China Council for International Cooperation on Environment and Development

Council Member Paper

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China Council for International Cooperation on Environment and Development

Emissions Trading and Institutional Innovation: Lessons Learned From China's Carbon Trading Pilots

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This document is prepared for the China Council for International Cooperation on Environment and Development (CCICED). It provides an overview of emissions trading and describes China's efforts to use an emissions trading system (ETS) to address environmental challenges. It also outlines lessons learned thus far through the seven carbon trading pilots and provides recommendations that may be useful as China works towards the development of a national greenhouse gas ETS.

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1. EXECUTIVE SUMMARY

This document is prepared for the China Council for International Cooperation on Environment and Development (CCICED). It provides an overview of emissions trading and describes China's efforts to use an emissions trading system (ETS) to address environmental challenges. It also outlines lessons learned thus far through the seven carbon trading pilots and provides recommendations that may be useful as China works towards the development of a national carbon ETS.

The Third Plenum of the 18th Party Congress laid out a transformative reform agenda for China. Chief among them included establishing an ecological civilization, placing market forces in the decisive role, and creating a carbon market. This paper weaves these reform initiatives together in the context of one specific market-based policy termed emissions trading. While the current ETS focus in China is on controlling carbon emission, this paper touches on the root causes of many atmospheric pollution problems and the co-benefits from control.

Over the past 20 years, there has been considerable debate about whether China could successfully develop and implement an effective ETS. Prior to the current carbon trading pilots, there was only one significant large scale ETS experiment in China. This was the "4+3+1" project to test SO_2 emissions trading for the control of acid rain.[1] Current carbon trading pilots in contrast have a much wider scope of coverage, longer length of run, more emissions trading infrastructure, and much greater transaction volume. While there is significant work that remains to be done before a national carbon ETS can be launched, it is now clear that there is no fundamental barrier to implementing an effective ETS in China.

The major conclusions of this report – presented by Section -- are as follows:

- **Emissions trading is a cost effective means to control greenhouse gas emissions while simultaneously achieving secondary environmental, energy, and water conservation benefits**. (Section 2.) It is a tool that is favored by policy-makers, regulators, and emitting enterprises because it guarantees results in the most cost-effective manner, provides maximum flexibility in achieving, and encouraging environmental innovation.

- **China has deep experience with the use of emission trading to achieve conventional pollutant emission reductions**. (Section 3.) This experience has

[1] Lin Hong, Zhang Jianyu, and Daniel J. Dudek, Acid Rain Control in China: Total Emission Control and Emission Trading, China Environment Press, May 2004, 300 pp.

provided carbon ETS policymakers with a foundation for the development of the carbon trading pilots and a national ETS.

- **The seven carbon trading pilots are policy experiments through which China is learning by doing**. (Section 4.1) Their success should be determined by the lessons that they provide China as it considers the development of a national ETS. Lessons learned and recommendations that can be drawn from the pilots include the following (Section 4.2):
  - Goal - A central goal of an ETS should be the establishment of an absolute cap protective of the environment and the achievement of an absolute reduction of emissions within a defined timeframe.
  - Cap and Scope – The value of an ETS in both economic and environmental terms is correlated with the relative proportion of the emissions inventory that is included within its scope.
  - Data Accuracy – Great effort should be placed on developing and constantly improving the quality of data used for ETS development, implementation, monitoring and evaluation. It is the bedrock upon which investment decisions are made by enterprises and compliance assessments by government.
  - Thresholds – Policymakers should establish absolute emission-based thresholds at a scope of coverage consistent with resources available to those who will administer, support, and be subject to the ETS. Thresholds are also critical in delineating the scale of enterprises that are expected to capably manage ETS responsibilities and opportunities.
  - Allocations – The method used to allocate quotas should be made in accordance with broader economic development objectives. Important benefits will be gained if multiple-year streams of quotas are made available to enterprises. Once issued, allocations should not be adjusted within a specific control period (except in support of enforcement actions).
  - Diversity of Sectors –In order to achieve the maximum effectiveness and lowest aggregate cost, the ETS should include a broad diversity of sectors, facility types, and sizes with different marginal control costs.
  - Direct and Indirect Sources – Direct and indirect sources should be separated. Energy efficiency can be encouraged through the use of policies specifically designed to stimulate energy savings. Comingling direct and indirect sources creates the problem of double counting reductions and undermining confidence in the ETS.
  - Mobile Sources –As allowed by available resources, the pilots could broaden their consideration about the feasibility of including mobile sources in their respective ETS programs.
  - Banking – An ETS should encourage enterprises to store quotas for later use or sale. Policymakers should encourage pilot enterprises to bank quotas by grandfathering a proportion of unused quotas from the pilot period to allow their use in the eventual national ETS.

- Long Term Decisions – National ETS policy-makers should give strong consideration to measures that encourage enterprises to make decisions that involve long term investments.
- Market Volatility – ETS policymakers should embrace a modicum of market volatility, understand that addressing perceived quota shortfalls and surpluses by adjusting the supply of quotas may contribute to volatility; and include measures that can be used to manage volatility without causing ill-effect on market incentives to reduce emissions.
- Risk Hedging Tools – National ETS policymakers should engage with appropriate authorities to consider a plan for carbon financial instruments to be phased into a national ETS market.
- Offsets –High quality offsets should be accommodated in a national ETS. Mechanisms should be included to introduce more ambitious environmental goals in the event that there is a dearth of available offsets and/or a precipitous price decline. Clear guidelines should be included in the ETS so that the market has the ability to adjust to such events.
- Enforcement – A robust system to discover and respond to noncompliance is at the core of an ETS. Such a system must ensure that noncompliance consequences are immediate, predictable, and of greater financial consequence than the value gained through noncompliance.

- **Thus far (as of Oct 10, 2014) more than 28.7 million quotas worth about 1.27 billion rmb (USD $205.4 million) have been transacted at an average price of 44.1 rmb/tonne**. (Section 4.3) Owing to regulatory restrictions and the short duration of the pilot period, with one important exception (Shanghai) future streams of quotas have not been transacted.

- **The primary value of the carbon trading pilots is to provide national ETS policymakers with a proving ground for new ideas**. (Section 5.) It would be a mistake to judge the success of the pilots based on how they may be compared to already-established traditional (and Western) ETS programs.

- **China's path forward starts with an evaluation of the pilots.** (Section 6.) A nationally administered ETS may be built out from the pilots; comprised of a limited number of sectors; inclusive of the industrialized eastern regions; or multi-sectoral and country-wide.

2. EMISSIONS TRADING: A COST-EFFECTIVE WAY TO CONTROL EMISSIONS

Emissions trading is a market-based form of regulation that mandates the achievement of a defined environmental objective and provides covered enterprises with the flexibility to select the specific means to achieve the goal. Often, an emission trading system (ETS) features a cap (fixed or declining) that limits the total amount of emissions that an enterprise can emit, a deadline for the objective to be achieved, and the flexibility to make reductions at a specific emissions point, through another point of emissions within its control, or by another enterprise covered by the program. The ETS program administrator must have a means to monitor emissions, verify compliance, and levy enforcement penalties.

Globally, and inclusive of China's seven carbon trading pilots, there are more than 20 ETSs. Some are currently operating (e.g., EU ETS, California's AB32 and Quebec, Regional Greenhouse Gas Initiative [RGGI]). Others are in the development stage (e.g., Korea, Brazil). Still others have hit roadblocks (e.g., Australia's carbon pricing mechanism was repealed by the Australian Senate on July 17, 2014).

Enterprises facing emission reduction obligations may favor an ETS[2] because it provides them with both certainty of objective, flexibility of method, and the ability to make decisions that are cost effective. Depending upon the ETS program, enterprises may choose to comply with a programmatic emission reduction obligation through one of three means:

1. The reduction of on-site emissions (e.g., via the use of process changes, the installation of controls, or fuel switching). Enterprises that over control can both satisfy their emission reduction obligations as well as free up emission rights[3] that can be sold.

2. Purchasing emission quotas from the government or other enterprises.

3. Paying third parties for emission rights that result from reductions at emission sources that are not otherwise required to make reductions.

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[2] As compared to a command and control program that would impose similar emission reduction obligations.

[3] For the sake of convenience, "emission rights" refers to government issued instruments (licenses) that provide the owner with the ability to emit a quantity of emissions as per the terms of the emission trading program. When associated with cap and trade programs such emission rights are generally referred to as "quotas," or sometimes as "allowances." When associated with project-specific ETS programs in China, such rights may be referred to as "emission offsets" or "Chinese Certified Emission Reductions." Delineated in tonnes that may be initially used in a particular year, quotas and offsets are forms of currency in an ETS. This is a term of art not meant to imply property rights in the strictest sense. Rather these are temporary authorizations to emit under the terms of the ETS.

Why Not a Carbon Tax Instead?

Some assert that a carbon tax is preferable to an ETS that features a hard cap. Contrasting arguments are summarized below:

- **A cap forcibly limits emissions, taxes do not**. Faced with a carbon tax, enterprises can simply choose to pay more and thereby exceed prescribed environmental limits. The only sure thing with a tax is that money will be raised.
- **A reliable MRV system is required for both an ETS and a tax.** Contrary to popular belief, both an ETS and a carbon tax require systems to monitor the consumption of fuels, emissions, and/or conventional pollutants.
- **It's more practical to tighten a cap than increase a tax.** In the face of an economic downturn there may be a decrease in carbon emitting activities, a waning in interest in carbon reduction investments, and a reduced price on carbon. With an ETS, a meaningful price on carbon can be maintained by including a mechanism that increases the ambition of the program by automatically ratcheting down the cap in a way that mandates more reductions from covered sources. In contrast, in the face of an economic downturn, under a carbon tax, policymakers would be faced with the dual difficult challenge of determining the appropriate tax rate to achieve a particular environmental objective and securing necessary approval from decision-makers.
- **An absolute cap can accommodate economic growth and guarantee environmental results.** An ETS can be designed to allow economic growth without sacrificing the integrity of the cap. Government managed price containment reserves and growth reserves (which must be built into the original cap), offsets (which expand the cap to sources that would not otherwise be controlled), and emissions banking can be used to provide a measure of relief to buyers as well as maintain the integrity of the cap. In contrast, with a tax, while carbon revenues will increase so too will emissions.
- **An ETS expands the pool of capital available to reduce emissions**. An ETS encourages enterprises to implement additional controls that serve to simultaneously reduce costs and free up quotas which can be sold or used to accommodate expansion. Capital for such controls can be secured either internally or from other enterprises that can gain surplus allowances in exchange for investments. In contrast, when faced with a tax, the best a manager can do is to compete for internal funds and minimize costs.
- **Emission reduction benefits of an ETS extend beyond the facility**. An ETS featuring offsets encourages investments (and spreads the benefits) beyond the borders (geographic, sectoral, and otherwise) of the cap and trade program. In contrast, with a carbon tax, enterprises cannot fund more cost effective reductions except through internal control investments to avoid tax payments.

Fundamental to all three methods is the need for the ETS program administrator to be able to reliably monitor and verify the emissions released by enterprises, the trading of surplus emission rights, and the ability to impose meaningful enforcement sanctions against non-compliers.

ETSs may be favored by policymakers because they (if well-designed and competently administered) guarantee results. Absolute environmental goals are established, program-wide reduction obligations are allocated to participating enterprises, actions are monitored, noncompliance is sanctioned, and results are achieved.[4]

An absolute (and declining) cap can accommodate economic growth without compromising environmental objectives. In the face of extraordinary economic growth, measures such as banking, price containment reserves, government-held reserves (all of which should be built into a cap), and offsets (which expand the cap to sources that would not otherwise be controlled by the ETS) can be used to both provide a measure of relief to buyers as well as maintain the integrity of the cap.

Participants may favor ETSs because compliance managers are provided with long-term predictable mandates, the flexibility to achieve compliance in the most cost-effective fashion, the ability to price emissions and monetize avoided emissions, and rewards for compliance. An attractive element of an ETS is that covered entities are provided with the responsibility to achieve defined environmental objectives and the freedom to seek out and pursue those options that are most attractive. Enterprises are provided with access to a marketplace, which includes multiple sources that have diverse marginal costs of control, a pool of capital to finance reductions, and a wealth of entrepreneurial ingenuity. As a result, shifts both subtle and dramatic occur. Under command and control, the only thing that binds disparate enterprises is that they each have their unique compliance problems. In contract, a cap and trade programputs a price on pollution and rewards efficiency, innovation and early action. One enterprise's compliance problem becomes another's profit opportunity.

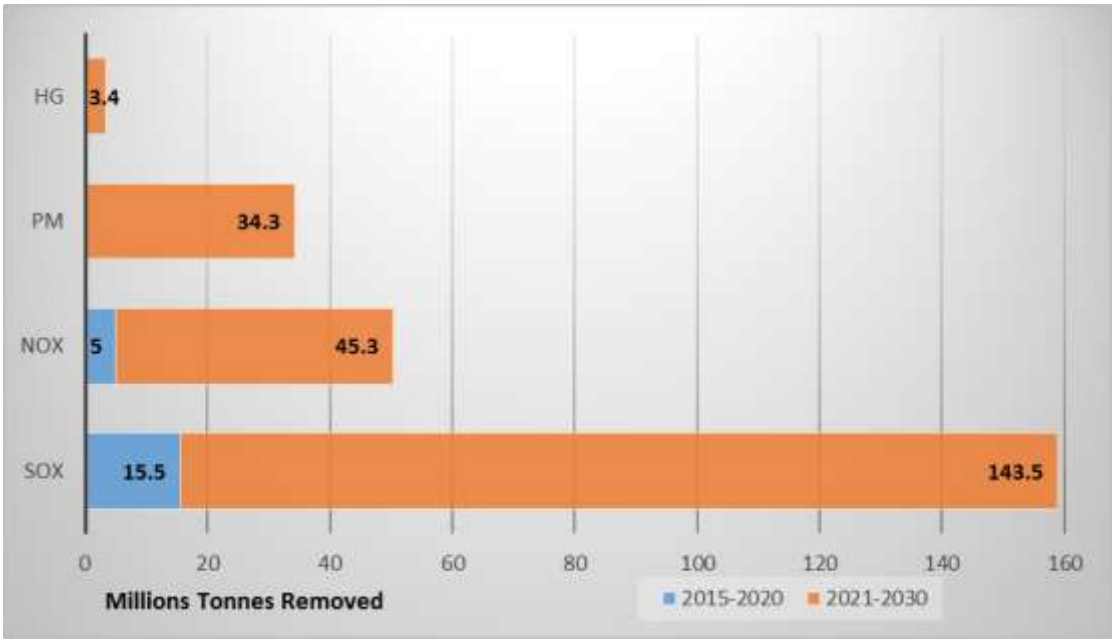
Emission reduction benefits of an ETS extend beyond the individual facility. A thoughtfully designed carbon ETS advances important secondary objectives:

- **Reducing conventional emissions** – CO_2 emissions can be reduced by switching to lower carbon fuels. For example, switching from coal to natural gas or renewables (e.g., wind, solar, hydro) will have a concomitant benefit of reducing other products of fossil fuel combustion, such as NOx, SOx, VOCs, PM, and Hg. For example, as shown in Figure 1, if in 2015 China were to commit to a power sector carbon cap at 4 GT for 2020 and 3.6 GT for 2030, it could also realize estimated co-benefits of an additional ~159 MT of SOx reduction (15.5 MT

[4] In China, some pilots are using an ETS as the means to realize carbon intensity goals, which mandate a reduction in emission per unit of economic output.

between 2015 and 2020 and another ~143.5 MT between 2021 and 2030), ~50.3 MT of NOx (5 MT, 45.3 MT) control, ~34.2 MT of PM (-0.1, 34.3) reduced, and ~3.4 MT of Hg avoided.

Figure 1. Co-Benefits of A 4 GT Power Sector CO_2 Cap[5]



- **Promoting energy efficiency** – One means of operating within a fixed (or declining) CO_2 allocation is to reduce the carbon intensity of operations. In so doing, liable enterprises reduce their power consumption and associated emissions.

- **Encouraging early reductions** – ETSs tend to reward early emission reductions. Enterprises that voluntarily reduce emissions ahead of schedule (e.g., before the commencement of the ETS or prior to a defined deadline) can gain credits that can be then later used or sold to others.

- **Advancing technology** – In putting a price on carbon emissions, ETSs also put a bounty on emission reductions. Giving environmental managers the ability to profit from the wise management of both operations that consume and create quotas will in turn prompt air quality entrepreneurs to seek new technology to monitor, measure, and reduce emissions. Linking quota management and revenues will turn waste managers into profit seekers.

[5] Source: EDF estimates with assumption of best case results of carbon emission management, demand-side management, energy efficiency and natural gas potential based on best world practices. The estimates are made using the TIMES electricity model developed by EDF in collaboration with the China Electricity Council (CEC).

- **Spreading the benefits beyond the ETS** – ETSs featuring offsets encourage investments (and spread the benefits) beyond the borders (geographic, sectoral, and otherwise) of the cap and trade program. The incorporation of offsets into ETSs will extend the benefits and incentives of an ETS well beyond its geographic confines – including the generation of meaningful co-benefits.[6, 7] The quid pro quo that goes along with the ability to create and sell offsets will cause sources that would otherwise be excluded from an ETS to voluntarily accept emission limitations and monitoring, reporting, and verification (MRV) requirements that would not otherwise be applicable.[8]

- **Expanding the pool of capital available to reduce emissions** – An ETS encourages enterprises to implement additional controls that serve to simultaneously reduce costs and free up quotas that can be sold or used to accommodate expansion. Capital for such controls can be secured either internally or from other enterprises that can gain surplus quotas in exchange for investments.

[6] Unlocking the Hidden Value of Carbon Offsetting. International Carbon Reduction and Offset Alliance. September 2014. http://www.icroa.org/documents/download.php?did=44

[7] EDF is working with China's National Development and Reform Commission (NDRC) and the Poverty Alleviation Office of the State Council (PAO) to explore a way to benefit the farmers in poor areas by joining them in the carbon market though offsets.

[8] With support from EDF, China's NDRC and PAO conducted research on *Low Carbon Development Study on Poverty Region*. A report analyzing the outcome of this study is expected to be released soon.

3. CHINA'S EXPERIENCES WITH EMISSIONS TRADING

China has deployed emissions trading-based programs to address both conventional pollutants (like SO_2) and greenhouse gas (GHG) emissions.[9] The fruits of these efforts provide China with valuable references as it considers using such an approach in its national climate change mitigation strategy. This section describes China's efforts to develop and deploy emissions trading programs,[10] as well as illustrates the key design features of the seven carbon trading pilots.

Emission trading as a tool to control pollutants began to be implemented in China almost three decades ago. In 1986, Taiyuan City of Shanxi Province issued a rule regarding pollutant emission trading, which made it the first area in China to adopt the market-based instrument to control pollution. In the early 1990s, the State Environmental Protection Administration (SEPA, now the Ministry of Environmental Protection) piloted an emission permitting system in 16 cities, on the basis of which six priority cities for pollution control (Baotou, Taiyuan, Guiyang, Liuzhou, Pingdingshang and Kaiyuan) were chosen to experiment with emission trading. These pilot projects accumulated experience in cap setting, permit issuance, monitoring and operation of the management system of emission trading.

In the 2000s, in order to control acid rain and SO_2 emissions, China tried to leverage international experience to proceed with its ETS. The Asian Development Bank (ADB) was among the most active international organizations to partner with central and local governments to support emissions trading.

Perhaps the most well-known SO_2 ETS was undertaken by SEPA with support from EDF between 2001 and 2004. Although officially named "*Promoting Policies of SO_2 Total Emissions Control and Emissions Trading in China*," it is also referred to as the "4+3+1 project" because it involved four provinces (Shanxi, Jiangsu, Shandong and Henan), three cities (Shanghai, Tianjin and Liuzhou) and one enterprise (China Energy Group).[11] This innovative project was implemented as a strategy to cap (aka "Total Emission Control") allowable SO_2 emissions during the Tenth Five-Year Plan

[9] The State Council of China published *Guidance on Further Promoting Compensation for the use of Pollutant Emission Right and Trading Pilot* on August 25, 2014. http://www.gov.cn/zhengce/content/2014-08/25/content_9050.htm

[10] This paper does not describe China's long and deep history with the Clean Development Mechanism. According to China's World Bank Market Readiness Proposal, "[b]y November 30 2012, the Chinese government has approved 4,778 CDM projects, 2,708 of which have been successfully registered after CDM Executive Board's approval, 52.1% of the world's total. The estimated average annual reductions of Chinese projects are close to 460 million tons of CO_2 equivalent, 65% of the world's total reduction of registered projects. Of the registered projects, 1,007 have been issued with an overall issuance volume of 660 million tons of CO_2 equivalent, 60% of the world's total."

[11] Shandong, Shanxi, Jiangsu, and Henan Province; the cities of Shanghai, Tianjin, and Liuzhou; and the Huaneng Group.

(2001–2005) [12]. It covered 727 companies (most of which came from the power sector) located in 131 cities that were responsible for about 20% of China's SO_2 emissions.[13]

The "4+3+1 project" covered a wide area with diverse representation of different characters: Shanghai city and Jiangsu province are most economically developed and have sound market-based economic structure.; The province of Shandong has the highest SO_2 emission in China. Henan is the most populated province. Shanxi province, with its numerous power plants and heavy industry, is a big energy producer and user.

The program's success led researchers to conclude that an ETS can be applied on either a local or national level. Importantly, it also contributed to the establishment of a set of standardized management and operation mechanisms for the total SO_2 emission control, provided insights into important characteristics of the emission quota system, and contributed to national capacity building which have since been drawn on by China to implement the carbon ETS pilots.[14]

Encouraged by the central government's demonstration projects, more provinces and cities began to use emission trading as a tool to achieve their emission control targets, especially for the compulsory targets of SO_2 and NOx set by the Eleventh Five-Year Plan. In 2007, the Ministry of Environmental Protection and Ministry of Finance jointly launched another emission trading program covering seven provinces, which subsequently expanded to eleven provinces (Jiangsu, Zhejiang, Tianjin, Hubei, Hunan, Inner Mongolia, Shanxi, Shaanxi, Chongqing, Hebei and Guangdong). An additional ten provinces not included in the national demonstration program voluntarily launched their own pilot emissions trading systems. These pilot provinces established their own integrated transaction platforms for air pollutants, water pollutants and GHGs.

In 2011, the State Council issued the *Decision to Strengthen Priority Work of Environmental Protection*[15] and reiterated the policy to establish an environmental market. The document also affirmed that a national emission trading center would be established. In August 2014, the State Council issued a special document[16] regarding pushing forward the demonstration program of emission trading and setting up a timetable for the first time for China to establish a national emission trading market.

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[12] SO2 Total Emission Control and Emission Trading Policy Implementation Demonstration Working Group (1999) Acid Rain Control in China: Total Emission Control and Emission Trading. China Environmental Science Press, Beijing.

[13] Tao Pan, Zhihong Wei and Deshun Liu, "Pilot SO_2 Emission Trading Projects in Power Sector in China." Research Center of Contemporary Management, Global Climate Change Institute, Tsinghua University, Beijing, 100084, P.R. China: http://is.gd/lCZkyM

[14] Ibid.

[15] http://www.gov.cn/zwgk/2011-10/20/content_1974306.htm

[16] http://www.gov.cn/zhengce/content/2014-08/25/content_9050.htm

According to the document, the demonstration will be concluded in 2015 and a national system of emission trading will be established in 2017.

4. CHINA'S SEVEN CARBON TRADING PILOTS

As a prelude to a potential national carbon trading program, on October 29, 2011, China's NDRC designated carbon pilot programs in five municipalities (Beijing, Tianjin, Shanghai, Shenzhen, and Chongqing) and two provinces (Guangdong and Hubei). In addition to putting a price on carbon, these seven programs offer China the opportunity to learn by doing, experiment with different ETS design choices, and give both local officials and industrial entities the ability to build capacity. Experiences gained from the pilots will help inform the design and implementation of a national carbon trading system.

This section describes the background against which the seven carbon trading pilots were developed, key design features, market activity, year one compliance results, and the role of the pilots.

4.1 Development Background

The crucible of circumstances within which the China's seven carbon trading pilots are being forged is unlike that faced by any other ETS. The result will be a set of programs that are custom-made to reflect the different economic, environmental, political, and social constraints faced by different regions in China. Some of the most significant factors are described below.

Compressed Development

The launch of the pilots within less than two years of the NDRC's announcement[17] has pressed policymakers to climb a very steep learning curve. This abbreviated period ruled out the pursuit of a more leisurely decision process (there was a more than six-year run-up for both RGGI and AB32). As a result, the policymakers developing the pilot ETSs sought and considered the advice offered by existing ETS policymakers, discarded what is inappropriate, and developed customized approaches that are appropriate for diversity of circumstances, challenges, and opportunities that mark each of the pilot cities and provinces. Policymakers are continuing to shape and refine their respective ETSs as they are being implemented.

[17] Launch dates were as follows: Shenzhen–June 18, 2013; Shanghai–November 26, 2013; Beijing–November 28, 2013; Guangdong–December 16, 2013; Tianjin–December 26, 2103; Hubei–April 2, 2014; Chongqing–June 19, 2014.

Diverse Geo-economic Features

As shown in Table 1, the pilots feature a diverse cross section of China's industrial landscape. They include China's first and second largest cities (Shanghai and Beijing), largest manufacturing area (the Pearl River Delta which includes Shenzhen and portions of Guangdong Province), the world's largest port (Shanghai), and the capital of China (Beijing).

Table 1. China and Pilot Region Size, GDP & Vehicles

			Population		GDP (2013)[18]		Vehicles (2012)[19,20]	
		Area (km2)	**Population (millions)**	**People per km2**	**Total (billion US$)**	**Growth Rate (%)**	**#Vehicles (millions)**	**#Vehicles per km2**
China		9,388,211	1,350	144	9,240	7.7	240	26
PILOTS	**Shenzhen**[21]	1,953	13	6,656	205	10.7	3	1,536
	Shanghai	6,340	23	3,628	329	7.5	2.1	336
	Beijing	16,801	20	1,190	282	7.7	4.9	294
	Guangdong	177,900	104	585	904	7.7	10.4	58
	Tianjin	11,917	13	1,091	210	13.8	2.2	185
	Hubei	185,401	58	313	353	11.3	2.9	16
	Chongqing	82,401	29	353	181	13.6	1.6	19
	Pilot Totals (% of China)	481,259 (5%)	247 (18%)	513[22]	2,463 (27%)		24.1 (10%)	50[23]

The pilots cover a geographic area exceeding 481 thousand square kilometers (5% of China's total land mass) within which about 250 million people live (18% of China's population). The two pilot areas with the greatest population and land mass are Guangdong (104 million people, 177,900 km2) and Hubei (58 million people, 185,900 km2). Following them are Beijing (20 million people, 16,801 km2), Shenzhen (13 million people, 1,953 km2), and Shanghai (23 million people, 6,340 km2). With estimated 240 million vehicles on the road in 2012, China is the world's largest automobile market sources. About 24 million (10% of China's total) were on the road in the pilot regions.

Growing Economy

Between 1989 and 2014, China experienced an average annual GDP growth rate of 9.1%. China's rapidly developing economy and a system that has rewarded

[18] http://www.stats.gov.cn/tjsj/ndsj/2013/indexch.htm
[19] http://www.statista.com/statistics/278425/number-of-registered-vehicles-in-china-by-province/
[20] 2012 data. China Ministry of Public Security. http://www.mps.gov.cn/n16/n1252/n1837/n2557/3671502.html
[21] As Shenzhen is a special economic zone that is located within Guangdong Province, data relative to population, area, GDP and number of vehicles are included within the data provided for Guangdong and are not separately added to the totals.
[22] People per square kilometer
[23] Vehicles per square kilometer

government officials for this growth complicates the adoption of absolute carbon caps. As shown in Table 1, the regions represented by the pilots contribute about 27% of China's gross domestic product (some estimates suggest the pilots make up an even greater proportion of China's total GDP).

The individual pilots have GDPs (2013) ranging from USD$181 billion (Chongqing) to USD$904 billion (Guangdong). GDP growth rates range from 7.5% (Shanghai) to 13.8% (Tianjin).

Regulated Power Sector

Observers[24] have concluded that the highly regulated nature of China's power sector makes it problematic to include such sources in an ETS. This sector, which is responsible for nearly 50% of China's combustion-related CO2 emissions, produces a commodity whose price and dispatch is highly regulated. The degree to which generation (including carbon) costs can be passed to end users is tightly controlled. However, this is also a sector that is very familiar with the importance of cost control as the key path to profitability. An ETS will be a key tool in this regard.

Carbon and Energy Intensity Goals

Pre-dating the carbon trading pilots are carbon and energy intensity reduction requirements. As a nation, China has a self-imposed goal of reducing CO_2 emissions by 40 to 45% per unit of GDP by 2020. And in March 2011, China announced a nation-wide 17% carbon intensity reduction target for the first time in Premier Wen's government work report [25]. Then the 12th Five Year plan for GHG Emission Control[26] was published in November 2011, which further specifies 2015 objectives (measured from a 2010 baseline) for each of the provinces and municipalities directly under the Central Government. These requirements have been the driving force behind emission control and energy savings measures adopted by the national and local DRCs. Hubei's and Chongqing's carbon and intensity goals are 17% and 16%, respectively. Shenzhen (which carbon and energy intensity reduction goals are self-imposed by the Shenzhen municipal government) has the most aggressive goals – 21% and 19.5%, respectively.

[24] http://www.sciencedirect.com/science/article/pii/S0301421514004637
[25] http://www.chinadaily.com.cn/language_tips/2014npccppcc/2014-02/27/content_17309663.htm
[26] http://www.lawinfochina.com/display.aspx?lib=law&id=9212&CGid=

Table 2. Carbon and Energy Intensity Goals

Region	12 Five Year Plan 2015 Carbon and Energy Intensity Reduction Goals[27]	
	Reduce Carbon Intensity by (%)	Reduce Energy Consumption Intensity by (%)
Shenzhen	21 (economy-wide)/25 (manufacturing)	19.5
Shanghai	19	18
Beijing	18	17
Guangdong	19.5	18
Tianjin	19	18
Hubei	17	16
Chongqing	17	16

12th Five Year Plan and Third Plenum

The 12th Five Year Plan provides policymakers with the following mandates regarding the need to reduce carbon intensity including through the use of emissions trading systems:

- We must significantly reduce the intensity of our energy consumption and CO2 emissions, as well as effectively regulate greenhouse gas (GHG) emissions.
- We will … gradually create a carbon emissions trading system.

The Third Plenum[28, 29] directs that measures be taken to:

- Implement resource pay-to-use systems and ecological compensation systems.
- Accelerate pricing reform of natural resources and their products, to completely reflect market supply and demand, the extent of resource scarcity, costs caused by ecological and environmental harm and the benefit of restoration.
- Persist in using resource fees, and the principle of "who pollutes/who destroys, who pays."
- Persist in the principle of "who profits, who compensates," perfect ecological compensation mechanisms for key ecology function areas.
- Develop environmental protection markets.
- Implement energy saving, carbon emission allowances, waste discharge quotas, and water rights trading schemes.

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[27] 12th Five Year Plan http://www.gov.cn/zwgk/2012-01/13/content_2043645.htm includes carbon and energy intensity reduction goals for all of the pilots with the exception of Shenzhen. Shenzhen's carbon intensity and energy consumption intensity reduction targets are self-imposed by Shenzhen municipal government. Shenzhen has voluntarily taken on an economy-wide 21% carbon intensity reduction target and a 25% carbon intensity reduction target for manufacturing sector in the 12th FYP period.

[28] Ibid.

[29] The Decision on Major Issues Concerning Comprehensively Deepening Reforms: http://politics.people.com.cn/n/2013/1115/c1001-23559207.html

- Establish marketized mechanisms to attract social capital to invest in ecological and environmental protection.
- Implement third-party supervision for environmental pollution.

Opportunity for Global Leadership

China's commitment to reduce carbon intensity and implementation of the pilots has already set China apart from other nations that understand the need, but lack well developed institutional infrastructure to take action to address the climate challenge. A commitment to follow-on with a national ETS -- for reasons that entirely consistent with China's own climate, air quality, water conservation, and energy security interests – will clearly establish China as a global leader.

4.2 Design Features, Lessons Learned, and Recommendations

While the seven pilots were initiated under a common NDRC directive,[30] each has been developed to meet the unique circumstances, challenges, and opportunities of the respective regions. This section describes some of the more significant design elements and touches on decisions that were made by non-Chinese (largely Western) ETS policy-makers. Lessons that have been learned through the pilot process are noted. Finally, two sets of recommendations are provided. The first set suggests how the pilots may further improve their programs (though they are nearly half-way through their term). The second set is provided for consideration by the designers of a national ETS.

Goal

Design Feature: Goal
Findings: The carbon pilots have achieved the goals and milestones established by the NDRC.
Recommendations: As pilots enter their second and third years, China should evaluate the pilots for lessons learned that will be useful in the design of a national ETS.
National ETS Recommendations: The primary goals of the national ETS should be to accomplish an emission reduction objective defined in absolute terms and by a defined date.

Policymakers should design an ETS with the primary goal of first capping and then reducing emissions from covered enterprises. The goal needs to be both programmatic and enterprise-specific, expressed in absolute (not relative) reductions, and include a defined deadline. Moreover, the program should specify that

[30] National Development and Reform Commission regarding the development of carbon emission rights Notification trading pilot work. Document Number 2601. October 29, 2011. http://www.sdpc.gov.cn/zcfb/zcfbtz/201201/t20120113_456506.html

enterprises may either deploy on-site or market-based solutions. Secondary objectives (e.g., promoting green jobs or advancing a particular technology or fuel) can be included if program designers determine that such objectives will not undermine the primary goal. Lastly, program designers should ensure that objectives such as market efficiency, volatility management, and new source accommodation do not trump environmental objectives.

Other ETSs generally feature the central goal of achieving an absolute reduction by a defined date. For example, California's AB32 is to reduce GHGs from covered entities by 15% between 2015 and 2020. The goal of the EU ETS is to achieve 21% reduction from 2005 levels by 2020. Though important, other objectives (e.g., the development of renewable energy and promotion of green jobs) are of secondary concern.

China's overall goal is to use the pilots to field test the various methods and means that are available to develop an ETS with Chinese characteristics.

NDRC's October 29, 2012 notice[31] establishing the seven pilots includes language which states that the purpose of the pilots is to implement "…the 12th FYP's requirement to gradually establish national carbon trading markets and promote market mechanisms to achieve by 2020 China's goal of controlling greenhouse gas at a low cost."[32] In the pursuit of this goal, the pilot regions were directed to:

- ✓ Strengthen organizational leadership
- ✓ Establish full-time professional teams
- ✓ Earmark special fund for pilot programs
- ✓ Speed up compiling implementation plans for the carbon trading pilot program
- ✓ Define overall idea, targets, key tasks, safeguard measures and project progress timeline
- ✓ Report the plan to DRC and implement after NDRC's approval.
- ✓ Start to work on the management decree of carbon trading pilot program
- ✓ Define the fundamental rules of pilot
- ✓ Calculate and define the total GHG emission control target
- ✓ Formulate GHG emission permit allocation plan
- ✓ Establish local carbon trading supervision system and registry
- ✓ Establish trading platform
- ✓ Develop supporting system for carbon trading pilot programs
- ✓ Ensure the smooth implementation of pilot program.

[31] National Development and Reform Commission regarding the development of carbon emission rights Notification trading pilot work. Document Number 2601. October 29, 2011. http://www.sdpc.gov.cn/zcfb/zcfbtz/201201/t20120113_456506.html

[32] National Development and Reform Commission regarding the development of carbon emission rights Notification trading pilot work. Document Number 2601. October 29, 2011. http://www.sdpc.gov.cn/zcfb/zcfbtz/201201/t20120113_456506.html

China's overall goal is to use the pilots to field test the various methods and means that are available to develop an ETS with Chinese characteristics. This topic is further addressed in Section 5.

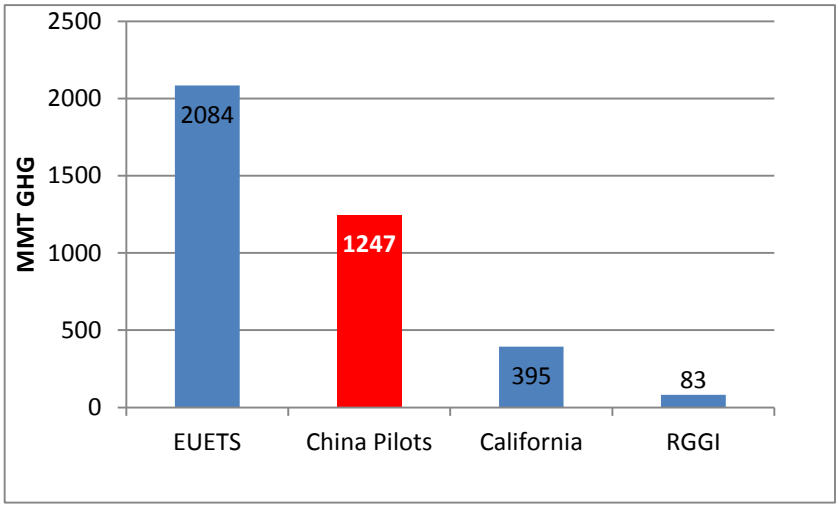
Cap and Scope

Design Feature: Scope and Cap
Findings: The inclusion of a large fraction of the emissions inventory will likely, over time, contribute to the achievement of the goals of the pilots. So too will the use of absolute caps. The use of adjustable caps, though understandable given the level of economic growth and leakage concerns, is a compromise that will likely undermine the ability of the ETSs to reduce emissions and promote innovation in the transformation to a green economy.
Pilot Recommendations: As pilots enter their second and third years the pilots should gradually expand the number of enterprises and increase the proportion of the emissions inventory included in each program. Administrators of the pilots with adjustable caps should avoid increasing their respective caps.
National ETS Recommendations: The value of an ETS is correlated with the relative proportion of the inventory that is included within its scope.

Fundamental to a cap and trade program is the establishment of an emissions cap. The cap represents that amount of emissions that can be released by all of the enterprises that are included in the program. Generally, the cap establishes a quantity of emissions that can be allocated at the start of the program, and a reduction that must be achieved in order to realize a health or environmentally based standard. Once established, the cap can be allocated among the enterprises (who will operate within the emission limits defined by the quotas that they hold and any other applicable control requirements) or held by the government for future distribution to achieve programmatic objectives.

Existing ETSs (EU ETS, AB32, RGGI, Acid Rain, RECLAIM) feature hard caps that decline over time. As shown in Figure 2, the relative proportion of covered emissions under the cap varies. By 2015, the AB32 cap-and-trade program will include approximately 350 companies (600 facilities) that are responsible for about 394.5 MMT (~85%) of California's GHG inventory. By contrast, the EU ETS, includes approximately 11,500 installations owned by 5,000 companies, located in 30 countries that are responsible for about 2,084 MMT of GHGs, or about 40% (Phase I) to (43% Phase II) of the emissions inventory. RGGI covers approximately 168 emitting entities located in 9 states which emit about 91 million tons or about 22% of the GHG inventory.

Figure 2. Comparative ETS Caps



Collective CO_2 emissions in the provinces and municipalities hosting the pilots exceed 2.4 billion tonnes.[33] As shown in Table 3, collectively, the seven pilots have a cumulative cap of 1.247 billion tonnes[34] and include ~1,937 enterprises. The largest is Guangdong with a first year cap of 388 million tonnes of CO2 and 242 enterprises. Though Shenzhen has the smallest cap – 33 million tonnes – it has the largest number of enterprises – 635. So, in total, about 53% of the total CO_2 emissions of these jurisdictions are included in the first year of the pilots.[35]

The seven pilots have ETS-wide absolute caps. Policymakers in these programs have affirmed that additional allowances will not be introduced into the system, regardless of economic growth rates and/or whether emissions exceed the initial cap.

[33] In comparison, India and Germany had combined CO_2 emissions of 2.492 billion tonnes in 2011.
[34] If treated as a single entity 1.247 billion tonnes would be the fifth largest CO2 emitter, after China, US, India, and Russia.
[35] As the pilots closed the first year and entered the second year, they have adjusted the total number of included enterprises. For example, Beijing reportedly may add 120 enterprises to its pilot in 2014. Guangdong has reportedly added and subtracted enterprises from its pilot since the start of the program.

Table 3. Overview of Pilot Scope, Caps, and Thresholds

Pilot	Scope and Cap[36]				ETS Threshold (CO2 tonnes per year)
	# Enterprises Under Cap	MMT	% CO2 Inventory Under Cap	Absolute vs Adjustable	
Shenzhen	635	33	40%	Absolute	3,000[37]
Shanghai	191	160	57%	Absolute	10,000 & 20,000[38]
Beijing	415	57	49%	Absolute	10,000
Guangdong	202[39]	388	54%	Absolute	5,000 & 10,000[40]
Tianjin	114	160	60%	Absolute	20,000
Hubei	138	324	44%	Absolute	165,000[41]
Chongqing	242	125	30%	Absolute	20,000
Totals	1,937	1,247	53% avg		

Data Accuracy

Design Feature: Data Accuracy
Findings: The breakneck pace at which the seven pilots were developed necessitated the independent development and application of emission quantification protocols. While there is insufficient transparency to independently assess the accuracy of the data, it is likely that the quality of the data correlate with the resources and time available to collect, evaluate, verify, and re-check the data prior to the launch of the ETS
Pilot Recommendations: Continue to improve data collection and evaluation methods. Use emission quantification protocols as they are supplied by NDRC. Develop new protocols if necessary. Take control over compliance registry if this function is being performed by the exchanges.
National ETS Recommendations: Evaluate and, as appropriate, use methods that have been developed by the pilots and on-going efforts to improve and the quality and reliability of the data. Coordinate with existing reporting of conventional pollutant emissions as a cross checking mechanism.

The accuracy of data used to define the baseline (starting point) of the program as a

[36] Communication with Sino Carbon Innovation & Investment Co., Ltd., April 16, 2014.
[37] Shenzhen also claimed the intention to includes commercial buildings that are $\geq$ 20,000 m^2. Public buses and taxis are expected to be included in 2015.
[38] Shanghai's threshold is 10,000 for non-industrial sectors and 20,000 for industrial sectors.
[39] Guangdong DRC reported on July that 18 emission control enterprises in Guangdong became emission report enterprises because of their carbon emission of the first emission dropped below the threshold. Therefore there are only 184 emission control enterprises need to surrender carbon quota that equals to their 2013 emission: http://www.gddpc.gov.cn/xxgk/gzdt1/gzdt/201407/t20140715_250335.htm
[40] Guangdong's threshold is 10,000 tpy for industrial enterprises and 5,000 tpy for hotels, restaurants, finance, commerce, and public buildings.
[41] Hubei's threshold is 60,000 tonnes of standard coal consumption equivalent. An emissions factor of 2.75 (average of 2.6 – 2.9) tonnes of CO2 per tce was used to derive the 165,000 tonnes per year of CO2 threshold.

whole, the initial allocations, and the quotas/offsets issued to (and used by) covered entities is of great importance. As ETS program administrators, covered entities, and service providers gain experience, MRV data collection systems will improve, and necessary and appropriate programmatic and facility-specific adjustments should be made.

A necessary precondition for the launch of existing ETSs has been the refinement of program-wide emissions inventories. For example, representatives of the California Air Resource Board (CARB) advised Chinese ETS policy-makers that the GHG emission inventory is essential to monitor California's progress toward GHG emissions goals and mitigation. Emission estimates rely on regional, state, and national data sources, and facility-specific emissions data reported through the mandatory reporting program. CARB not only monitors total present and past GHG emissions, but also mandates the collection of facility-level emission data. Of particular focus is the assessment of emissions as well as the implementation of MRV methods designed to both quantify and cross-check reported information.

Each of the pilots has undertaken efforts to develop and improve emission inventories, and each pilot follows their own protocols. Pilot stakeholders also have begun to use MRV guidelines. Ten MRV guidelines have already been formulated and an additional 12 are expected to be finished by this year. National electronic reporting systems are also under development.

In some cases, the registry of quotas has been maintained by the relevant emission exchanges (as opposed to the ETS regulator). While an understandable interim measure, compliance assessment must be undertaken by the government. Compliance and transaction functions should be separated to avoid conflicts of interest and to minimize coordination problems.

China’s carbon pilots launched while in the midst of developing and improving their emission inventories. This process invariably involves data secured by and through the enterprises, third-party verifiers, DRC implementers, statistical bureaus, and other sources. The quality of the inventories has improved over the course of the first year, and will continue to improve during the remaining two years of the pilots.

Third parties play a prominent role in verifying enterprise emissions in China’s ETS pilots. Such verifiers must meet qualification criteria and can be subject to significant penalties if the government determines that they failed to perform their responsibilities. The qualifications of third-party verifiers vary by pilot, but generally should have independent corporate capacity and fixed premises, a certain number of professional and technical personnel, and working experience in GHG emission verification for a certain period of time.

Thresholds

Design Feature: Thresholds
Findings: ETS policy-makers have incorporated thresholds that are tailored to match their resources (which are limited) and ambitions (which are high).
Pilot Recommendations: Consistent with the desire to expand to control a greater share of the emissions inventory, the pilots should adjust the thresholds in a fashion that will allow for the expansion of the proportion of the inventory that is included in the ETS.
National ETS Recommendations: Absent a compelling reason to act otherwise, national ETS policymakers should consider the use of uniform ETS thresholds that are based on the quantity of emissions released during or after a baseline year. The level should be harmonized with the resources of those that will administer, support, and be subject to the ETS as well as the practical ability of sources to engage in an ETS. Over time, it may be appropriate to gradually decrease the threshold as the proportional coverage of the ETS increases. However, there will be a lower limit for small scale sources of emissions that may be more efficiently covered by direct regulation.

An ETS should establish thresholds that are applied to determine which enterprises are included in the ETS. Such thresholds may be expressed in terms of GHG emissions that are emitted [42] or size. In California's AB32, enterprises that emit ≥25,000 tonnes of GHGs are included in the program (as well as suppliers of natural gas, distillate fuel oil, and liquefied petroleum gas). By contrast, RGGI mandates the inclusion of fossil-fuel fired electrical power generating units that have a rated capacity of ≥ 25 MW. The EU ETS has sector-specific thresholds.

As shown in Table 3, six of the seven pilots have emissions thresholds. Shenzhen, a city that has a few large emitters has the lowest threshold --3,000 tonnes per year for manufacturing facilities. Chongqing and Tianjin each have established a 20,000 tonnes per year threshold. Hubei, which has a relatively higher proportion of heavy industries and large energy users, has an ETS that features a threshold that is equal to 60,000 tonnes of standard coal consumption equivalent and equates roughly to 165,000 tpy CO2.

Interestingly, there is an inverse relationship between the size of threshold and number of enterprises included in the ETS. Shenzhen's ETS, with the smallest threshold covers about 635 enterprises (about 40% of the municipality's CO2). Hubei's ETS has the largest threshold and the second smallest number of enterprises.

[42] Either over a given baseline year at the start of the ETS or which are introduced after the commencement of the program

Despite the difference in threshold size, the two ETSs cover about the same fraction of their respective GHG inventory – 40% for Shenzhen and 44% for Hubei.

Allocations

Design Feature: Allocations
Findings: ETS policy-makers have selected a variety of different methods to allocate quotas. The methods used are a function of the vision of the ETS policymakers. The short duration of the pilots (2013 – 2015) is a structural (but understandable) obstacle that complicates the utility of the markets to covered enterprises.
Pilot Recommendations: In order to provide national ETS policy-makers with the most useful information, the pilots should continue to pursue distinct quota allocation methods. Nonetheless, enterprises will be more inclined to utilize the market if allocations are made as soon as possible and once distributed, quotas are not adjusted.
National ETS Recommendations: The decision on allocation method (e.g., to use benchmarking or grandfathering, and the degree to which quotas are auctioned) should be made in accordance with broader economic development objectives. Enterprises will be more apt to utilize the market if they receive quotas early in the program and if the quotas are issued (or made available for sale) in multiple years. Once issued, allocations should not be adjusted within the control period (except in support of enforcement actions).

The method by which quotas are allocated is an important design consideration. The merits of grandfathering (giving the allowances to enterprises based on their historical emissions), benchmarking (distributing quotas based on an enterprise's relative carbon intensity as measured against like sources) have been widely debated. The central issues are fairness, equity, and efficiency.

Another important consideration is the degree to which the allocation measures encourage long-term planning. Decisions concerning when quotas are issued, in what vintages, for what duration, and whether the quotas can be adjusted will have significant influence on whether a compliance manager will rely upon or avoid the quota market. At one extreme is the US SO2 Acid Rain program where quotas were issued in fixed quantities over a 30-year duration. At the other extreme are the Chinese pilots where enterprises may learn the quantity of CO2 quotas that they receive on an annual basis and may have the quotas adjusted at the end of each year.

As shown in Table 4, the seven pilots have used a variety of measures to distribute the initial allocations. Auctions, grandfathering, benchmarking, and game theory have all been employed.

Table 4. Allocation and Adjustments Methods Used by the Pilots

Pilot	Allocation/Distribution Method of Quotas	Adjustment	
		Yes/No	Limits
Shenzhen	• Free. Benchmarking. Game theory. Auctioning. • 3 years allocated (but not issued) in year 1.	Yes	Yes
Shanghai	• Free. • Benchmarking for electricity, aviation, airport and port; • Grandfathering for industrial sectors except electricity, and the buildings of market, commerce, hotel and railway. • Taking the early reduction into account of allowance allocation. • 3 years allocated & issued in year 1.	Yes	No
Beijing	• Free for 2013 and 2014, 2015 is uncertain. • Historical emission (other industry sectors), historical emission intensity (heat supply and thermal power), benchmarking (new facilities). • Auction possible.	Yes	Yes
Guangdong	• 2013: Free (97%) with Auction (3%)[43]. • 2014: 95% free for power section, and 97% free for other sectors. • 2015 is 90% free with 10% non- gratuitous. • Benchmarking for pure electric generating set, cement, grinding and clinker production process, long process of steel production; • Grandfathering for cement mining process and other powder process, oil processing and ethylene production, short process of steel production.	Yes	No
Tianjin	• Free. Auctioning possible. • Benchmarking for the existing capacities of electric power, heat supply and combined heat and power. • Grandfathering for the existing capacities of other sectors; • Advanced carbon emissions intensity for the new facilities.	Yes	No
Hubei	• Free. Auction (no more than 3%). • Grandfathering, benchmarking.	Yes	Yes
Chongqing	• Free. • Grandfathering.	Yes	Yes

An important difference between China's pilots and other ETS systems is the ability of the ETS administrator to adjust allocations after the initial distribution of the quotas. Considered an enhancement by the pilots, this feature allows the ETS administrator to moderate market volatility, eliminate quotas that would otherwise contribute to steep price declines, reward enterprises that have extraordinarily low carbon intensity operations, or protect those enterprises that provide essential public services and/or are prone to the negative effects of leakage. All seven pilots have measures that allow for the administrator to make such adjustments, but have established limits for such adjustments.

[43] Emission control enterprises need to purchase 3% of their total allowance through auction, in order to receive the 97% free allowance in 2013. But in 2014, the emission control enterprises don't need to purchase the 3% or 5% paid allowance to receive free allowance.

Diversity of Sources

Design Feature: Diversity of Sources
Findings: China's carbon trading pilots are multi-sectoral. As a result, the programs are characterized by sources with markedly different marginal control costs. The rich diversity of enterprises has made the development, implementation and enforcement of the pilots more complicated.
Pilot Recommendations: As allowed by available resources, the pilots should broaden the diversity of enterprises that are included in the ETSs.
National ETS Recommendations: In order to achieve the maximum effectiveness and lowest aggregate cost, the national ETS should include a broad diversity of sectors, facility types, and sizes.

An ETS may focus on a single sector (e.g., RGGI and the US SO2 Acid Rain program which both focus on the electric generating sector) or multiple sectors (e.g., California's AB32 and the EU ETS). A single sector ETS may be attractive to administrators because of the comparative ease of development, implementation, and enforcement. However, an ETS that includes multiple sectors is likely to include a larger number and diversity of enterprises with greater diversity of control costs and more opportunity for cost savings.

A covered entity may consider trading with another entity if cost savings (or profits, in the event of a seller) can be realized when via a trade as compared to on-site solutions. Such savings (or profits) are more apt to be realized if the program includes entities that have different marginal control costs. All things being equal, sources with similar marginal costs of controls will have little incentive to trade with each other. Such similar sources are likely better managed through the use of command and control program in which the regulator defines and prescribes a single (or common) solution that is to be adopted by similar sources.

As shown in Table 5, enterprises representing at least 32 different sectors are included in China's seven carbon trading pilots. With representatives from about 26 different sectors, Shenzhen may have the most diverse ETS. At the opposite extreme, Guangdong focuses on four sectors – cement, electricity generation, iron and steel, and petrochemicals.[44]

Table 5. Sectors Included in China's Carbon ETS Pilots

Sector (Approximate # Sectors included)	Shenzhen (26)	Shanghai (18)	Beijing (32)	Guangdong (4)	Tianjin (6)	Hubei (8)	Chongqing (7)

[44] Guangdong has announced its intention to expand the ETS to include buildings, ceramics, nonferrous metals, paper, plastics, textiles, and transportation).

Table 5. Sectors Included in China's Carbon ETS Pilots

Sector (Approximate # Sectors included)	Shenzhen (26)	Shanghai (18)	Beijing (32)	Guangdong (4)	Tianjin (6)	Hubei (8)	Chongqing (7)
Aluminum							●
Auto production			●			●	
Aviation (ground equipment)		●					
Buildings	○		●	○			
Building materials		●					
Calcium carbide							●
Caustic soda							●
Buildings[45]			●	○			
Cement			●	●		●	●
Ceramics			●	○			
Chemical fibers	●	●					
Chemicals	●	●	●		●	●	●
Commerce		●	●				
Electricity	●	●	●	●	●	●	●
Food and beverage production	●		●				
Ferroalloy							●
Finance		●	●				
Glass	●		●			●	
Heat supply		●	●		●		
Hotel		●	●				
Iron & steel		●		●	●	●	●
Nonferrous metals		●		○		●	
Oil & gas					●		
Paper	●	●	●	○		●	
Petrochemicals		●	●	●	●		
Plastics	●		●	○			
Port		●					
Printing	●						
Railway		●					
Rubber	●	●	●				
Service[46]			●				
Telecommunication	●		●				
Textile	●	●	●	○			
Thermal power	●		●				
Transportation	○			○			
Water supply	●						

● Included in year one
○ May be included in future years (post year one)

[45] Buildings sector includes indirect emission from electricity usage of buildings in universities and research institutions, government agencies, hospitals, library, prison, supermarkets and shopping mall,
[46] Service industry includes but not limited to property management companies, cable and phone service companies, consulting companies, PR companies, safeguarding companies.

Direct and Indirect Emission Sources

Design Feature: Direct and Indirect Sources
Findings: China's carbon trading pilots typically merge into the ETS, assign quotas to, and accommodate the trading of quotas by and between direct and indirect sources.
Pilot Recommendations: Given the short remaining time of the pilots, it is difficult to imagine circumstances where it makes sense to separate direct and indirect sources. If end of pilot surplus quotas may be carried over, it may be prudent to serialize quotas issued to indirects so that they can be separated in the national ETS. Pilots may also wish to commence work on the establishment of an indirect-only energy savings market.
National ETS Recommendations: Direct and indirect sources should be separated. Energy efficiency can be encouraged through the use of a policies designed to specifically stimulate energy savings.

Many ETSs focus on direct emitters of pollutants. Care is taken to ensure that the emissions inventory, allocations/credits, and compliance assessments are drawn from the same data set. Particular effort is made to establish distinct inventories and programs for: (a) direct (point) sources of emissions; and (b) entities whose emissions are indirect and/or cannot be reliably measured. While it *can* be acceptable to allow indirect sources to satisfy compliance obligations with direct-source derived credits, measures (e.g., energy efficiency) undertaken by indirect sources should not be used to generate offsets (or free up quotas) that can be used by direct sources. In general, enterprises that produce no direct emissions and/or whose emissions cannot be accurately measured should be excluded from the opportunity to generate and supply credits to direct sources.

China's ETS pilots merge direct and indirect emission sources. For example, both power generators (e.g., power plants) and users (e.g., large commercial buildings in Beijing and Shanghai) are included in the same ETS, provided allocations, and allowed to trade credits with each other. This makes problematic the tracking of emissions and could result in double counting of emissions and/or reductions.

Mobile Sources

Design Feature: Mobile Sources
Findings: The inclusion of mobile sources in at least two of China's carbon trading pilots is a reflection of the current and growing contribution of emissions from this sector.
Pilot Recommendations: As allowed by available resources, the pilots could broaden their consideration about the feasibility of including mobile sources in their respective ETS programs.
National ETS Recommendations: Given the growing contribution of mobile source derived-emissions, China should evaluate the feasibility of including mobile sources in its forthcoming ETS , the optimum point of regulation (e.g., on the vehicle manufacturer, the fuel provider, and/or the driver), and whether such sources are regulated as liable entities, or treated as potential credit generators.

While most ETSs typically focus on stationary sources of pollution, California is a notable exception. The US also runs a Corporate Average Fuel Economy (CAFÉ) trading program[47] that uses market based measures to encourage the manufacture of clean energy vehicles. California runs a Zero Emissions Vehicle (ZEV) program[48] that includes a market-based elements and Southern California's South Coast Air Quality Management District uses market-based measures to encourage ride sharing[49]. The US has developed protocols through which emission reductions can be rewarded to entities that reduce emissions associated with marine vessel hoteling[50], accelerated vehicle scrappage[51], use of remote sensors to repair high-emitting vehicles[52], truck stop electrification[53], and train retrofits[54]. Also, California's AB32 cap and trade program expands in 2015 to include suppliers of natural gas, distillate fuel oil, and liquefied petroleum gas.

Mobile sources contribute a significant quantity of CO2 emissions in China and in the pilots, and are specifically targeted in the Guangdong and Shenzhen ETS. In Shenzhen, the number of vehicles on the road has grown from about 200,000[55] in 2003 to more than 3,000,000 in 2014. Given this rapid growth, the highest number of

[47] http://www.law.cornell.edu/cfr/text/49/part-536
[48] http://www.arb.ca.gov/msprog/zevprog/factsheets/zev_tutorial.pdf and http://www.arb.ca.gov/msprog/zevprog/zevprog.htm
[49] http://www.aqmd.gov/docs/default-source/rule-book/reg-xxii/rule-2202.pdf?sfvrsn=4
[50] http://www.aqmd.gov/docs/default-source/rule-book/reg-xvi/rule-1632.pdf?sfvrsn=4
[51] http://www.aqmd.gov/docs/default-source/rule-book/reg-xvi/rule-1610-old-vehicle-scrapping.pdf?sfvrsn=4
[52] http://www.aqmd.gov/docs/default-source/rule-book/reg-xvi/rule-1605.pdf?sfvrsn=4
[53] http://www.aqmd.gov/docs/default-source/rule-book/reg-xvi/rule-1613.pdf?sfvrsn=4
[54] http://www.arb.ca.gov/railyard/demover/locotech.htm
[55] http://guangzhou.auto.sohu.com/20120228/n336132538.shtml

vehicles per square kilometer (1,536 in Shenzhen versus 16 in Hubei), and their contribution to Shenzhen's CO2 emissions (29%), Shenzhen understands that it cannot cap and reduce emissions unless it includes mobile sources in the ETS.[56] Shanghai has also elected to include mobile (domestic aviation[57] and dockside port) sources in its ETS.

Banking

Design Feature: Banking
Findings: China's ETS pilots include both banking provisions as well as mechanisms that are designed to counteract the price depressing effects of banking.
Pilot Recommendations: Pilots should encourage banking by affording a measure of protection to unused quotas. In the face of a perceived surplus of quotas, ETS administrators should take the opportunity to ratchet down the cap.
National ETS Recommendations: Banking serves a valuable purpose and should be included in a national ETS. Extra reductions are an important source of environmental benefits not available under traditional regulatory programs. Policymakers should encourage pilot enterprises to bank quotas by grandfathering a proportion of unused quotas and allow their use in the national ETS.

An emissions bank is an administrative mechanism that allows enterprises and others to create, gain recognition for, and store allowances or credits for later use or sale. The lack of a bank will cause managers to forego emission controls that produce surplus reductions if such reductions cannot be used in a contemporaneous fashion.

Existing ETSs generally include banking mechanisms that afford protections to unused quotas and offsets. This is the case with the EU ETS, the Acid Rain program, RGGI, and, to a degree, AB32.[58]

At the opposite extreme, unlimited banking, when combined with overly generous allocations (made over the short- or long-term), will moderate the level of carbon reduction investments. This has been the case in the EU ETS where aggregate demand for allowances and certified emissions reductions (CERs) fell after the global economic crisis. Nonetheless, many critics[59] assert that the program should be

[56] Over the next five years, Shenzhen intends to build an ETS that targets public buses and taxis, private vehicles, and freight and cargo vehicles.
[57] Shanghai's ETS includes domestic aviation-derived CO2 emissions associated with the five airlines that are registered in Shanghai.
[58] Offset holders are somewhat cautious because offsets can be invalidated years after their issuance if it is determined that the offset creator broke the rules, even if the transgression occurred years before the credits were sold and/or placed in the bank.
[59] https://t.co/FmhzKlPb5O, http://t.co/KZMqT7187Q, http://t.co/qtV7P1P8AO

scrapped because the abundant supply of surplus quotas has resulted in a steep drop in prices and a decline in projects that reduce emissions.

All of the pilots allow for the carry-over, or banking, of unused quotas. Concerned about the effect that surplus quotas may have on market price, Hubei has included "use it, trade it, or lose it" provisions that will result in the cancellation of unused quotas unless they are traded[60]. Other pilots can cancel surplus quotas (regardless of whether they have been acquired through trades). And some have actively contemplated the use of funds to purchase and retire quotas as means to moderate falling prices from any excess supply.

Long-Term Decisions

Design Feature: Long Term Decisions
Findings: The pilot ETS programs provide enterprises with little incentive to make long term decisions.
Pilot Recommendations: To the extent possible ETS administrators should decide if they can advocate for the carry-over of surplus quotas, refrain from adding or subtracting quotas from the market and/or enterprise accounts. If this is not possible, clear guidance should be provided as to the conditions that may result in such actions.
National ETS Recommendations: National ETS policy-makers should give strong consideration to the following measures that encourage enterprises to make decisions that involve long term investments:

- Rules that are stable and not subject to frequent and unpredictable change
- Emission allocations and offsets that are issued over multi-year periods
- Allowing the trading of multi-vintage (streams) of allowances and offsets
- Allowing the trading of allowances that are freed up owing to a shutdown/curtailment
- Avoiding requiring allowance/offset sellers to reverse trades if they shut down or curtail operations

One measure of the success of an ETS is the degree to which enterprise compliance managers invest in long-term solutions. A program that facilitates such planning is one that is marked by a multi-year duration, stable rules (that are not subject to change), long-term emission reduction objectives, multi-year offset and quota streams (that can be managed by covered enterprises), the ability to use offsets without buyer liability, and the existence of banking mechanisms where quotas can be safely stored. In the absence of such provisions, risk-averse compliance managers will be inclined to pursue on-site compliance solutions that apply a very high discount to opportunities that may be available through the ETS market.

[60] http://gkml.hubei.gov.cn/auto5472/auto5473/201404/t20140422_497476.html

Existing ETSs have varying levels of success in encouraging long-term solutions. If considering just the term of the program, for example, the successful US Acid Rain ETS effectively issued and afforded protections to 30+ year quota streams. This, in turn, provided compliance managers with the confidence that allowed them to make long-term investments in facility upgrades (that achieve compliance and/or free up surplus quotas) and pursue multi-year or multi-decadal quota purchases and sales. In contrast, California's AB32 program has, at best, a seven-year term. Sources in Phase III of California's AB32 will operate within the program for barely three years before the program ends.[61] Such a short time frame may discourage long-term investments.

China's ETS pilot policymakers and enterprises face multiple challenges in this regard. Unless extended[62], all will cover emissions only through 2016. Given that the pilots launched (and issued allocations and published rules) as late as June 2014 (e.g., Chongqing), the term may only be 18 months. Enterprises are further discouraged from making long-term plans because rules limit quota issuance to current years,[63] prohibit the trading of yet-to-be issued quotas, and still do not allow for the use of risk hedging mechanisms like options. The planning horizon is further narrowed as all pilot administrators reserve the ability to adjust allocations at the end of each year.

Market Volatility

Design Feature: Market Volatility
Findings: The ETS pilots are concerned with and have given themselves numerous tools to dampen extreme market volatility.
Pilot Recommendations: If feasible, pilots should reassure themselves that markets function best with a modicum of volatility and understand that such tools (whether used or not) may contribute to volatility. Yet-to-be issued quotas should be made available in such a fashion as to minimize the need to use such measures. And measures that do the least harm (e.g., more ambitious goals, price reservces, and flow control[64]) should be considered in lieu of more extreme measures (e.g., canceling quotas held by enterprises in the face of low prices or issuing additional "cap-busting" quotas in the face of high prices).
National ETS Recommendations: National ETS policy-makers should give strong consideration to guidance provided above. To the extent feasible, consideration should also be given to the accommodation of risk hedging tools.

[61] Proposals have been put forward to extend the term of AB32's cap and trade program to 2030.
[62] At least one of the pilots is reportedly considering a second phase which would have the effect of continuing the ETS beyond 2015. The scope of enterprises included in any such second phase may increase (to include those below the phase 1 threshold and/or in a previously excluded sectors) or decrease (for example, in the event that a national ETS picks-up sectors and/or enterprises that were previously included in phase 1).
[63] With the exception of Shanghai.
[64] Flow control is a mechanism that allows the ETS administrator to adjust the quantity of quotas or CCERs that can be carried over from one year to the next. To be most effective, the mechanism should be included in the ETS and use explicit and transparent formulas that can be used by the market to reliably make predictions about the quantity of quotas or CCERs that can be carried over from one year to the next. In addition to dampening price volatility, such measures will diminish supply/demand imbalances, reduce pressure to over allocate quotas, and provide investors with a more predictable investment environment.

A common concern among ETS policymakers and administers is that markets, though powerful, are also unpredictable. While they may applaud the positive attributes of a market (faster, better, cheaper achievement of environmental objectives) they are also concerned about managing two challenges—market volatility and manipulation.

Existing ETS policymakers have developed a number of means to mitigate these concerns. In the face of extreme prices, RGGI and California's AB32 will make available additional quotas (which are included within the cap, but held back just for such purposes). In both circumstances, the price triggers and volumes are defined in the implementing regulations. The AB32 program also includes extensive provisions that prohibit (and the means to monitor) behavior that may lead to market collusion and/or manipulation.

Like their western counterparts, Chinese ETS policymakers are also concerned about these issues. In the face of extreme volatility, some pilots allow the local DRCs to release more quotas (dampening prices) or provide the financial resources to purchase quotas (boosting prices). However, an explicit and transparent set of guidelines is not specified as to when the government will intervene or how. This introduces an element of uncertainty that can have the effect of curbing enterprises' willingness to participate in the market. A concern for all pilots is to ensure that such actions do not undermine and thwart the very forces that have the potential to make the market work.

With the EU ETS experience in mind, Chinese ETS administrators have incorporated a variety of volatility management measures. Considered enhancements which address perceived flaws in the EU ETS and other ETSs, these measures can be used to adjust the quantity of quotas available (to individual enterprises or the market as a whole), detect illegal market manipulation, and impose penalties that are meant to deter behavior that could exacerbate market volatility.[65] The use of auctions (and auctions with price floors) has also been used to manage price volatility in the first year of the pilots.[66]

Depending upon the program, additional quotas (i.e., those distributed subsequent to initial allocations) can be designed into the initial cap (as is the case with Shenzhen). The total quantity of quotas can be adjusted (up or down) ex post based on production data and the carbon intensity of operations.[67]

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[65] The ability to use CCERs and price floors are also considered to be a volatility management mechanism. Allowing any amount of CCERs to be used dampens price increases. Limiting the amount which may be applied against enterprise compliance obligations to 510% is meant to help ensure that prices do not fall precipitously.

[66] Shenzhen, Guangdong, and Hubei have distributed a portion of quotas through the use of auctions. Guangdong's auctions have included a price floor of ¥60/tonne in 7 auctions held in first year; while in the second year, this floor price was dropped to ¥25/tonne.

[67] The ETS administrator's ability to adjust quotas after their issuance (ex post adjustment) is inconsistent with the need to set clear signals to enterprises.

In the first year, ETS administrators have injected additional quotas through the use of auctions[68] and retired quotas that were deemed to be surplus.[69]

Risk Hedging Tools

Design Feature: Risk Hedging Tools
Findings: Restrictions imposed by national regulators largely prevent the use of risk hedging tools. This constrains trading, reduces compliance opportunities for enterprises and increases costs.
Pilot Recommendations: If feasible, pilots should accelerate the issuance of and accommodate the trading of future vintage quotas.
National ETS Recommendations: National ETS policymakers should engage with appropriate authorities to consider a plan wherein carbon financial instruments can be phased into a national ETS market.

Private capital in particular will tend to flow towards low-carbon investments when there is long-term certainty in policy, most directly represented by a stable, long-duration forward curve for carbon prices. While stable rules are key, the same is true for the ability to use financial instruments that allow enterprises to manage risk. Such tools are a fundamental element of existing ETS markets. The ability to transact puts, calls, and other derivatives allows compliance managers to:

- Establish a forward (out-year) curve for prices and access the futures market
- Access and reduce the cost of capital needed to implement emission abatement projects that have large capital outlays and out-year returns
- Manage price volatility
- Lock in exposure to fluctuating prices
- Lock in long-term credit supply and delivery
- Lock in long-term carbon revenues from abatement projects
- Leverage scarce capital to manage risks and participate in the market
- Reduce the amount of capital needed to participate in the market, comply, and operate profitably (e.g., when quotas are bought on margin).

At their launch, the Chinese ETS pilots allowed enterprises the ability to transact only the physical product. This effectively limited trading to quotas already issued (i.e., vintage 2013). Year 2 (v2014) and Year 3 (v2015) quotas were not issued and could

[68] As was done by Shenzhen when less than 200,000 tonnes were offered and 74,974 tonnes of quotas were sold at a price of ¥35.43/tonne through an auction that was held on June 5, 2014.
[69] On or about April 23, 2014 Shenzhen declared its intention to cancel approximately 3 MT of surplus quotas. Hubei's regulations mandate that quotas be cancelled at the end of the year unless they have been used or traded.

not be traded.[70] Important benefits will be gained should China elect to accommodate risk products. These products allow credits to be transacted using options, forward contracts, leases/loans, and margin agreements. The ability to use these instruments is critical to effectively transmit a robust and long-term carbon price throughout the economy, and to incentivize abatement measures and clean technology innovation.

Offsets

Design Feature: Offsets
Findings: Though the pilots provide for their use, the use and benefits of including offsets has largely been untapped.
Pilot Recommendations: Pilots should continue to encourage the creation and banking of offsets. To the extent feasible, local content requirements should be phased out. Doing so will provide a means by which different pilots (one hosting and the other using the China Certified Emission Reductions (CCERs)) can explore linkage.
National ETS Recommendations: High quality offsets should be accommodated in a national ETS. As with banking, it would be prudent to include a mechanism whereby more ambitious environmental goals can be established in the event that there is a dearth of available offsets and/or a precipitous price decline. And clear guidelines should be included in the ETS such that the market has the ability to adjust to such events.

High-quality emission reductions derived from sources outside of the cap and trade program will reduce the cost of compliance and should be encouraged. Offsets should be disallowed from activities that result in shifting demand (i.e., offsets resulting from capped sources that compensate for reductions by moving emitting activities outside the cap) or which cannot guarantee post-project enforcement and monitoring.

Existing ETSs provide for the use of offsets. The importance depends on the level at which the initial cap is set, the robustness of the economic growth of the covered enterprises, and the relative quantity of offsets that are allowed to be used for compliance purposes. In the EU ETS, CER and quota prices are significantly lower from peak years (pre-financial crisis). The prospect of an excess supply contributed to California's decision to limit both the quantity of offsets that can be used for compliance purposes[71] and the number of methodologies that can be used to create offsets.

Mindful of the EU ETS example, China's pilots limit the quantity of CCERs that can

[70] Shanghai stands as an exception. Unlike the other pilots, it issued and allowed enterprises the ability to transact vintage 2013, 2014, and 2015 quotas.
[71] California's AB32 limits the quantity of offsets that may be used to just 8% of an enterprise's compliance obligation. This compares to the EU ETS which includes limits of 50% in Phase I and 13.4% in Phase II.

be used for compliance purposes to 5–10%.[72] As show in Table 6, some pilots have also imposed local content requirements that specify that some quantity of CCERs result from projects within the geographic boundaries of the pilot (e.g., 50% in Beijing and 100% in Hubei). And some pilots restrict (or mandate) the use of particular methodologies. Thus far, a relatively small quantity of CCERs has been transacted.[73]

Table 6. Allowable Offsets in Pilots

Pilot	Maximum Allowed	Required Local Content
Shenzhen	10%	-
Shanghai	5%	-
Beijing	5%	50%
Guangdong	10%	70%
Tianjin	10%	-
Hubei	10%	100%
Chongqing	8%	100%

As of October 16, 2014, there are 369 CCER projects in public notification period and 47 projects have been registered. Among the 47 registered CCER projects, 17 are wind power generation, and 13 are hydro power generation projects. These 369 projects represent 57 million tonnes of CO2e. On September 26th, the first CCER project review meeting was held by NDRC, and 10 projects were reviewed. Based on past experience, CCERs may be issued 2 to 4 week after the projects are approved by NDRC.

Enforcement

[72] Which, considering the aggregate volume of quotas, suggests that CCERs could be used to satisfy compliance obligations of 102 MT.

[73] Just 10,000 tonnes in Beijing and 10,000 tonnes in Guangdong have transacted. This compares to a traded volume of >23 MT of quotas.

Design Feature: Enforcement
Findings: Notwithstanding a multitude of challenges, the pilots have diligently and creatively used available mechanisms to encourage and achieve compliance during the first year. The lack of transparency makes it difficult to independently verify the compliance status of enterprises included in the ETSs. An extraordinary amount of manpower was expended by the pilots in order to achieve the reported high level of compliance.
Pilot Recommendations: Continue to build third party verification capacity, enterprise training on compliance requirements, and require compliance certifications to be made by the top senior executives within the enterprises.
National ETS Recommendations: Strengthen ETS MRV systems. Give ETS administrators the maximum advantage of the powers granted by the Basic Environmental Law. Ensure that noncompliance consequences are immediate, predictable, and of greater financial consequence than the value gained by being in noncompliance. In order to maintain the integrity of the cap, include a mechanism that, in the event of excess emissions, results in the automatic debiting of a like (or greater) quantity of quotas from the system.

An ETS must have a means to determine whether enterprises are complying with its requirements and to impose sanctions against those that fail to comply. Non-compliance situations resulting in excess emissions should always be resolved by retiring a quantity of emissions that is equal to or greater than the exceedance (and should never be resolved only through the payment of a fine [unless such fine is used to retire a quantity of allowances/offsets to make the cap whole]).

The power to implement and enforce an ETS should be granted through law. In the absence of a legal foundation, the administrator may lack the authority to compel covered enterprises to participate in the ETS or comply with directions issued by the administrator.

In the existing western ETS, laws passed by legislative bodies provide the basis for the ETSs. In the case of the EU ETS, international treaties bind treaty signatories and each nation administers critical elements of the program through regulations founded on laws passed by respective legislative authorities. RGGI states are bound together by a memorandum of understanding that is signed by each of the governors. Each governor also signed laws that grant his respective state with the ability to implement and enforce the requirements of the ETS. For example, authority to implement California's AB32 is found in a law signed by its governor and in regulations that are administered by CARB.

As shown in Table 7, the pilots also include different mechanisms to deter excess emissions. Some mandate the surrender of subsequent year quotas (e.g., twice the exceedance in Guangdong and Hubei, three times the exceedance in Shenzhen,).

Others combine quota forfeiture, fines, and blacklisting, along with other sanctions (e.g., Hubei, Shenzhen). Programs that do not mandate a forfeiture of quotas equal to or greater than the exceedance invite enterprises to choose the least expensive option, making it more challenging to maintain the integrity of the cap.

Table 7. Noncompliance Consequences and Compliance Rewards

	Monetary Fine (rmb)		Fines Based on Quota Prices	Shortfall Deducted From Next Year	Special Benefits Available With Compliance
	Min	Max			
Shenzhen	-	-	Shortfall x 3P6	Shortfall x 1	Financial support for emission reduction/energy savings projects
Shanghai	50,000	100,000		Shortfall x 1	Financial, credit, & technology support
Beijing	-	-	Shortfall x 3 to 5 Pa	-	Financial, credit, & technology support
Guangdong	50,000	50,000	-	Shortfall x 2	Direct financial (and encouraging financial institutions to provide) support for emission reduction/energy savings projects
Tianjin	-	-	-	-	Direct financial support and priority treatment of energy savings and emission reduction projects
Hubei	-	150,000	Shortfall x 1 to 3Pa	Shortfall x 2	Direct financial support, priority treatment of emission reduction/energy savings projects, green credit & financing
Chongqing	-	-			

P6 = Average quota price over prior 6 months
Pa = Average quota price (no time period specified)
Ph = Highest daily price of compliance period
Shortfall = Quantity of quota shortfall (reported emissions minus surrendered quotas)

Of China's seven pilots, Shenzhen, Beijing and Chongqing's are is founded in law[74]. The other pilots are implementing their respective ETSs based upon administrative measures[75], which have legal character, but are susceptible to being contested. Such measures lack the force of law and have reportedly given recalcitrant sources reason to resist efforts to compel compliance with the ETS mandates.

Prior to the passage of the amended Basic Environmental Law in April of 2014 (see

[74] Pilots' Inspiration of National Carbon Market, National Center for Climate Change Strategy and International Cooperation (NCSC).
[75] Shanghai, Guangdong and Hubei's Carbon Trading Management Decree were passed during the provincial or municipal government executive meeting and published by the government ; while Tianjin's Carbon Trading Management Decree was a government document published by the Tianjin Municipal Government Office.

following text box),[76] the Administrative Penalty Law[77] limits the amount of penalties that can be assessed against noncompliant enterprises. Because the amount of such penalties is limited by law (and are not imposed on a daily basis), scofflaws may consider such penalties as a relatively inexpensive cost of doing business. For example, Shanghai's ETS penalty measures cap the noncompliance consequence at 50,000–100,000 rmb/violation. No provision is included for next year deductions. Just considering the economics, at the average price of 39.40 rmb /quota it is rational to pay the fine for any amount of shortfall that is greater than about ~2,538 quotas (100,000 rmb /38.84 rmb/tonne). Put another way, the 100,000 rmb penalty functions as a de facto cap on prices. A facility that is short by 100,000 quotas should only buy quotas if they cost less than 1 rmb/tonne. One that is short by 400,000 ought to pay the fine unless the quotas cost 0.25 rmb/tonne. In essence, a one-time fine between 100,000 rmb and 50,000 rmb rewards scofflaws in direct proportion to the magnitude of their noncompliance.

Basic Environmental Law—The Promise of Meaningful Enforcement

On April 24 2014, something very remarkable happened in China. The basic environmental law first introduced in 1989 was amended after a hiatus of 25 years.

Chief among the momentous changes is the scrapping of the cap on financial penalties for noncompliance that was embedded in each of the media-specific environmental laws. For example, China's Clean Air Law has a current limit (until January 1, 2015) of ¥200,000 or $32,000 at current exchange rates. This has had a relative fiscal impact equivalent to a mosquito bite for most enterprises. So while the rhetoric from senior government officials about the importance of environmental protection might have been strident, the real consequence of not meeting obligations has been relatively trivial in financial terms. No one should have been wondering why emissions have continued to rise.

All of this changes with the new law. There will be no limits on penalties. And penalties will now be assessed on a cumulative basis levied from the day of violation to the date of compliance. For the first time in China, incentives will be aligned so that compliance will be cheaper than noncompliance.

Given these dual challenges (i.e., that only Shenzhen, Beijing, Chongqing's ETSs are based on law, and the limitations on the ability to impose meaningful financial penalties), ETS policymakers have creatively built in other means to compel compliance. For example, Shenzhen, Guangdong, Chongqing, and Hubei each have the ability to confiscate a multiple of the shortfall from the subsequent year's allocation. Noncompliance can also include a form of naming and shaming which can affect an enterprises' ability to bid on government contracts.

[76] https://www.chinadialogue.net/Environmental-Protection-Law-2014-eversion.pdf.
[77] http://www.china.org.cn/english/government/207306.htm

On the other hand, enterprises that are in compliance can be rewarded with direct financial support for, and/or favorable treatment of applications associated with energy conservation and emission reduction projects.

Despite these carrots and sticks, some liable entities are immune to such measures—e.g., those that do not require credit support, nor participate in government contracts. Others may operate as if they are inoculated against such measures because they provide essential public services. Unless directed by his superior to comply, a profit-minded compliance manager operates under the premise that the ETS administrator will not be so bold as to require compliance from a government agency, wastewater treatment facility, hospital, or university.

Information regarding compliance rates has focused on one question: did covered enterprises surrender a sufficient quantity of quotas? Compliance rates for enterprises included in the pilots are just now being assessed. Table 8 provides more detail regarding the first year compliance status of the Shenzhen, Shanghai, Beijing, Guangdong, and Tianjin pilots.

Table 8. Compliance Performance in Pilots

Region[78]	**Total Units**	**In Compliance?** [79]		**Compliance Ratio**[80]
		Yes	No	
Shenzhen	635	631	4	99.40%
Shanghai	191	191	0	100%
Beijing	415	402	13[81]	97.1%
Guangdong	184[82]	182	2[83]	98.90%
Tianjin	114	110	4	96.50%

[78] Insufficient data was available for Hubei and Chongqing at the time of publication.
[79] Here, "compliance" refers only to requirements that covered enterprises retire a quantity of quotas that equals reported emissions. Insufficient data is available to provide data as to whether enterprises were in compliance with other mandates of pilot regulations. This report does not address compliance assessments for other elements of the ETS rules (e.g., accurate reporting, cooperation with third party auditors, etc.).
[80] Compliance Ratio = Number of Compliance Enterprises/ Number of Emission Control Enterprises. This ratio cannot reflect the compliance status from the perspective of allowance surrendered by the emission control enterprises for compliance purpose.
[81] Beijing DRC published a list of 257 non-compliance units in mid-June 2013, which include many universities, public institutions, government agencies and enterprises. However, on mid-September, Hong Jiyuan, Deputy Director of Beijing DRC, announced that only 13 units did not comply for 2013, and fine has been issued to them.
[82] An additional 18 enterprises were added after the commencement of Guangdong's pilot.
[83] The two non-compliance enterprises did not submit emission report, refused to receive third party verification, and did not surrender allowance to compliance. In Guangdong, 99.97% emission are compliance.

4.3 Markets to Date

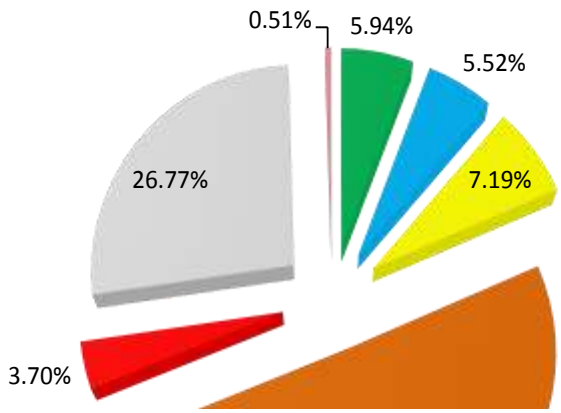
From the start of trading on June 18 of 2013 through October 10, 2014 more than 28.67 million quotas worth about 1.26 billion rmb (USD $205.3 million) have been transacted at an average price of 44.12 rmb/tonne. Table 9 summarizes market-wide and pilot-specific market information.

Table 9. Pilots Quota Market Summary
(October 10, 2014)

	Total Quotas Transacted	Total Value		Average Price		Last Done	
		(rmb)	($)	(rmb)	($)	Quantity	Price (rmb)
Shenzhen	1,702,870	115,183,609	18,698,638	68	11	4301	54
Shanghai	1,582,860	61,822,916	10,036,188	39	6	1,500	35
Beijing	2,062,176	102,033,996	16,563,960	49	8	500	53
Guangdong	14,442,228	790,982,146	128,406,192	55	9	19	31
Tianjin	1,061,220	21,933,598	3,560,649	21	3	20	27
Hubei	7,673,810	168,593,018	27,368,996	22	4	22,004	26
Chongqing	145,000	4,457,300	723,588	31	5	145,000	31
Totals	**28,670,164**	**1,265,006,583**	**205,358,212**	**44**	**7**		

Figure 3 shows the relative amount that has been traded in each pilot. Guangdong accounts for about 50.37% of quotas traded and valued at ~791 million rmb, followed by Hubei (26.77% and ~ 168.6 million rmb), Beijing (7.19% and ~102 million rmb), Shenzhen (5.94% and 115.2 million rmb), Shanghai (5.52% and ~61.8 million rmb), Tianjin (3.87% and ~21.9 million rmb), and Chongqing (0.51% and ~4.5 million rmb).

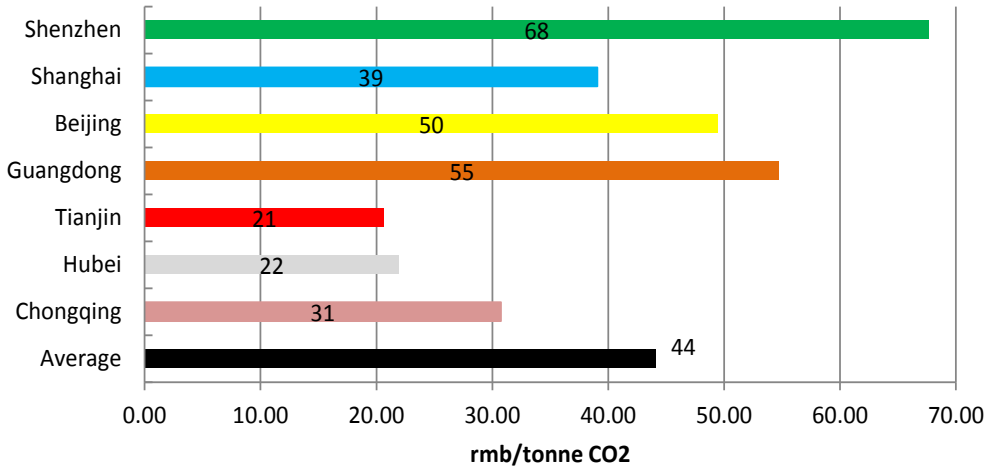
Figure 3 Relative Quantity of Quotas Traded
(June 13, 2013 – October 10, 2014)



Average prices range from a low of 20.67 rmb ($3.36)/tonne (Tianjin) to 67.64 rmb ($11.23)/tonne (Shenzhen) with an overall average of 44.12 rmb ($7.16)/tonne. In

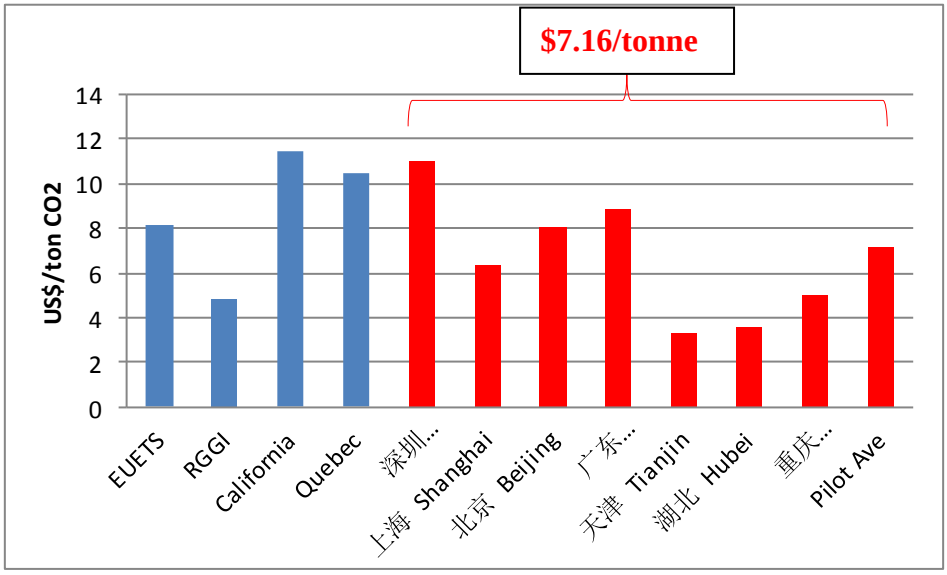
addition, small quantities of CCERs have traded in Beijing and Guangdong.[84] Figure 4 provides additional information regarding comparative prices.

Figure 4. Comparative Quota Price
(June 13, 2013 – October 10, 2014)



For comparison purposes, Figure 5 contrasts China's average quota prices with recent transactions in the EU ETS, RGGI, California, and Quebec. From this chart, it is clear that China's price on carbon is in line with from other global ETS markets.

Figure 5. China's Price on Carbon



[84] These trades of CCER are forward sales with the expectation that the tonnes traded would ultimately be issued CCERs.

5. VALUE OF THE PILOTS

Some critics of China's carbon ETS pilots have noted shortcomings in the design, development, and implementation of the pilots.[85,86] They called for foundational law, better emission inventories, wider scope, more reliable MRV systems, more rigorous penalties, greater transparency, less secrecy, more predictability, fewer initial allocations, a longer term, a unity in rules, greater use of financial instruments, greater capacity, the need for transferable property rights, clear guidance from national authorities, etc. Some observers have extended criticisms one step further. They argue that shortfalls in the carbon pilots are indicative of China's commitment to and/or ability to develop and implement an effective national ETS.

The aforementioned conclusion is short-sighted. While emission reductions should be the objective of an ETS, the carbon trading pilots have a different purpose. The pilots were initiated by China to provide the nation with the opportunity to learn by doing, experiment with different ETS design choices, and give both local officials and industrial entities the ability to build capacity.

It should be remembered that China is at an early stage in the development of an ETS. Each of the seven programs is a pilot, or experimental points, which are independently undertaken by local officials under the broad direction of the national government. They are not meant to be end points. Nor are they necessarily intended to be pillars in a bridge to a national ETS.

Instead, they are proving grounds for a multitude of ETS approaches that are as unique as the challenges and opportunities that confront each set of ETS policymakers. From their implementation, China will be able to extract valuable insights into the distinctive challenges, obstacles, and solutions that arise prior to proceeding with the development of a nationally administered ETS. Approaches that fail will be rejected. Those that succeed can be carried forward.

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[85] See in particular Bo Kong and Carla Freeman (Bo Kong and Carla Freeman, "Making Sense of Carbon Market Development in China" September 2013. *Carbon & Climate Law Review*, 2013, Vol. 7 Issue 3, p194) who used the term "mission impossible" and predicted that "…the odds are heavily stacked against a successful ETS." The authors note that "[a] rush toward ETS is likely to lead to a series or cascade of risks…that could be used to discredit the utility of the cap-and-trade mechanism in putting a price on carbon in China." "That this rush to build carbon markets at the local level hearkens to a worrisome degree to a sort of 'great leap forward' is striking when China's ETS efforts are examined in comparative perspective." They assert that "[t]he risks of parochialism, incomparability, and incompatibility suggest that the bottom-up approach to carbon market construction as is currently designed and implemented is unlikely to constitute a pathway toward a coherent and coordinated nationwide carbon market…"

[86] See a Reuters story which opens with "[a]s China lays down plans for a national carbon trading scheme, the world's biggest emitter of greenhouse gases risks repeating mistakes made in carbon trading in Europe by flooding its pilot markets with free quotas."

Thus, the elements of each pilot will be plumbed for collective lessons rather than judged for individual success. The value of the pilots to China will become clear only after national policymakers are able to reflect on the pilots and extract these lessons.

6. CHINA'S PATH FORWARD

The path from the seven carbon trading pilots starts with an evaluation of the pilots. Through the pilots China is gaining hands-on experience that is both timely and germane. These programs are facing challenges and finding opportunities that, to a large degree, are directly relevant to those exist on a national level. While national policymakers are encouraging the pilots to experiment, they are simultaneously harvesting the results. Problems are being studied. So too are alternative solutions. In this way, national policymakers are finding as much value in discovering what does, as what does not, work in the Chinese context.

In a very real sense, the pilots are already a success. Independent of emissions reductions that may be achieved, they have provided policymakers with information that will be necessary to answer three questions:

- What unique circumstances (obstacles and opportunities) define the landscape within which an ETS will be deployed?

- What design elements and best practices seem to be most effective?

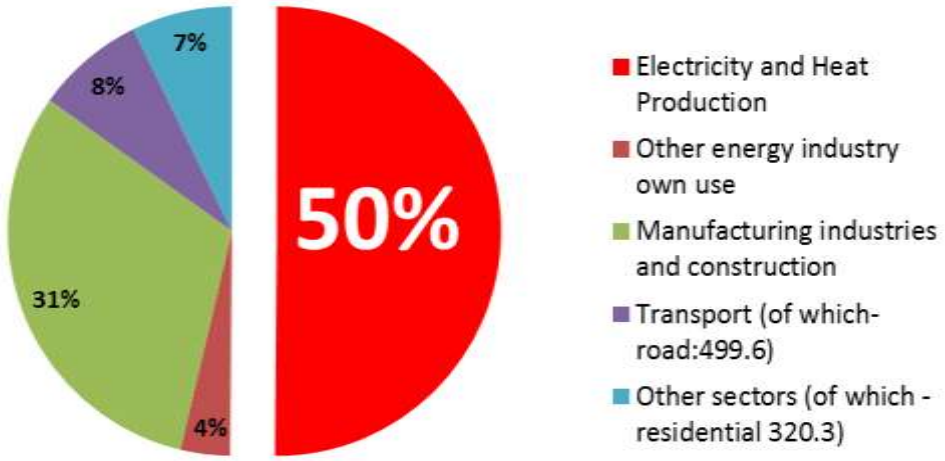
- Can emission trading be used as the centerpiece of China's climate mitigation efforts?

If China elects to move to a national program, it may consider a number of paths including:

- **Regional programs built out from the existing pilots –** Under this scenario, China may build multiple regionally based ETSs, each with one of the original pilots at their center. The 27 non-pilot provincial-level administrative units would be required to join one of the seven original pilots. In order to avoid a race to the bottom, this approach could include the imposition by the central government of both qualitative and quantitative core ETS elements (e.g., penalty provisions that serve to protect the integrity of the cap) that must be incorporated in all of the successor programs. Furthermore, in order to ensure the qualitative equivalence of the programs, some elements (e.g., maintenance of the countrywide emissions inventory, compliance accounts, etc.) will likely need to be run by the central government. In the absence of common core requirements, and/or the management and administration of key elements, it will be difficult to link the programs and guarantee that national climate objectives will be met.

- **Sectoral program focused on a limited number of sectors –** Here, China may decide to structure a single ETS around one or more emitting sectors. Figure 6 suggests it may be logical to develop an ETS that focuses on electricity- and heat production-sources from which slightly more than 50% of China's GHG emissions are derived. Focusing on just the power sector has the advantage of limiting the number of sources to be managed. It also would greatly simplify the allocation, benchmarking, MRV, and enforcement process. China would be able to draw upon experience gained through other power sector-focused ETSs (e.g., RGGI and the US Acid Rain programs). A sectoral program could be a fitting complement to the power plant reduction program that has been proposed in the United States.

Figure 6. China CO_2 Emissions by Sector in 2011



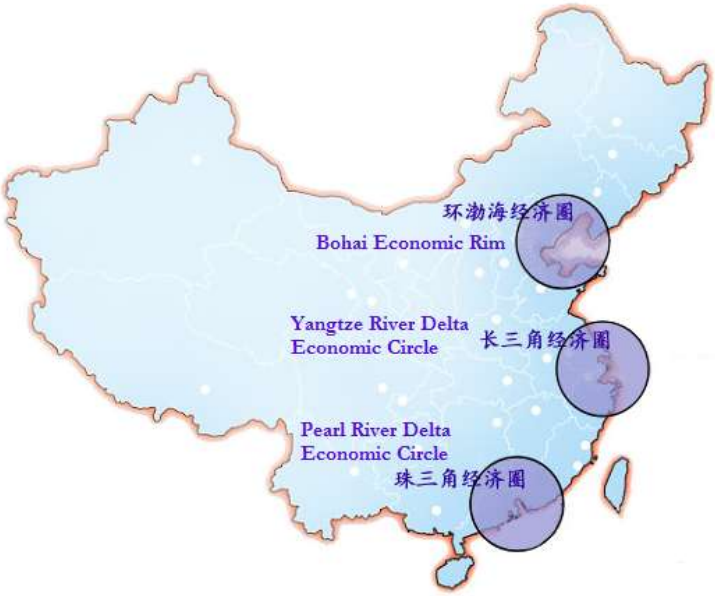
Source: International Energy Agency

- **Geographically focused program –** China may choose to develop a multi-sectoral program that focuses on sources located on the eastern seaboard (e.g., the Yangtze River Delta, the Pearl River Delta, and the Bohai Economic Rim areas) (see Figure 7). Considered together, in 2007 these three regions represented about 50% of China's GDP. In 2008, the aggregate emissions from these regions were approximately 48% of China's total GHGs. To encourage investment, such a program could allow for the development of CCERs from otherwise excluded and less developed western provinces which is consistent with China's Large-Scale Development Strategy for the Western Region.

- **Multi-sectoral nationwide program –** Another option is to build a multi-sectoral program that includes enterprises from across the nation. As compared to a single-sector or geographically limited program, this kind of ETS may amplify

the challenges associated with launching and operating the program. But the diversity of sources, marginal control costs, and rates of development may also bring with it cost savings, market liquidity, and investment opportunities that might not be available with a more homogenous program.

Figure 7. Three Key Economic Regions



7. CONCLUSION

NDRC's issuance of *Document 2601* on October 29, 2011 initiated a process that has resulted in the commencement and operation of seven cap-and-trade programs. In the aggregate, the programs include ~1,937 enterprises that emit 1.247 billion tonnes of GHGs. Barely three years later, though only mid-way through their term, the pilots have arguably already served their purpose. Seven different paths to the national program have been laid. Experience has been gained in every major aspect of program development. Emission inventories (and emission measurement methods) have been developed and refined. Third party verifiers have grown in number and gained experience. And industrial enterprises have continued to develop knowledge and capabilities that will help them gradually reduce carbon emissions.

It is with these experiences in mind that China's policymakers have elected to commence the development of a national ETS. Should China roll out such a program in the 13th FYP, there is little doubt that it will have been shaped by lessons gained through the seven pilots.