regarding carbon trade at the national level, in which the emissions entitlement is fully defined. Thereby, the regulated enterprises will become more active in carbon trading, which will play an important role in carbon reduction and greatly help the Chinese government to fulfill its emissions targets.

Furthermore, at both local and central levels, a series of legal documents should be released and completed in order to support an effective operation of the national ETS program. For instance, the guidelines and regulations regarding the MRV mechanism need to be further developed. Especially, as none of the pilot ETS programs has issued legislative documents supporting the verification work of the third party institutions, many enterprises do not allow the verifiers to enter their facilities for inspection, which thwarts the smooth operation of the MRV system. Some other issues, such as the selection of third party organizations, should also be specified and normalized.

\textsuperscript{190} Shen, Ying, Crossing the River by Groping for Stones: China’s Pilot Emissions trading Schemes and the Challenge for a National Scheme, Asian Pacific Journal of Environmental Law (Volume 18), 2015, 36.
within the national legal institution. Given the establishment of a specific law that provides a general legal framework concerning carbon trade, the local governments can release corresponding management measures in consideration of the local circumstances. It seems that the local governments of each pilot ETS program are waiting for the central government to first carry out the national legislation concerning carbon trade. This may explain why only a few pilot regions have released corresponding but still incomplete local legislation to regulate carbon markets.
Conclusions

China, as the largest CO$_2$ emitter in the world, faces increasing pressure on carbon reduction from international and domestic constituents. Even though the Chinese government started to apply command-and-control regulations in the late 2000s to tackle this issue, sole reliance on mandatory administrative measures cannot help China fulfill the progressively stringent target of carbon emissions in a cost-effective way. Therefore, the Chinese government has considered employing market-based instruments, including emissions trading and carbon taxes, for the purpose of CO$_2$ emissions control. Given China’s economic and legal contexts, an emissions trading system (ETS) is more appropriate than carbon taxes in the current stage from both theoretical and empirical perspectives.

In late 2011, China’s National Development and Reform Commission approved the operation of seven pilot ETS programs in the regions of Beijing, Tianjin, Shanghai, Shenzhen, Guangdong, Chongqing and Hubei.$^{191}$ Since the initiation of Shenzhen’s carbon market in June, 2013, the other six regional emissions trading systems have started their operations successfully.$^{192}$ This “Two Provinces and Five Cities” carbon trading experiment is now approaching the end of its pilot period (2013-2015), and the experience gained from the experiment must be analyzed to construct a future nationwide carbon market.

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$^{191}$ Zhang, Zhongxiao, Carbon Emissions Trading in China: The Evolution from Pilots to a Nationwide Scheme, Australian National University, Crawford School of Public Policy, Center for Climate Economic & Policy, CCEP Working Paper 1503, 2015, 2.

During the operation of the seven pilot programs, some initiatives and problems were revealed in their framework design as well as market performances. First, as the first trial in the world, both direct and indirect CO₂ emissions are covered in the carbon trade mechanism. Second, based on the regional differences in geography and economic development, each pilot ETS program has their own characteristics. For instance, whereas Chongqing—one of China’s industrial bases—includes 4 major heavy and light industries, Shenzhen covers 26 different sectors, including both industrial enterprises and non-industrial entities. Third, Shenzhen has applied an innovative method of allowance distribution by introducing game and competition into the allocation process, which provides more chances for the regulated enterprises to acquire initial allowances.

Aside from this novel experience, some lessons are also detected in this learning-by-doing process. All of the regional emissions trading systems assign relative caps rather than absolute caps, which may greatly lead to increasing aggregate emissions targets given China’s rapid economic growth. Moreover, based on the experience of Guangdong’s carbon market, the employment of auctions in quotas distribution may trigger negative sentiments among the controlled entities, especially as other ETS programs do not lead auctions to play a significant role in allowances distribution. For this reason, the design of auction mechanism should be more nuanced and subtle. In addition, all the pilot ETS programs in China do not have a complete and robust MRV institution, which may harm the efficiency of emissions trading. Furthermore, the penalty levels in all the emissions trading systems are not very stringent so that the enterprises may not have strong motivation to reduce CO₂ emissions and surrender their carbon allowances on time.
Given the issues within their framework design, the market performance of China’s pilot ETSs is not as good as expected. Low allowances prices and low trading volumes are the major characteristics of China’s experimental emissions trading systems. Hubei has the largest trading volumes with a very constant price trend during the pilot period, which can be attributed to its strict cap setting and government intervention. Assigning the market to function itself, Shenzhen enjoyed the largest standard deviation of prices during the first implementation period. Nevertheless, as the participants of Shenzhen’s ETS program get used to carbon trading, the price trend has become much more stable in the following periods. Compared with other six pilot ETS programs, Guangdong’s largest standard deviation of prices in the second implementation period comes from its adjustment of the auctions policy. To a great extent, auctions play a significant role in Guangdong’s carbon trade mechanism, and thus greatly impact its market performance.

The experience and lessons drawn from China’s emissions trading experiment provide several important suggestions on the construction and operation of China’s national ETS program. First of all, the Chinese government should consider adopting a nationwide emissions trading system in an evolutionary manner by further including more regions and strengthening regional connections. Second, given China’s concern with both economic growth and carbon reduction, it is more logical, from a long term perspective, for the Chinese government to set up a gradually increasing trajectory of emissions control targets. Third, while the central government can release a national guideline that imposes the minimum requirements for some crucial elements, such as emissions coverage, an extent of autonomy should be remained to the localities. The cooperation between the national and the local governments is essential for a well-functioning nationwide carbon market in China. Fourth, it may be appropriate for the Chinese government to introduce
some “cost-containment” mechanisms into the national ETS program for the purpose of hedging. Last but not the least, both national carbon trade law and a robust penalty mechanism should be established in order to guarantee the effectiveness and efficiency of the nationwide carbon market.
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