Master's Thesis
Environmental Management

An emissions trading scheme for China: design and administrative feasibility

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1. Introduction

1.1 Background

Emissions trading or cap-and-trade is a major market-based instrument used to control pollution by providing economic incentives for emissions mitigation. In general, a certain limit or cap on the amount of a pollutant that may be emitted normally is set by a governmental authority. This limit or cap is allocated and sold by the central authority to firms in the form of emissions permits which represent the right to emit or discharge a specific volume of the specified pollutant. These permits can then be traded and transferred on secondary markets. Participants can choose either to meet their cap by reducing their own emissions below their cap by stimulating technological innovation, and then may sell the excess allowances to gain extra income; or to let their emissions remain above their cap, and buy allowances from other participants in the tradable carbon market.

Emission trading, together with the Clean Development Mechanism (CDM) and Joint Implementation (JI), are defined as the three “flexibility mechanisms” by Kyoto Protocol to enable involved parties to meet their emission limitation commitments. Since then, various trading schemes have been established around world such as European Union (EU), Australia, New Zealand, the United States, and Japan. The favorable performance and accumulated experience of those trading systems also arouse the interest and confidence of some developing countries in Asia such as India and South Korea to promote their emission trading system (see also chapter 1.5).

China, as the world's largest economy and the largest greenhouse gas (GHG) emitter, is confronted with great abatement obligation which derives from internal needs and external pressure. On the one hand, China is a country deeply vulnerable to climate change and highly vulnerable to extreme storms and extreme events and massive flooding. Also the past fast catching-up growth gave rise to many environmental problems such as pollution haze which arouse wide public concern and exert a negative impact on public health in domestic part. On the other, China signed the United Nations Framework Convention on Climate Change (UNFCCC) and Kyoto Protocol and made climate commitments that are consistent with the “450ppm” scenario developed by the International Energy Agency (IEA). As the world's largest emitter, China is of great potential to make surprising accomplishment for emission reduction. While being more active in global cooperation and international negotiation, China shoulders increasing pressure to take actions that contribute to global sustainability. All these elements bring China with a real reason to participate in a global emissions mitigation effort and to rethink its future growth pathways.
So far, China’s approach to controlling greenhouse gas emissions has been based on a direct regulatory (command and control) system, mainly through administrative and political measures. Economic tools (e.g. resource taxes, channeling of subsidies and investment) have played a limited role (Wu 2011). While China failed to control emission using traditional regulatory instruments in the past decades, it moves to market-based instruments such as environmental taxation and emission trading since they are now widely recognized as indispensable policy tools that could help China meet its energy and carbon intensity targets – both domestic and international – in a more controlled, monitored, and/or predictable way. The central government indicated earlier its willingness to apply cap-and-trade to control China's energy consumption and airborne emissions and launched seven pilot schemes, laying out plans in its 12th Five Year Plan (2011-2015) to “gradually develop a carbon trading market”. There is a reason to believe that emission trading scheme (ETS) is becoming an increasingly essential and influential instrument for China to regulate emissions and move towards a low carbon economic development path. Therefore, the discussion of establishing an ETS that fits China present economic development mode as well as environmental political system is of great theoretical and practical significance. Study on global ETS frameworks and characteristics of China environmental governance will provide insights on the adaptation of such a national macro environmental policy in China.

1.2 Objectives

The objective of this study is to find solutions to tackle energy-environmental problems in China. Emission trading, as a favorable instrument, will be discussed as a main regulatory solution to combat air pollution, GHG emissions, and unsustainable energy consumption pattern in China.

Generally, two key questions are supposed to be answered in this study:
1) How to establish a national ETS to fight against energy-environmental problems in China? How might the key components of China’s national ETS look like?
2) How is the political environment and environmental governance in China? Are there bureaucratic, legal, and infrastructure foundations to adopt a national ETS?

Therefore, two major tasks have been included in the following research. The first part concentrate on the policy design, in which key components of an ETS as an environmental policy will be proposed ranging from allowance allocation mechanism to enforcement strategies. A framework of a national ETS that adapts to China’s economic, political and environmental context will be the main outcome.

The second task is to study the characteristics of China’s environmental political system, with a specific focus on energy and climate governance. The bureaucratic characters, legal foundations, and infrastructure capacity will be discussed to examine the challenges and opportunities to develop a national ETS in China.
1.3 Methods and data

Since there is no national ETS in China at present, the policy design is based on the experience from existing global trading schemes and performance of China’s seven pilot schemes. Existing practices from both abroad and domestic part have been gathered and their pros and cons have been compared so as to propose for a national ETS in China. Relevant data from National Bureau of Statistics of China (NBS), Ministry of Environmental Protection China, National Development and Reform Commission, China Statistical Yearbook, China Carbon Market, the World Bank, UNFCCC, Ecofys etc. have been used for statistical analysis and mapping. Concerning the political economy and environmental governance in China, qualitative analysis has been carried out. Publically available information, such as published government regulations, academic or commercial reports, official press releases and other media coverage have been used to inform the analysis. Besides, face-to-face interviews with staffs working in Shenzhen Environment Exchange and Shenzhen Institute of Sustainable Development also provided valuable information for the analysis.

1.4 Thesis structure

Chapter 2 examines China’s energy-environmental problems, and provides an overview of the carbon market as well as CDM in China. Facts and reasons for energy problems ranging from energy shortage, low energy efficiency to unsustainable energy mix are explored. Problem of air pollution and relevant government responses are discussed. Issues concerning carbon emission in China are also covered, including historical trends and regional emissions. In order to serve as a starting point for the following analysis, this chapter also gives a shot on why ETS has been chosen to tackle energy-environmental problems in China, and what is the situation of the carbon market and CDM there.

Chapter 3 illustrates how existing carbon trading schemes have been designed in global carbon market and considers how a national ETS could be designed in China. As a chapter for policy design, key components of an ETS are discussed in detail. These components include emission caps, allowance allocation mechanisms, monitoring, reporting and verification (MRV), enforcement strategies, as well as cost management measures (e.g. carbon offsets, price stabilization mechanism, banking and borrowing). Experiences from other trading schemes and Chinese pilots schemes for establishing and implementing an ETS are explored and specific ideas to build up China’s ETS are proposed respectively. Issues regarding carbon leakage in general are also discussed, putting a focus on how to quantify the risk of leakage and which sectors are exposed to the risk.

Chapter 4 studies the characteristics of China’s political system and environmental governance for energy and climate issues. Central and provincial governors, big
enterprises, research institutes, media are the key player that are discussed, together with their influence on environmental policy creation and implementation in China. Phenomena of bureaucratic competition, administration ranking, and corruption are presented, with a specific focus on how they influence China’s energy governance and China’s administrative capacity for ETS. This chapter also describes the development of environmental policies, climate policies and energy policies in China which together served as legal foundation for carbon trading in China. Besides, it also analyzes China’s infrastructure capacity focusing on the energy-environmental institutional framework as well as the fundamental carbon trading infrastructures.

1.5 Overview of global ETS

The European ETS (EU ETS) started in 2005. Since then, the international carbon market involving 1 regional (31 countries), 4 national and 13 sub-national trading schemes came to flourish and continue to develop at pace (see figure 1.1 and 1.2). The global carbon market was worth about US$142 billion by 2011 (Fankhauser, 2011). Following EU ETS with its 2084Mt CO₂ cap in 2013, China now became the second largest carbon market in the world, covering 1115Mt CO₂.

Figure 1.1 Overview of global ETS

**Kyoto Protocol.** Established in 2005, its target is to reduce emissions by 5% below 1990 levels in 2008-2012 collectively, for the 37 countries with mandatory targets. Countries can reduce emissions at home, buy permits from one another, or buy carbon offsets from projects in developing countries under the Clean Development Mechanism (CDM).

**EU ETS.** Established in 2005, EU ETS is mandatory for all 27 EU members, plus Iceland, Liechtenstein, Norway and Croatia, covering about half of total EU carbon emissions. The target is to reduce emissions by 21% below 2005 levels by 2020. Under the scheme, companies get most permits free during the second phase based on historical emissions, but many electricity generators will have to pay for all these from 2013 (third phase). More than 3,000 airline operators joined the scheme in 2012. Table 1.1 provided a brief overview of the EU ETS.

**New Zealand ETS.** Mandatory scheme launched July 1, 2010, with the target to cut greenhouse gas emissions between 10% and 20% by 2020 on 1990 levels. Under the scheme, emissions permits are allocated based on an average of production across each industry. Sectors include forestry, electricity, industrial process emissions and transport, waste (start in 2013), and agriculture (start in 2015) are covered. From July 1, 2010, to Jan. 1, 2013, emitters have the option of paying a fixed price of NZ$25 per ton of carbon, and only have to surrender 1 permit for every 2 units of emissions.

**Australia Clean Energy Bill.** Adopted by the Australian Parliament, this scheme covers emissions from all sources except agriculture and land use, or the combustion of biomass, biofuels and biogas. The national target is to cut emissions by 5% below 2000 levels by 2020. Under the scheme, 500 companies pay a fixed price of A$23 per ton of carbon from July 2012, rising by around 5% a year, and move to a free trading market in 2015.

**Northeast U.S. RGGI.** Launched January 2009, RGGI covered carbon from power plants in 10 states in the U.S. Northeast. The target is to reduce emissions by 10% below 2009 levels by 2018. It allows offsets from five different types of clean energy projects, including capturing methane from landfills and livestock manure, but only if carbon price reached a level of US$7 per ton.

**California Climate Change Law.** Launched in 2013, it covers emissions from power plants, manufacturing and transportation fuels (start in 2015). The target is to cut the state’s emissions to 1990 levels by 2020. Most of allowances were allocated free in the early years, and emitters are allowed to use offsets to fulfil up to 8% of their compliance obligation.

**Japan Tokyo metropolitan trading scheme.** Launched in April 2010, Tokyo scheme covers around 1,400 top emitters in the metropolitan area. Japan aims to cut emissions by 25% by 2020 from 1990 levels. Under the scheme, Tokyo sets emission limits for
large factories and offices, which can be met by using technology such as solar panels and advanced fuel-saving devices.

**South Korea ETS.** Expected to start in 2015, it covers about 470 companies from all sectors that together produce about 60% of the country’s emissions. The South Korean government has set a 2020 emissions reduction target of 30% below projected “business as usual” levels.

**China: Pilot trading schemes.** In November 2011, China approved pilot tests of carbon trading in seven provinces and cities – Beijing, Chongqing, Guangdong, Hunan, Shanghai, Shenzhen and Tianjin, which started trading since 2013/2014. A national trading scheme is expected to be launched in 2016.

Figure 1.2 Time framework of global ETSs

![Figure 1.2 Time framework of global ETSs](image)


<table>
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<th>Table 1.1 Overview of EU ETS</th>
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<tr>
<td><strong>Objective/Target</strong></td>
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<td><strong>Countries</strong></td>
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|                         | annual thermal capacity, oil refineries and coke ovens.  
|                         | • Production and processing: ferrous metals  
|                         | • Mineral industry: cement, lime, glass, bricks, ceramics. Other: pulp, paper and board  
| oxide from the production of nitric acid and with start from 2012 commercial aviation (>10,000 t CO₂/year).  
| production of petrochemicals, ammonia, nonferrous metals, gypsum and aluminum, nitric, adipic and glyoxylic acid. Exemption is introduced for flights in and out of Europe  
| Cap | • Decentralized system with national caps.  
|     | • Annual cap of 2.181Gt CO₂.  
|     | • Centralized system with single EU-wide cap.  
|     | • Cap 2013 of 2.084Gt CO₂ with annual decrease of 1.74% of average phase II allocation (i.e. an annual reduction of the cap of about 38 Mt/year).  
|     | • Separate cap for aviation of about 210 Mt CO₂/year (95% of annual average 2004 – 2006).  
| Allocation | Mostly free allocations in accordance with national rules with guidance from EU criteria.  
|             | Mostly free allocations in accordance with national rules with guidance from EU criteria.  
|             | In total about 40% auctioning in 2013, with the aim to reach full auctioning by 2027. Free allocation is based on community harmonized benchmarks.  
| Offsets | Yes (from CDM-projects)  
|             | Yes (from CDM-projects)  
|             | Yes (from CDM-projects)  
| Banking/ Borrowing | Only banking within the trading period allowed  
|                  | Inter-period banking allowed. Borrowing not allowed.  
|                  | Inter-period banking allowed. Borrowing not allowed.  

2. Energy-environmental problems and current carbon market in China

2.1 Energy problems in China

2.1.1 Energy shortage

China’s growing energy consumption is accompanied by energy shortages since its own domestic power generation cannot fill the gap. The following two figures compare the growth of energy production and consumption in China. From 2001 to 2010, the growth rate of energy consumption (11%) has exceeded the growth of energy production (10%) (see figure 2.1 and 2.2). This gap led to increasing imports of oil and even coal to a limited extent so far. Chinese foreign dependence on oil, iron ore, aluminum ore, copper, and other minerals already exceeds 50% (NDRC, 2011).

Figure 2.1 Growth of total primary energy production by sources (1950-2010)

![Graph showing growth of primary energy production by sources from 1950 to 2010 with AAGR values for different periods: 1980-2001 (4%), 2001-2006 (10%), 2006-2010 (7%).]
No doubt that the rapid economic growth, massive urbanization and heavy industrialization have placed enormous strains on energy resources in China during 21st century. As urbanization and economic development will continue over the next several decades which need more energy resources to fuel it, increasing energy demand for high speed development is expected to climb up in the coming decades (IEA, 2007). This will make energy security a critical and urgent concern for this country.

In recent years, China has also experienced increased extreme weather events such as droughts, floods and other natural disasters. Both the National Climate Change Program (NDRC, 2007) and the first White Paper on Climate Change (State Council, 2008) pointed to China’s vulnerability from the negative consequences of climate change. Those extreme natural phenomena have directly affected China’s energy supply. In the summer of 2011, a NDRC representative indicated that the country would experience a serious energy shortage, as areas in the southwest and central regions usually served by hydropower had suffered severe droughts (China Daily, 2011).

2.1.2 Low energy efficiency

Energy intensity is referred to energy consumption per unit of output and is considered as an indicator for energy efficiency. It has undergone a gradual decrease during the past 10 years in China (see figure 2.3). This means economic growth proceeded at a faster rate than the increasing rate of energy consumption.
While it is a good news that energy intensity is falling, there is a story covered behind this trend. The table 2.1 indicates that the improvement in sectoral energy efficiency exerted a profound impact on energy intensity reduction. Yet, such effect in sectoral improvement is supposed to generate more reduction than how it is at present. Thus, there must be another factor which serves as an obstacle to further reduction: effects of structural changes to economic activity. According to Xuan Xiaowei et al. (2014), changes in China’s economic structure increased energy intensity by 0.163 tce/10,000 yuan from 1995 to 2008, whereas the sectoral energy efficiency improvements actually led to a reduction of 0.755 tce/10,000 yuan, offsetting the increase caused by structural changes and moreover yielding the overall decline in energy intensity of the economy. The most significant change in the economic structure of China since 1980 has been the enormous decrease in agriculture’s share of GDP, which fell from 38.0% in 1980 to 9.4% in 2009. At the same time, industry’s share of GDP increased from 26.9% to 42.1%, and services increased from 29.6% to 42.1% (NBS, 2010). The huge difference in energy intensity among sectors observed in table 2.1 thus also means that increasing industry’s share of GDP should result in higher energy intensity.
2.1.3 Coal-based energy mix

While figure 2.1 indicates that coal is the main fuel source for primary energy production in China, figure 2.4 shows the very similar story for secondary energy production. They two together provide the big picture of China’s coal-based energy mix for the past three decades, in which over 70% of the overall energy has been generated from coal. As a home energy source and cheap fuel source in China, coal has consistently maintained its dominant share. Although the energy consumption by combustion of coal has decreased slightly by source shares since 2000, it remained at a level of 70% in 2010.

There is a surge in electricity demand driven by industrial demand for crude steel, chemicals, cement and automobile production which consumes near 70% of all produced electricity. In addition to increasing output, the electrification (share of electricity in total energy demand) of the industry is steadily increasing over time as well. Coal-fired power had a three-quarter share in the increase in electricity production in 2013, whereas the expansion of hydropower, wind power and nuclear power contributed to the rest of increase in electricity production (Davidson, 2014; BP, 2014).

By 2012, 66% of the electricity is generated for coal, which followed by hydropower accounting for 22%. This made the electricity emission intensity remain at high level. Figure 2.5 compares the emission level per energy supply (tce) in China to other regions, in which China is top-ranked and it is hardly to deny that this owed a large
debt to the tremendous coal consumption which cannot be found in the other regions.

![Figure 2.5 Energy-related CO₂ emissions per total primary energy supply (2009)](image)

Source: China Energy Group at Lawrence Berkeley National Laboratory, 2012.

### 2.2 Airborne problems in China

#### 2.2.1 Air pollution

The air in China, especially in the urban areas, is among the most polluted in the world. According to a report of the World Health Organization (WHO), of the ten most polluted cities in the world, seven can be found in China. Coal combustion generates particulate matter known as "PM". As a country greatly fueled by coal, the PM2.5, which is a particulate matter with diameter of 2.5 micrometers or less, has been an impressive parameter to present the problem of air pollution in China.

Figure 2.6 provides a global glance at satellite-derived PM2.5 in 2010, which exactly points out how China is suffering from its bad air, especially in the urban area of the north. Coal combustion without doubt is a key driver for this situation. Industrial boilers and furnaces consume almost half of China’s coal and caused pollution in urban area. Another major source of air pollution comes from the use of diesel oil and gasoline in the transportation sector. The vehicle population in China has been growing rapidly over the past decade and will likely continue to do so for the foreseeable future. Sulfur dioxide and soot caused by coal combustion results in the formation of acid rain, which now falls on about 30% of China’s total land area. Although newly-built coal-burning power plants are equipped with desulfurization units, the pollution problems caused by coal burning, in particular air pollution
problems, are still serious.

![Figure 2.6 Satellite-Derived PM2.5 in 2010](image)

Source: National Aeronautics and Space Administration (NASA), 2010.

Zhong Nanshan, the president of the China Medical Association, warned in recent year that air pollution could become China's biggest health threat. According to Cedric Sam et al. (2015), many cities in China were exposed to unpleasant air for most of the time in 2014. Figure 2.7 presents the air quality throughout the year 2014 for some big cities in China. The colors stand for different air qualities from green as the excellent air to black as the most polluted, while the numbers below each color unit implied the number of days within a year that respective air quality have been monitored. Most of the days have been reported with moderate level. Excellent air has hardly been measured throughout the year. The situation was better for cities in the south such as Kunming and Shenzhen, yet this is not sufficient to hold a positive attitude towards the air condition in general in China.

After record-high air pollution in northern China in 2012 and 2013, the State Council issued an Action Plan for the Prevention and Control of Air Pollution in September 2013, aiming to reduce air pollution by over 10% from 2012 to 2017. China’s strategy has been largely focusing on the development of other energy sources such as nuclear, hydro and compressed natural gas. On 20 August, 2015, ahead of the 70th anniversary celebrations of the end of World War II, the Beijing’s government shut down industrial facilities and reduced car emissions in order to achieve a "Parade Blue" sky for the occasion. This action resulted in \( \text{PM}_{2.5} \) concentration below the 35 mg/m\(^3\) national air quality standard, according to data from Beijing Municipal Environmental Protection Monitoring Centre (BMEMC).
2.2.2 Carbon emissions

China’s carbon emission, which accounted for 29% of global share in 2013, was much larger than the second-largest, the United States (16%) and the European Union (11%). Remarkable trends can be seen in figure 2.8 for the top emitting countries/regions, which account for 55% of total global CO₂ emissions (Jos G. J.Olivier et al. 2014). The International Energy Agency has estimated that about half the growth in global energy-related CO₂ emissions from now until 2030 will come from China (IEA, 2009). China’s emission growth trajectory is therefore a critical factor in the world’s chances
of keeping global warming below 2°C.

In 2013, China’s CO₂ emission growth rate (4.2%) was about 6 percentage points lower than its historical average 10% annual increase in emissions in the 11 years between 2001 and 2011. This is primarily due to a decline in electricity and fuel demand from the basic materials industry, possibly due to the slowdown in economic growth when the stimulus package was terminated and the production of hydropower rebounded, aided by an increase in the use of renewable energy and by energy efficiency improvements. Unlike many developed countries, China’s manufacturing industry is the sector with the largest consumption of electricity and fuels. Therefore, the demand for energy in general is largely driven by trends in basic materials production (Houser, 2013).

The somewhat higher annual increase compared to 2012 (3.4%) is due to an uptake of production increase by the heavy industry in 2013. As reported by National Bureau of Statistic (NBS), there was a relatively small increase of 3.7% in domestic coal consumption, whereas in the preceding decade, the annual growth rate was mostly around 10%. In contrast, the increase in natural gas consumption was 10.5% in 2013, following annual increases of about 18% on average. The annual increases of 3.4% in 2012 and 4.2% in 2013 are the lowest since 2001, the year after which the increase in Chinese emissions on average accelerated from about 3% to 10%, annually. Even in the two recent recession years, China’s CO₂ emissions continued to increase by about
6% per year.

The distribution of carbon emissions varies among the 30 mainland provinces in China (see figure 2.9). In 2012, the total carbon emissions were mainly contributed by Eastern coastal regions such as Shandong and Zhejiang, and by the energy based provinces such as Inner Mongolia and Shanxi. Provinces like Inner Mongolia who is rich in fossil resources, have experienced a 7-fold increase of CO₂ emissions since 2000. The total emissions from several of the major provinces are already larger than the emissions from certain developed countries. If Shandong were to be considered as a single country, it would be listed as one of the world’s top 5 countries with a high level of total carbon emissions (over 800 Mt CO₂ per year) (Zhu Liu, 2015).
Although the Eastern coastal regions contribute to high emission levels, the per capita emissions in China’s less developed regions are much higher than in other provinces. Zhejiang and Ningxia is a good comparison. When taking a look at these underdeveloped regions of high levels of per capita emissions, for example the red Inner Mongolia, we may find two reasons explaining it: first, these regions serve as energy and resource basis which provide the electricity and industrial materials that have been consumed in other regions. For example, more than one-third of the power generated by Inner Mongolia is exported to other provinces, and the economic value of Inner Mongolia’s total export to other provinces is equivalent to about 50% of the GDP produced by Inner Mongolia. And the developed regions such as Beijing, on the other hand, are mainly the consumers and the importers of the electricity. Moreover, the carbon intensity in these less developed regions is higher than that of the developed regions, for example, the carbon intensity of Inner Mongolia is more than 5 times that of Beijing (Liu et al., 2013).

2.3 Reasons for choosing ETS

The souring energy consumption and heavy reliance on coal has taken its toll on China. In the past three decades, China witnessed a nationwide deterioration in its air quality, the widespread problem of acid rain, and the fast-climbing carbon emissions. The enormous economic losses from environmental damage and concerns about national energy security have promoted the central authority to take serious actions to combat energy-related environmental problems. A series of policies and measures were promulgated to curb emissions such as SO₂ and NOₓ, with heavy reliance on the command-and-control (CAC) approaches and Pollution Levy System (PLS) to induce emissions mitigation from polluting plants.

However, the deteriorating air quality proves that these regulatory mechanisms failed to yield the expected outcome. In 2005, instead of achieving the 10% reduction goal set by the national 10th Five-Year Plan (FYP), China emitted 27% more than it did in 2000 and became the world's largest emitter. While central government boasted over the ambitious target of the 10% reduction in its 11th FYP (2006-2010) by 2011, the pollution reduction target in 2011 still failed to be realized.

These failures brought about query on the effectiveness of previous conventional CAC approaches and PLS for emission control in China. Although strict top-down CAC measures has the advantage of fitting well with the Chinese administrative system, the inadequacy and cost-inefficiency of reliance on direct regulatory system provide a strong motivation for the Chinese government to build and rely much more on market-based instruments, such as environmental taxation and emission trading schemes to ensure continued energy and carbon intensity reduction.

Emission trading is seen as a major market-based instrument for improving energy efficiency, which remains the primary concern for the Chinese government in
addressing climate challenges. Theoretically, it could improve the performance of regulatory regimes designed to improve air quality by giving sources the flexibility to achieve emissions constraints more cheaply than CAC alternatives. It provides companies the flexibility to choose either adopting lower emissions practices, or purchasing permits. For those facing greater expenses to reduce emissions compared to other firms there is more incentive to buy permits, whereas for others it may be more efficient to invest in new plant to reduce emissions. This inherent flexibility among participants in the market means emissions trading can achieve emissions reductions with a lower overall cost.

Beside theoretical advantages, experience with emission trading has demonstrated its superiority to CAC approaches under certain circumstances from practical dimension. European governments have indeed achieved emission mitigation via EU ETS. Since the emergence of the European Union Emission Trading Scheme (EU ETS) in 2005, the world has seen a rapid growth in carbon markets. This has been discussed in Chapter 1. Even though there is uncertainty from economic downturn, many believe that carbon markets remain one of the most trusted and attractive instruments we have to combat climate change (Fankhauser, 2011).

### 2.4 Current ETS in China

After laying out plans to “gradually develop a carbon trading market” in its 12th Five-Year-Plan (2011-2015), China launched seven pilot emission trading schemes which are expected to serve as testing ground for a national ETS to be implemented in (or after) 2016. China committed to a 40-45% carbon intensity reduction by 2020 compared to 2005 levels in COP15 in 2009. Later in 2011, in the White Paper on China’s Climate Change Policies and Action, the government outlined in more detail its plans for establishing a carbon market: “China will, drawing on the experience of the international carbon emissions trading market while taking into consideration its actual conditions, gradually promote the establishment of a carbon emissions trading market. The country will further reform the price formation mechanism of carbon emissions trading by standardizing voluntary trading in emission reduction and discharge rights, gradually establish trans-provincial and trans-regional emissions trading systems, so as to give full play to the fundamental role of the market mechanism in optimizing the allocation of resources, and realize the objective of controlling greenhouse gas emission at minimum cost.” (State Council Information Office, 2011).

Selection of cities for pilot carbon trading markets started in 2011, and it was followed by the designing phase in 2012. The first ETS began in June 2013, in the city of Shenzhen (population: 7 million), together with the following carbon market in Beijing, Guangdong, Tianjin, Hubei, Shanghai and Chongqing (SEI, 2012.). The seven ETS are expected to eventually regulate between 0.8 -1 billion tons of CO₂. If those trading schemes were to be linked they could becoming the second largest
cap-and-trade programme aside from the EU ETS (which is about twice as big). The detailed information for seven pilot schemes can be seen below in figure 2.10 and 2.11.

Figure 2.10 Pilot schemes with provincial GDP growth rates profile

Source: FY, 2014

Figure 2.11 Overview of the design of pilot schemes

2.5 CDM in China

The Clean Development Mechanism is one of the three market-based mechanisms in Kyoto Protocol, of which the only one relevant to developing countries. After initial hesitation, China endorsed the implementation of CDM in China in 2004. And the CDM designated national authority (DNA) in China, the National Development and Reform Commission (NDRC), issued the “Measures on the Operation and Management of Clean Development Mechanism Projects” in 2005 as CDM guidelines. Since then, China has quickly become the dominant CDM carbon credit supplier (see figure 2.12).

Figure 2.13 CDM projects share by the end of 2011


By July 2015, China had approved 5048 CDM projects, mainly focusing on new and renewable energy, energy conservation and the enhancement of energy efficiency, methane recycling and reutilization and other areas. A total of 3798 Chinese projects have been successfully registered with the CDM Executive Board, accounting for almost 50% of the world’s total registered projects, and the resulting certified emission reductions (CERs) has reached an annual issuance volume of 626 million tons of CO₂ (NDRC CDM Project Database, 2015).

At provincial level, most of the projects are in less developed regions such as Yunnan, Sichuan and Inner Mongolia. These projects are mainly about renewable energy such as hydro power in Sichuan and wind power in Inner Mongolia. Although Inner Mongolia has a relative high GDP per capita, its population density is very low and it is far less developed than regions like Beijing and Shanghai. The flat and vast grass
land there makes Inner Mongolia a favorable place for wind power projects.

Figure 2.12 Total number of projects versus GDP/capita in each province

![Total number of projects versus GDP/capita in each province](image)

Data source: NDRC CDM Project Database, 2015.

Several shortcomings are there for the CDM in China. Primarily, the buyers are almost exclusively from outside of China, and thus it does not encourage competition within sectors or between regions in China to find low-cost ways to reduce carbon intensity and increase energy efficiency. Moreover, the actual emission reductions fail to reach its expectation in terms of the great deal for the CDM in China. The one year increase from 2009 to 2010 in China is close to the entire reduction through CDM globally over the eight years (Fankhauser, 2011). Besides, uncertainty over the future of the CDM, is an increasing concern and consequent driver for China to develop its own stand-alone domestic trading system, while at the same time staking out its position in a global trading system (Liu 2011).
3. Policy design: ETS as an option in China

A carbon trading system requires several elements to function smoothly, especially in terms of administrative and monitoring capacity. In general, the construction of a carbon trading system involves five main components:

1) Setting the total emission limit (or cap, target);
2) Allocating the emission permit (or credit, allowance);
3) Prudent GHG monitoring, reporting and verification (MRV) rules;
4) An accountability system in case of non-compliance (or enforcement strategies).

Each of these components is indispensable, and together they require not only creditable carbon emission measurement and statistics, but also a fair allocation mechanism, free market conditions and reliable oversight, as well as strict monitoring. This chapter discusses how these components could be established in a national emission trading scheme in China.

3.1 Targets

The emission cap is the level of total emissions that can be emitted nationally/regionally during a compliance period. The central authority would have power to change emission cap over time, either in accordance with a predetermined target of emission reduction (e.g. agreed upon as a result of international climate change negotiations) or in response to changes in technology or information regarding any environmental consequences of GHG emissions.

3.1.1 China’s climate commitments

China’s emissions target provides an indication of emission trajectory in a national ETS. China has become the largest emitter since 2007. As the adverse impact of climate change gains more recognition in the international community, it is reasonable for China to determine its mind to undertake more stringent climate obligation in the not-so-far future. Therefore, China made several commitments since 2009 for its obligation. They include (State Council, 2011a; NDRC, 2014; Xinhua, 2015):

1) Goals to be achieved during 12th FYP (2011-2015), or the end of 2015:
   - Increase of non-fossil fuel usage in primary energy consumption from 8.3% in 2010 to 11.4% in 2015;
   - 16% decrease in energy consumption per unit of GDP (energy intensity);
   - 10% reduction target for national emission by 2015 relative to 2005 level;
   - 17% decrease in CO2 emissions per unit of GDP;
2) China’s climate change-related goals for 2020 indicated by the National
Development and Reform Commission (NDRC):
· Reduce CO₂ per unit of GDP (carbon intensity) by 40-45% relative to 2005;
· Increase the ratio of non-fossil energy to the consumption of primary energy to 15%;

3) The Beijing announcement in 2015 for 2030 target:
· Decrease in CO₂ emissions per unit of GDP by 60-65% from 2005 level;
· Increase of non-fossil fuel sources in primary energy consumption to about 20%.

These binding targets are consistent with the “450ppm” scenario developed by the International Energy Agency (IEA) in its World Energy Outlook, in which each country contributes to stabilizing atmospheric GHG levels at 450ppm of CO₂-equivalent (CO₂e). A 40% reduction in carbon intensity by 2020 would be an important contribution from China in the global effort to stick to 2°C Limit (IDDRI, 2014).

“China's carbon dioxide emission will peak by around 2030 and China will work hard to achieve the target at an even earlier date,” Chinese Premier Li Keqiang said in a statement after meeting French President Francois Hollande in Paris. Before peaking, the absolute emission will continue to grow. However, the increasing emission does not mean China’s targets are not ambitious. The substantial reduction of carbon intensity can reduce growth of emissions and hasten the peaking of China’s emissions.

<table>
<thead>
<tr>
<th>Table 3.1 Climate commitments in China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Binding Target</td>
</tr>
<tr>
<td>Increase of non-fossil fuel sources in primary energy consumption</td>
</tr>
<tr>
<td>Decrease in energy intensity</td>
</tr>
<tr>
<td>Decrease in carbon intensity</td>
</tr>
</tbody>
</table>

(State Council Information Office, 2011; INDC, 2015)

From the EY analysis (see figure 3.1), to meet the 12th FYP goal of 40% emission intensity (emissions per unit of GDP) reduction by 2020 against the business-as-usual scenario (emissions intensity continues at 2010 level and GDP growth remains at 9%), the total abatement from the start of 2011 to the target date of 2020 is estimated to be over 30 Gt (giga ton) CO₂e (EY, 2014). Of course, the actual economic growth is lower 9% and emission intensity is declining compared to 2010 levels. This may make the estimated 30 Gt abatement a bit exaggerating. Yet this number indicated the huge abatement potential in China for the following five years. This also means great efforts on reducing emissions intensities across all sectors of the economy are
required, in particular high emitting industrial sectors (such as coal fired power generation), mining, manufacturing industries (such as steel and cement) and transport.

Figure 3.1 Abatement trajectory by 2020 in China


### 3.1.2 Carbon emission trend and projection

From the domestic data, the CO₂ emission level has grown from 3.9 Gt in 2002 to 9.6 Gt in 2011, with an average growth rate of 10.2%. Together with the annual increase of 3.4% in 2012 and 4.2% in 2013 (the slowest growth rates since 2001), China’s carbon emission climbed to 10.3 Gt in 2013. This increase is mainly due to the relative increase in coal consumption which is responsible for three-quarters of China’s CO₂ emission (NBS, 2014) (see table 3.2 and 3.3).

Restrictions on investments in construction activities (buildings, power plants, and infrastructure) result in a substantial slowdown in the growth of demand for materials, halving the growth in China’s manufacturing industry who consumed the largest proportion of electricity and fuels. Thus, not only the growth of Chinese economy but also growth of other key energy trend indicators, such as production of cement, steel and electricity, decreased significantly in 2012 and 2013, compared to the preceding ten years. So, the slowdown of the growth of CO₂ emissions in China as observed in 2012 has continued in 2013 (Houser, 2013).

<table>
<thead>
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</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>3.6</td>
<td>3.6</td>
<td>3.9</td>
<td>4.5</td>
<td>5.3</td>
<td>6.2</td>
<td>6.5</td>
<td>7.0</td>
<td>7.8</td>
<td>8.3</td>
</tr>
<tr>
<td>2010</td>
<td></td>
<td></td>
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<tr>
<td>2011</td>
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<td>2012</td>
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<tr>
<td>2013</td>
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<td></td>
</tr>
</tbody>
</table>
Table 3.3 Growth rate of selected energy trend indicators in China

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Average growth rate 2002-2011</th>
<th>Growth rate 2012</th>
<th>Growth rate 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP</td>
<td>10.6%</td>
<td>7.7%</td>
<td>7.6%</td>
</tr>
<tr>
<td>CO₂ emissions</td>
<td>10.2%</td>
<td>3.4%</td>
<td>4.2%</td>
</tr>
<tr>
<td>Electricity consumption</td>
<td>12.3%</td>
<td>5.9%</td>
<td>7.5%</td>
</tr>
<tr>
<td>Coal consumption</td>
<td>10.5%</td>
<td>2.4%</td>
<td>3.7%</td>
</tr>
</tbody>
</table>


Figure 3.2 CO₂ emission projections to 2020

Source: Klimablog, 2013.

The absolute CO₂ emission in 2013 is 10.3 Gt and the growth rate from 2012 to 2013 is 4.2%. Following this growth rate during the next five-year period, the CO₂ emission would be likely to reach a high level of 13.1 Gt in 2020 (figure 3.2).
3.1.3 Proposed cap for national ETS in China

A centralized cap is proposed for China’s national ETS. Instead of allowing each provincial government to determine their own regional caps, **one single community cap set by the central government** is more favored in the context of China. This is because local governments tend to set loose rules to guarantee the competitiveness of local economy rather than to lay a tightened cap. Regional competitiveness is very strong in China — each region wants to act as an engine of growth. According to one analysis, “Local governments show no sign of willingness to actually cut emissions to lower levels, but rather simply to reduce the rate of growth in energy consumption” (Qi et al 2008). This will be further discussed in the chapter 4.

In practice, there are two kinds of cap. One is to cap absolute emissions; the other is an output-based cap. An absolute cap has the advantage of guaranteeing a maximum allowed quantity of emissions while also giving industry some degree of predictability in terms of emissions (instead of cost). It can, however, be argued that the system is vulnerable to severe growth shocks, as it may involve difficulties adjusting to unexpected increases in economic growth, or, as has been observed in recent years, to keeping the cap relevant in recessions (Fankhauser, 2011). Schemes with **output-based caps**, such as the New Zealand ETS, adopt intensity targets, which are expressed in terms of emissions per unit of output. Under intensity targets, the scheme is linked to future GDP and allows for the automatic adjustment to sudden growth shocks. Notably, an output-based cap can tackle uncertainty about future GDP, as opposed to the absolute cap; however, it does not deal with uncertainty about future emission intensity or abatement costs. Output-based caps are understood to be less economically efficient, as they preclude the option of reducing emissions by reducing production. At the same time, they are attractive to industry, as they do not place a limit on output (Ingrid Jegou and Luca Rubini, 2011). **Both kinds of cap exist in the current Chinese pilot schemes**. The Chongqing pilot program, for instance, places an absolute cap on all emissions in the municipality. The Shenzhen ETS, on the other hand, bases its cap on carbon intensity.

Here, **targeting the absolute emissions** is suggested. Since China’s GDP is supposed to continue to grow at a relatively high rate, capping on carbon intensity is not sufficient to limit the total absolute emissions in this country which is not the ultimate goal for establishing an ETS. However, the influence on absolute emission from the expansion of economic activities for the following years can not be ignored. What has been discussed above is that although China has committed to cut its carbon intensity, the total emission will continue to go up before it reaches the peak by 2030 for example. Therefore, unlike many other trading schemes, a **growing cap with a decreasing annual growth rate before peaking** is favored in the Chinese national ETS for the next five to ten years. The cap shall be in line with China’s overall 40–45% carbon intensity reduction target by 2020, compared to 2005 (or 11.7%–19%
The following figure indicates the proposed growing cap. The carbon emissions from 2010 to 2013 are the actual emissions reported by NBS. Instead of following the path of a 4% annual growth rate, the growth of emissions is supposed to slow down by years at a rate from 3% to 1% (GDP grows by 6-7%). Thereby, the emissions in 2020 would be 11.8 Gt rather than exceed 13 Gt.

Figure 3.3 Proposed emission cap for China’s national ETS

![Graph showing proposed emission cap for China’s national ETS]

### 3.2 Scope and addressees

#### 3.2.1 Coverage of gases

Among the GHGs emissions in China, CO$_2$ emission occupied the largest share, accounting for nearly 80%. No doubt it will be one target in the coming national ETS, especially for power generation and energy-intensive industry sectors (e.g. oil refineries, steel, iron, aluminum, metals, cement, lime, glass, ceramics, pulp, paper, chemicals). At present, all pilot schemes covered emissions of CO$_2$ only (except for Chongqing scheme).

Despite this, the other five gases in GHG inventory containing Methane (CH$_4$), Nitrous Oxide (N$_2$O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and Sulphur Hexafluoride (SF$_6$) shall also be involved gradually. For example, N$_2$O can be covered for production of nitric, glyoxal and glyoxic acids. Aluminum production can be a focus of PFC.

Emissions from direct sources and indirect sources shall be covered. The direct sources, from the Shenzhen Market Supervision Administration guidance “Specification with guidance for quantification and reporting of the organization’s
greenhouse gas emissions”, cover four areas: i) Emissions from stationary combustion; ii) Emissions from mobile combustion (transport fuel); iii) Process emissions (including biological, physical or chemical processes that produce greenhouse gas emissions); iv) Fugitive emissions (intentional or unintentional discharges, including equipment junction leakage, refrigerant leakage, anaerobic wastewater treatment). The indirect emissions are consistent and relates to emissions from the use of electricity and heat (including the use of steam).

Figure 3.4 GHGs emission by gases in China (in CO₂ equivalent)

Data source: UNFCCC

3.2.2 Coverage of sectors

Compulsory participants are those who are required by legislation to hold permits to cover their emissions of specified GHGs. In principle, emission permits shall be linked to the level of GHGs actually released into atmosphere. Thus, an ideal emission trading scheme would target all emitters. In practice, however, engaging so many individual sources into the trading scheme is vagarious. There are likely to be significant administrative advantages if trading scheme is restricted to large emission sources. The challenges is to achieve an economically balanced number of participants, emission coverage and abatement opportunities. For example, targeting energy suppliers such as petroleum refineries rather than end users of energy like car drivers may result in efficiency losses, but these may be outweighed by the lower administration, monitoring and transaction costs associated with an emission trading scheme.

To determine the participants that shall be involved in China’s ETS, there is a need to identify large emitters. According to the sector share of carbon emission from China, manufacturing and power generation sectors are the largest emission contributors. In 2012 manufacturing including cement production accounted for 47% of China’s total carbon emissions, while thermal power generation contributed 32%. Besides, transportation, cement production and heating are not ignorable contributors
When taking a look at the profile of energy-intensive sectors in China, it is readily to find that industry and manufacturing sector (including cement production) are the two largest energy consumers which together account for 76% energy consumption in 2013 (China Statistical Yearbook, 2014). To some extent, the energy consumption profile is similar to carbon emission profile. This is mainly due to coal-based energy
Buildings and transportation sector could also be one concern in those commercial cities located on more developed eastern coast, say Shanghai and Shenzhen, where has a higher GDP per capita and lower GDP growth rates compared to the central and western regions. The less commercialized central areas, say Hubei and Chongqing, are more expected to mainly focus on targeting heavy industrial sectors without involving building and transport.

Taking both sectoral carbon emission and energy consumption into consideration, sectors involving power generation, mining and processing of ferrous and non-ferrous metals, cement production, chemicals, and aviation are supposed to be covered by China’s national ETS. Besides, entities that exceed certain emission level shall also be covered by the scheme since they can be considered large emitters as well. At present, companies emitting more than 10,000 tons per year have been seen as large emitters in regions like Shanghai, Guangdong and Tianjin and they are obliged to report their emission annually. The number 10,000 tons/year may be a bit small when it comes to country level. Therefore, number like 20,000 tons/year (or even larger) is more preferred for China’s national scheme.

3.3 Allowance allocation mechanism

3.3.1 Basic allocation approaches

In current global trading schemes, there are three ways to allocate allowance, involving free allocation either via grandfathering or benchmarks, auctioning as well as the so called carbon price mechanism.

Free allocation means, after the central government determined the annual emission target, operators can obtain certain amount of emission permits for free either based on their historical emission level (Grandfathering) or certain standards (Benchmark). Free allocation is chosen as an allocation methodology in many emissions trading schemes to limit the total cost burden to industry, thereby protecting industry competitiveness against countries and regions without carbon pricing applied. As free allocation has been considered to smooth the transition into a carbon priced policy environment by limiting the initial costs, the share of free allowance granted therefore is supposed to go down over time. One practical example following this principle is the case of EU ETS which will be discussed below. This tendency and wish to lower the free allocation is incentivized by the fact that it lowers the overall cost-efficiency of the emissions trading scheme, because free allocation prohibits the full pass through of carbon costs in the production chains which would result in the highest economic efficiency (Wu Qian et al., 2014).
Here it is necessary to compare the two different methods for the free allocation of emissions allowances: grandfathering and benchmarks.

Grandfathering defines a fixed amount of allowances to be allocated using historical baseline data and is therefore also referred to as the “historical emissions approach”. Its main advantage is its relative simplicity, relying only on historical emissions data. It is also a relatively straightforward methodology to comprehend and understand, thereby providing clarity and predictability to the participants in the scheme. However, grandfathering undermines the objectives of ETS by rewarding those who have done the least in the past. It is not fair to an efficient company which inherently has less potential to reduce will receive less allocation than the less efficient competitor, despite or even because of his actions in the past. So this allocation methodology is only suitable for installations and production capacity that is already in operation at the time the emissions trading begins. It does not correct automatically for new entrants and or for added capacity or production for which additional methods are thus needed (Ingrid Jegou and Luca Rubini, 2011).

Benchmark, on the other hand, is not based on the historical emissions of a covered entity but a certain emission performance standard per unit of activity which could be the tonnage of a certain product (e.g. steel or cement), an amount of energy used (e.g. a kWh of electricity) or a unit of economic output (e.g. value added of industry). When applying benchmarking, every company receives the same amount of emission allowances, the benchmark, for the same unit of activity. Those that perform worse than the benchmark do not get sufficient allowances and need to buy additional allowances. Those that perform better than the benchmark, receive more allowances than needed and can sell the surplus. Benchmarks can either be combined with historical activity level (e.g. historical steel or cement production) to arrive at the final allocation, or combined with the actual occurring activity levels during the trading period (i.e. the actual steel or cement production). Such an approach can reward early actions undertaken by participants to reduce emissions before the emissions trading scheme started. It may also be more fair for both existing operators and new entrants. However, benchmarking can be complex when turning to the setting of benchmark such as defining the unit of activity. Besides, it puts a higher cost burden for the less efficient share of production (Bram Borkent et al. 2014).

**Auctioning** is another important allocation mechanism. When it is applied, compliance entities need to obtain allowances by purchasing them from a designated auctioneer. In comparison to free allocation mechanisms, auctioning is a more simple procedures and of higher efficiency and transparency. It could ensure full cost pass through of the carbon price. The gaining in auctions can serve as revenue which is often used on the further mitigation and adaptation efforts or for compensation. However, auctioning means large upfront payments which definitely brings additional burden to industries. Therefore, it is more likely to result in opposition from the industries.
There is another supplementary way for allowance allocation—*allowances are sold at a fixed price* by government and companies purchase demanded permits. When allocated free allowances failed to cover the emission, companies can buy those permits at fixed price from government. One case in practice is the ETS in Australia. During the first period (2012-2015), carbon price was set at A$23 (US$24) per ton of carbon (with an annual increase of 5%). Such a Carbon Price Mechanism is more like a carbon tax, but do help participants to adapt to future free market.

### 3.3.2 Allocation mechanism in pilot schemes

With the launch of ETS pilot program in 2013, local Development and Reform Commissions (DRCs) in the pilot regions have released Carbon Emission Allowance Allocation Plans one after another. In general, the local authorities defined the baseline years (e.g. 2009 – 2011) for data collection, set the reporting thresholds (e.g. annual energy consumption above 1000 ton standard coal or annual emissions above 2000 t CO₂), select ETS sectors and finalize a list of compliance enterprises. The allocation to covered enterprises is primarily based on the historical emissions data. The allocation to new entrants is based on benchmarks or expected emissions of the planned new capacity (see below).

<table>
<thead>
<tr>
<th>Shanghai</th>
<th>Tianjin</th>
<th>Beijing</th>
<th>Shenzhen</th>
<th>Guangdong</th>
</tr>
</thead>
<tbody>
<tr>
<td>allowances in 2013</td>
<td>160Mt</td>
<td>160Mt</td>
<td>50Mt</td>
<td>33Mt</td>
</tr>
</tbody>
</table>

**Baseline year**

|-----------|-----------|-----------|-----|-----------|

**Sectors**

- Industry (not including power), public building and manufactory
- Power and heat, iron and steel, chemical, petrochemical, oil and gas
- Power and heat, cement, chemical, other industrial and service sectors
- N/A
- Power and heat cogeneration, mining in cement, petrochemical, iron and steel scrap processing

**Calculation**

- Historical emission + early action credits
- Power: average historical emission per production *production
- Others: historical level
- Power: average historical emission per production *production *reduction factor
- Average historical level *reduction factor
- N/A
<table>
<thead>
<tr>
<th>Sectors</th>
<th>Power, aviation, ports</th>
<th>New entrants and expanded capacity</th>
<th>New entrants and expanded capacity</th>
<th>Power, hydro, building, other manufactory and industry</th>
<th>Power, cement and long process steel</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Benchmarking</strong></td>
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</tr>
<tr>
<td><strong>Calculation</strong></td>
<td>Benchmark × historical production</td>
<td>Benchmark × historical production</td>
<td>Benchmark × historical production</td>
<td>Benchmark × historical production</td>
<td>Benchmark × historical production × control factor</td>
</tr>
<tr>
<td>Adjust by actual production</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td><strong>Auctioning</strong></td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Since 2014, &lt;3%</td>
<td>2013 and 2014: 3% 2015: 5-10%</td>
</tr>
<tr>
<td>New entrants</td>
<td>Planned capacity and loading rate</td>
<td>benchmarking</td>
<td>benchmarking</td>
<td>benchmarking</td>
<td>Benchmarking or planned energy consumption</td>
</tr>
</tbody>
</table>

Source: China Carbon Market, 2014. (ChinaCarbon.net.cn)

Grandfathering has been widely applied in these pilots, where the total amount of allocation equals to the amount of historical emissions multiplied by a reduction factor. In some of the pilots, Shanghai for example, pure grandfathering based on historical emissions is adjusted in such a way that early movers will receive recognition for their efforts by building in credits for efficient technology to the allocations. Shanghai also allows enterprises to use the latest year’s data if emissions increased over 50% from 2009 to 2011 when great variance of production during baseline years occurred. Here deserves a notice that historical activities from 2009 to 2012 may be not representative for the full picture, since both GDP growth rate and total emission growth rate experienced a decrease compared with early 2000’s. Major energy intensive sectors ranging steel to power sector have already experienced production suspension. Therefore it is necessary to adjust allocation, for example to apply sector reduction factors or efficiency factor and so on. But here is one more problem. Although this seems to be a right thing to do, the various factors being used to adjust allocation make the calculation more complicated and confusing for participants as there are too many of them and even not all those factors are disclosed.
to the public and well-explained to enterprises. Some interviewers complained that: “There are industry emission control factor, declining factor, load correction factor, efficiency factor and so on. So many, but without providing any document accessible to the public illustrating where and how to use them. I bet, more than a dozen of companies are not clear about how to apply those factors in calculation.”

While rules for grandfathering in China’s carbon market is so dynamic, benchmarking, as an approach to reward the most efficient participants, has more uniform calculation formula. Most of the power and heat suppliers received allocations based on benchmarks of different combustion technologies and installation capacity. The basic formula for these benchmarks is calculated as “t CO₂/ MWh”. Apart from power and heat, benchmarks have not been deployed at a large scale except for Shenzhen. It developed benchmarks for glass (based on the tonnage of glass production) and other manufacturing industries (based on value added as activity indicator). Shanghai also used benchmarks (production based) to decide allocations to airlines and ports. These production based benchmarks are developed because there is good existing reference data on energy intensity of the whole sector. Moreover, adjustment of allocation based on actual production is introduced in Shenzhen, power and heat sectors in Tianjin and Shanghai (Wu Qian et al., 2014).

Auctioning, relative to the other two approaches, has not been widely applied in many of those pilot regions. But Guangdong set an example among the pilots by deploying the use of auctioning to allocate allowances. Guangdong requires all compliance enterprises to purchase at least 3% of their total allowances for the period 2013 – 2014 at auction. After four auctions, 10.7 million allowances were sold at a reserve price of CNY60 (US$10). Otherwise, companies are not eligible for receiving the rest of the allowances for free. This percentage will increase to 5-10% in 2015. Companies can also purchase allowances from the secondary market, where the price is floating around the reserve price and the trading volume is quite small as the biggest market in China (Guangdong DRC, 2013). Hubei also did the first auction on 31st March 2014, and 2Mt CO₂ allowances were purchased at CNY 20 (US$3.3) per ton, and it plans to auction up 8 million allowances of 2014 (Hubei Emission Exchange, 2014; Hubei Emission Exchange, 2014)). Corrections to the allocation during the pilot based on actual production, so-called dynamic allocation, are included in the ETS Implementation Plans for Shenzhen, Tianjin and Shanghai (Shenzhen Municipal Government, 2013; Tianjin Government, 2013; Shanghai Municipal Government, 2013a).

3.3.3 Proposed allocation plans for China’s ETS

Given China’s vast size, dynamic growth pattern, and tremendous needs, it may be real to enable governments at provincial level to rule their allocation plans, and the local Development and Reform Commissions would be a suitable authority being responsible for this affairs. These plans should be approved by the central government
and the National Development and Reform Commissions (NDRC) can take over this work.

There also have some other proposed principles that shall be obeyed here for allocation plan. As China’s national ETS will have an increasing cap, the amount of permits will also increase during certain time frame. Yet, the proportion of free allocation, either by grandfathering or benchmark, can be reduced gradually after the beginning phase. 100% of free allowances are suggested for the first 3 years, after which can decrease with an annual rate of 3-5%.

Going forward, benchmarking should be expanded to more sectors other than power and heat. With respect to the “industrial value added” benchmarking, it is important to understand this indicator will not necessarily reflect the real emission performance of production due to different value added structures of different industries. The use of product based benchmarks should be encouraged to put comparable production at a comparable footing. Table 3.5 proposes the fundamental ways of calculation for different sectors.

Table 3.5 Allowance allocation plan by sector

<table>
<thead>
<tr>
<th>Industries (steel, petrochemical, chemical, nonferrous metal, cement production, fabrics, papermaking, rubber, chemical fibre etc.):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allowance = Historical emissions + early emissions reduction allowance + new installations</td>
</tr>
<tr>
<td>Early emissions reduction allowances are determined based on 30% of emission reductions converted from verified energy reductions. The coefficient for converting energy reductions to emission reductions is 2.23 t-CO₂/ton of standard coal.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Power:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allowance = electricity benchmark × annual electricity × emission control factor</td>
</tr>
<tr>
<td>Electricity benchmarks is determined by different generator types, which could refer to Table 3.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heat:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allowance = heat benchmark × heat supply × emission control factor</td>
</tr>
<tr>
<td>Emission control factors see from Table 3.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Buildings (malls, office buildings and railroad stations etc.):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allowance = Historical emissions + early emission reduction allowance</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Airports and airlines:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allowance = emissions per unit business × annual business volume + early emission reduction allowance</td>
</tr>
<tr>
<td>For airlines, business volume is the annual turnover, and for airports is annual transportation volume.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ports:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allowance = emissions per unit throughput × annual throughput + early emission reduction allowance</td>
</tr>
</tbody>
</table>

Source: Wu Qian et al., 2014
Table 3.6 Electricity emission benchmark by generator type in China

<table>
<thead>
<tr>
<th>Capacity (10 MW)</th>
<th>Electricity emission benchmark (tCO₂/10 kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2013</td>
</tr>
<tr>
<td>Gas power</td>
<td>3.800</td>
</tr>
<tr>
<td>Coal fire</td>
<td></td>
</tr>
<tr>
<td>Ultra-supercritical</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>66</td>
</tr>
<tr>
<td>Supercritical</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>60</td>
</tr>
<tr>
<td>Subcritical</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>30</td>
</tr>
</tbody>
</table>

Source: Shanghai Municipal Government, 2013b.

Table 3.7 Emission factors for different sectors

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing and other industrial companies</td>
<td>98%</td>
<td>96%</td>
<td>94%</td>
</tr>
<tr>
<td>Service entities</td>
<td>99%</td>
<td>97%</td>
<td>96%</td>
</tr>
<tr>
<td>Gas combustion facilities in thermal power plants</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Coal combustion facilities in thermal power plants</td>
<td>99.9%</td>
<td>99.7%</td>
<td>99.5%</td>
</tr>
<tr>
<td>Gas combustion facilities in heating plants</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Coal combustion facilities in heating plants</td>
<td>99.8%</td>
<td>99.5%</td>
<td>99.0%</td>
</tr>
</tbody>
</table>


Auctioning should be encouraged and carefully arranged. Critical decisions on the level of reserve price and the amount of allowances need to be carefully studied. Government intervention should be minimized. Auctioning by a trading platform could be more cost effective to discover the carbon price through market mechanism. There is still a lot to be sorted out including the legal status, who is the auctioneer, how to use the revenue etc.

Moreover, learning from the pilot schemes, the correction factors of different pilots should be compatible with each other so that companies in the same industry but located in different regions can be treated equally. The use of those factors shall be well illustrated and published as official document which is available for all participants. Transparency of the allocation process is also one concern. Government ought to disclose sufficient information about how allocations are calculated and the allocation to individual installations.

Expert committee, allocation working groups, workshops are good practices already taking place in some pilots. They should be encouraged and enhanced. Establishing expert groups either through industry associations, or leading company representatives themselves, is helpful to the industry to identify common issues, establish positions and increase mutual understandings. The government should
facilitate this kind of mechanisms as well because it is effective to communicate with industry.

3.4 MRV and Enforcement Strategies

3.4.1 Existing MRV and enforcement strategies

Credible information on emissions is the fundamental underlying basis for an emissions trading scheme. It is therefore important that emissions are accurately and consistently monitored (M), reported (R), and verified (V). It is a standardized method to produce an accurate CO₂ emissions inventory, through the quantification of CO₂ emissions. This, together with enforcement provisions including sanctions for non-compliance, ensures that the overall scheme is trustworthy. To build up a MRV system, the key questions are to answer when and how to these as well as who is in charge.

Figure 3.7 Overview of a MRV

Emissions can be measured by direct emissions monitoring, where real time emissions are measured by a device (such as a Continuous Emissions Monitor or CEM System). Alternatively, emissions levels can be calculated using emission factors of fuels or of chemical processes. In either case, emissions then need to be reported to the relevant authority on a regular basis. Monitored emission data then shall be reported to certain authorities, for example the government, annually. Before that, the annual emission report needs to be audited or verified either by government inspectors or third party experts, works including to check of monitoring plans, emission reports and to make recommendations for improvement to the monitoring plan (Lloyd’s Register, 2015). The figure 3.7 provides an overview of a MRV.
Take EU MRV as an example. Starting with the preparation and adaptation works, the monitoring plan has to be prepared and submitted for approval by an accredited verifier the year before monitoring begin. The actual annual monitoring then starts from 1st January. Since the next year after the monitoring, by 30th April every year, operators shall submit a verified emission report to the European Commission (EC). And by every 30th June, they need to carry a valid document of compliance relating to the relevant reporting period. After that, the EC would make every emissions report publicly available including information specific to that installation, its fuel consumption, CO2 emissions, technical efficiency and so on (European Commission, 2011a).

By creating incentives for compliance, the design of an ETS can help minimize the need for penalties. Enforcement provisions that identify consequences for the event that entities are non-compliant can help the system function. These may include monetary sanctions, criminal penalties, or tightened emission caps for the following monitoring period. The following table provides a summary of MVR and enforcement provision in different trading schemes.

Table 3.8 Global overview of MVR and enforcement provision

<table>
<thead>
<tr>
<th>Regions</th>
<th>MRV</th>
<th>Enforcement</th>
</tr>
</thead>
</table>
| Canada - Québec          | *Reporting frequency: 1 year. Report to be submitted by June 1 of each year.  
                          |   * Verification: GHG reporting for emitters participating in ETS (higher threshold than regulatory reporting requirement) must send a verification report carried out by an organization accredited to ISO 14065. | 3,000-500,000 CAD (approx. 2,300-384,000 EUR) and up to 18 month in jail in the case of a natural person, and 10,000-3,000,000 CAD (7,675-2,300,000 EUR) in the case of a legal person. Note: The Canadian dollar is currently being traded close to parity with the US dollar. |
| Cap-and-Trade System     |                                                                      |                                                              |
| USA - California         | * Reporting is required for most sectors above 10,000 mt CO2, at once a year.  
                          |   * Operators must implement internal audits, quality assurance and control systems for the reporting program and the data reported.  
                          |   * Emission data reports and their underlying data require independent verification. | * There are separate and substantial penalties for mis- or non-reporting under Mandatory GHG Reporting Regulation.  
                          |                                                                      | * Under the Cap-and-Trade Regulation, if an entity fails to surrender a sufficient number of compliance instruments to meet its compliance obligation, there is a |
| Cap-and-Trade Program    |                                                                      |                                                              |
third-party verification annually for all reporters that exceed 25,000 mt\textsubscript{CO\textsubscript{2}e}.

A separate violation of this article for each required compliance instrument that has not been surrendered, or otherwise obtained by the Executive Officer.

- A separate violation accrues every 45 days after the end of the Untimely Surrender Period for each required compliance instrument that has not been surrendered.
- Adjustment to Compliance Obligation: Outside of enforcement, there is also an automatic adjustment to the compliance obligation due equal to the number of compliance instruments short for that compliance surrender deadline multiplied by four. One fourth of that amount is retired and the remaining three quarters are auctioned by the state.

| USA - Regional Greenhouse Gas Initiative (RGGI) | • Emissions data for emitters is recorded in the U.S. Environmental Protection Agency's (US EPA) Clean Air Markets Division database in accordance with state CO\textsubscript{2} Budget Trading Program regulations and US EPA regulations. Provisions are based on the US EPA monitoring provisions.
  • Data is then transferred to the electronic platform of the RGGI CO\textsubscript{2} Allowance Tracking System, which is available for public view. |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Penalties for non-compliance are set by each state.</td>
<td></td>
</tr>
</tbody>
</table>

| Swiss ETS | • Monitoring plans are required for every installation (approved by a competent authority) no later than three months after the registration deadline.
  • Entities have to submit an annual monitoring report, based on self-reported information (by 31 March). The Federal Office for the Environment may order third party |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine of 125 CHF/tCO\textsubscript{2} (103.89 EUR/t CO\textsubscript{2}). In addition to the fine, entities must surrender missing allowances and/or international credits in the following year.</td>
<td></td>
</tr>
</tbody>
</table>
EU ETS

- Monitoring plan is required for every installation.
- Annual self-reporting based on harmonized electronic templates prepared by the European Commission.
- Verification by independent accredited verifiers required before 31 March each year.
- In addition, the Commission has developed specific monitoring and reporting guidelines for aircraft operators as well as a EU ETS verification guidelines for aviation.
- MRV will take place on the basis of ton-kilometers.
- A regulation for the monitoring, reporting and verification of emissions from shipping is expected to be adopted shortly by the Council and Parliament.

<table>
<thead>
<tr>
<th>Japan - Tokyo Cap-and-Trade Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Participants are required to submit annually (fiscal year) their emission reduction plans and emissions reports based on &quot;TMG Monitoring/Reporting Guidelines&quot; and &quot;TMG Verification Guidelines&quot;. These reports also require third-party verification.</td>
</tr>
<tr>
<td>• CO₂ emission factors are fixed during the five year compliance period.</td>
</tr>
<tr>
<td>• Six GHG gases have to be monitored and reported: CO₂, CH₄, N₂O, PFC, HFC and SF₆.</td>
</tr>
<tr>
<td>• Verified reduction amounts can be used for compliance, but cannot be traded to other facilities except energy related CO₂. Verification is required only when it is used for compliance.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Korea ETS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Annual reporting of emissions must</td>
</tr>
<tr>
<td>• Penalty shall not exceed three</td>
</tr>
</tbody>
</table>

| EUR 100/t CO₂ for each excess ton emitted. The name of the non-compliant entity is also published. |
| China  - Tianjin pilot system | Annual reporting of CO₂ emissions. Third-party verification is required. | In case of non-compliance, companies are disqualified for preferential financial support and policies for three years. |
| China  - Shenzhen pilot system | Annual reporting of CO₂ emissions with a tier approach taking into account the size of the company. Third-party verification is required. | Penalties for non-compliance range from CNY 50,000 (EUR 6,544) to CNY 150,000 (EUR 19,632). Furthermore, companies failing to surrender enough allowances to match their emissions are fined three times the average market price of the past six months. The missing allowances can be withdrawn from the account of the company or deducted from next year's allocation. |
| China - Shanghai pilot system | Annual reporting of CO₂ emissions. Third-party verification is required. The Shanghai DRC has released guidelines for monitoring and reporting for the following nine sectors: Iron and steel, electricity, building materials, nonferrous metals, textiles and paper, aviation, large buildings (hotels, commercial and financial) and transport stations. | Between CNY 10,000 (EUR 1,308) – CNY 50,000 (EUR 6,544) can be imposed for non-compliance. In case of serious violations, further sanctions may be imposed, e.g., entry into the credit record of the company, publication on the internet, cancelation of ability to access special funds for energy conservation and emissions reduction measures. |
| China - Hubei pilot system | Annual reporting of CO₂ emissions. Third-party verification is required. The Hubei DRC has released a | Penalties for non-compliance range from CNY 10,000 (EUR 1,309) to CNY 150,000 (EUR 19,632). |

be submitted within three months from the end of a given compliance year (by the end of March). Emissions must be verified by a third-party verifier.

* Emissions reports are then reviewed and certified by the Certification Committee of the Ministry of Environment within five months from the end of a given compliance year (by the end of May).
  * If the liable entity fails to report emissions correctly, the report will be disqualified.

times the average market price of allowances of the given compliance year or KRW 100,000/ton (EUR 70).

* In 2015 and 2016, there is a price ceiling of KRW 10,000 (EUR 7). Therefore, the maximum penalty in this time period would be KRW 30,000 (EUR 25).
|-------------------------------------------------------------|

### 3.4.2 Proposed MRV and enforcement strategies

**Monitoring.** We have discussed above that emissions can either be measured by direct emissions monitoring where real time emissions are measured by a device, or be calculated using emission factors of fuels or of chemical processes. During monitoring, it is necessary to know the types of emissions that shall be covered and the point of obligation where emission exists and demands monitoring. Therefore, several important questions have to be answered: what types of emissions are covered by the ETS (see GHG inventory)? Does liability occur before GHGs have been emitted (e.g. a coal mining company being liable for the emissions in the coal it produces before the coal is sold and burnt.)? Does liability occur at the point the GHGs are emitted (e.g. a coal fired power station is liable for its combustion of coal to generate electricity.)? Or does it lie with the owner of the outputs to which emissions are generally attributable (e.g. a manufacturer is liable for the emissions from the electricity they use which is sourced from the grid and includes a mixture of coal, gas and renewable sources.)? The answers determine the points for monitoring and thereby the way to monitor.
One characteristic in China needs to be considered here. Unlike many other regions, prices for things such as water and electricity in China are not governed by free market but rather regulated by central government which prevents generators from passing cost burden to consumers. This makes it difficult for China to apply double liability for emissions associated with electricity and heat generation exists alike other international ETS. The so-called double liability means, for instance, a power generator shall be liable for emissions from combusting fuel as direct emissions and the end user of the electricity will also be liable for the same emissions as indirect emissions. Such a double counting of emissions may then encourage emissions reduction from power generators and end users. To adapt to the situation in China, it is better to let companies who consume electricity or heat be liable at both the points emissions occur and indirect emissions from their energy use.

**Reporting.** This is a process that is closely associated with monitoring. The main content involve the types of GHG emission covered, the amount of emissions being monitored, the objects and the way for monitoring and so on. Table 3.9 illustrates a detailed example of reporting requirements. On October 15, 2013, the NDRC announced GHG accounting methodologies and Reporting Guidance for ten sectors: power generation, power distribution, cement, steel, chemicals, aluminum electrolyte, plate glass, magnesium smelting, ceramics and aviation (NDRC, 2013). The Australian government signed with the NDRC on April 10, 2013 to work on the development of the MRV Guidelines for three more sectors: coal, refining, oil and gas exploration. In January 2014, the NDRC issued a note on its website that all companies that emitted more than 13,000 t CO₂e in 2010 must report their future annual emissions of all six major GHGs.

**Table 3.9 Proposed inventory of reporting requirements**

<table>
<thead>
<tr>
<th>Company information</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Emissions boundaries</td>
<td>• Organizational boundaries</td>
</tr>
<tr>
<td></td>
<td>• Facility boundaries</td>
</tr>
<tr>
<td>Covered emissions total</td>
<td></td>
</tr>
<tr>
<td>Monitoring plan information</td>
<td>• Development of monitoring plan</td>
</tr>
<tr>
<td></td>
<td>• Changes in the monitoring plan</td>
</tr>
<tr>
<td></td>
<td>• The actual monitoring</td>
</tr>
<tr>
<td></td>
<td>• Monitoring methods selected</td>
</tr>
</tbody>
</table>

Depending on monitoring method selected, the following information is required about the monitoring process:

<table>
<thead>
<tr>
<th>Calculation method based on time</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Source of emission factors for each combustion emissions source</td>
</tr>
<tr>
<td></td>
<td>• Source of quantity measurements</td>
</tr>
<tr>
<td></td>
<td>• The division of process emissions by raw materials (finished or semi-finished products)</td>
</tr>
<tr>
<td></td>
<td>• Consumption type of direct emissions</td>
</tr>
<tr>
<td><strong>Material balance method</strong></td>
<td><strong>Value of emission factors and quantity measurement</strong></td>
</tr>
<tr>
<td>-----------------------------</td>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td><strong>Consumption of purchased electricity and thermal emissions from heat</strong></td>
</tr>
<tr>
<td><strong>Measurement method based on time</strong></td>
<td><strong>Input quantity</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Output quantity</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Source of information for quantity of fuel or material containing carbon</strong></td>
</tr>
<tr>
<td><strong>Uncertainty parameters and the methods used to reduce Uncertainty</strong></td>
<td><strong>Measuring emission value</strong></td>
</tr>
<tr>
<td><strong>Other circumstances should be described (such as CO₂ clearance)</strong></td>
<td><strong>Continuous measurement of time</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Related operating instructions</strong></td>
</tr>
</tbody>
</table>

**Verification.** This is an essential part emission reporting to ensure whether data is accurate and complete. This work is normally done third party after emission report is issued and before allowances are surrendered for the compliance year. In the national scheme, NDRC can issue a list of approved verifiers. To ensure verification transparency, companies could be required to change their verifiers after a set of number of years. In Shenzhen scheme, verifier is required to change for at least three years.

**Enforcement.** Financial penalties can be set for non compliance of reporting, verification and surrendering allowances. Basically, there are three kinds of way to state a penalty. One is to define a fix fine as penalty; the other is to bind it with market carbon price. For example, the fine in Shanghai scheme for not surrendering allowances is about CNY50,000-100,000. However, the Shenzhen scheme stated a penalty of three times the average market carbon price for the non compliance. The third kind is to deduct allowances for next year’s allocation. This enforcement measure has been applied in Guangdong and Hubei schemes that twice the missing allowances will be deducted from next year.

Chinese experience with trading other emissions is not very encouraging. For example, the country’s SO₂ emissions trading schemes are predominantly based on self-reporting. Emissions are not regularly monitored. The regulatory infrastructure is far from complete and not up to international standards. ETS in China faces considerable challenges in setting up robust monitoring, reporting and verification.
mechanisms. Besides, one significant reason why China’s 1989 EPL had not been effective is a matter of basic economics - it often cost a business more to abide by the law than to pay a fine for violating it. For example, a certain large electricity generator complex in China was reported to have faced spending between RMB 500,000 and 600,000 to control its pollution output. However, when its factory was shut down after failing to comply with the law, it had to pay only a one-time fine of RMB 10,000 (Robert L. Falk and Jasmine Wee, 2014).

Therefore, a strong enforcement mechanism in national ETS is suggested. 1-5 times of fine (or more) linking to average carbon price for non-compliance of MRV and exceeded emissions could be one part. Considering the possible depression of carbon market, the floor of penalty fines shall be set together. Moreover, deduction of missing allowance and disqualification for preferential financial support for next 1-3 year(s) can be another part of the enforcement mechanism.

3.6 Cost management

3.6.1 Offsets

Unlike other markets, ETS is usually complemented with an emissions offset scheme since this theoretically has been regarded as the least-cost approach to reducing GHG emissions. The World Resources Institute defines a carbon offset as "a unit of carbon dioxide-equivalent (CO₂e) that is reduced, avoided, or sequestered to compensate for emissions occurring elsewhere". While companies in compliance can purchase allowances in an ETS to cover emissions, carbon offsets could serve as another way to gain carbon credits which oftentimes may be cheaper or more convenient alternatives. Since unequal prices of carbon can cause economic collateral damage if production flows to regions or industries that have a lower price of carbon (carbon leakage), offsets have been viewed as an important policy tool to equalize carbon price and maintain stable economies, and have been widely applied that link with a trading scheme.

A well-known case is the Clean Development Mechanism (CDM). The Kyoto Protocol has sanctioned offsets as a way for governments and private companies to earn carbon credits that can be traded in the market place. The protocol established the CDM, which validates and measures projects to ensure they produce authentic benefits. China remained a dominant CDM carbon credit supplier quickly after its joining. Thus, carbon offset is not a new and unwell-known concept in China.

In a national scheme, emitters shall have the option of trading carbon offsets in the form of Chinese Certified Emission Reductions (CCERs) which are issued by the National Development and Reform Commission (NDRC), especially allow more developed eastern coast to import emission offset credits from other provinces. In
June 2012 the NDRC published “Tentative Measures for the Administration of Voluntary Greenhouse Gases Emissions Trading” to encourage voluntary trading via CCERs and to ensure that trading activities are conducted in an appropriate manner. The document also includes strict personnel and capital requirements to qualify CDM Designated Operational Entities (DOEs) for the assessment of CCER Generating projects. By April 2014, 178 CCER methodologies based on CDM methodologies published. About 200 projects have been approved by the NDRC (World Bank and Ecofys, 2014). Companies can use China Certified Emission Reduction (CCER) to settle allowances. In that process, one ton of CCER equals one ton of carbon emission allowance. CCER can be used up to 5% of the total allowance allocated. The following table summarized carbon offsets for both Chinese pilots and EU ETS which helped to gather inspiration to build up carbon offset for national scheme (see table 3.10).

<table>
<thead>
<tr>
<th>Carbon offsets</th>
<th>Chinese pilots</th>
<th>EU ETS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quantity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beijing</td>
<td>CCERs allowed up to 5% of annual allocation (50% from Beijing, incl. forest carbon sinks).</td>
<td>During 2008-2020, participants may use carbon offsets up to a maximum of 11% of its 2008-2012 allocation, or, for new participants: 4.5% of their emissions in 2013-2020</td>
</tr>
<tr>
<td>Chongqing</td>
<td>CCERs allowed if emissions&gt;allocation (up to 8% of compliance obligation).</td>
<td>CDM credits from Least Developed Countries (LDCs) allowed. Credits from other CDM and JI projects only eligible if registered before 2013.</td>
</tr>
<tr>
<td>Guangdong</td>
<td>CCERs allowed up to 10% of annual compliance obligation (of which &gt;70% from Guangdong).</td>
<td></td>
</tr>
<tr>
<td>Hubei</td>
<td>CCERs from Hubei allowed up to 10% of annual allocation.</td>
<td></td>
</tr>
<tr>
<td>Shanghai</td>
<td>CCERs allowed up to 5% of annual allocation.</td>
<td></td>
</tr>
<tr>
<td>Shenzhen</td>
<td>CCERs allowed up to 10% of annual compliance obligation.</td>
<td></td>
</tr>
<tr>
<td>Tianjin</td>
<td>CCERs allowed up to 10% of annual compliance obligation.</td>
<td></td>
</tr>
<tr>
<td><strong>Quality</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beijing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chongqing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guangdong</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hubei</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shanghai</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shenzhen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tianjin</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Beyond the historically strong relationship between suppliers of Chinese renewable energy offsets and European buyers, there is potential for CERs from China-based projects to fetch higher prices from domestic buyers. For most of Chinese companies, trading offsets – or allowances for that matter – is an unfamiliar arena. China would be a net exporter of offsets.
Domestic demand for offsets will inevitably vary between provinces. After factoring in the level of emission reduction targets and allowances provided through the system, the scope of supply and demand for offsets will depend on the existing supply of offsets eligible for use under each region, as well as limits set on the use of offsets against emitters’ compliance obligations.

With over 70% of the world’s CERs issued in China, a big question on the minds of Chinese CER suppliers is how much domestic demand they can actually expect to absorb existing and new offset supply. There is concern from policymakers about the situation in which supply exceeds demand. However, the difficult situation in restricting offsets may also occur since some companies who are the participants in ETS were, on the other, CDM offsets suppliers in the past. Moreover, the large existing offset supply can provide limits on the potential for new offset project development. In Shenzhen, the existing CER supply in this region already makes up more than 8% of the capped emissions (Daphne Yin, 2013).

### 3.6.2 Price stabilization mechanism

The Allocation Supply Reserve (ASR) and the Market Stability Reserve (MSR) are two approaches that have been considered to be able to provide a more stable carbon price signal. While the ASR primarily aims to facilitate dynamic allocation in order to prevent carbon leakage and provide incentives for carbon-efficient growth, the latter is focused to improve the supply–demand balance in the market (Bram Borkent et al, 2014). The core idea is to deposit surplus when fewer allowances are needed due to economic recession and to withdraw those allowances without compromising cap when there is higher production expectation (see figure 3.7). Consequently, this will contribute to a stronger and more stable carbon price signal when facing uncertain economic conditions and provide certainty about sufficient allowances. The difference between these two reserves is that ASR interacts with the free allocation, while the MSR works with the auctioning volumes.
3.6.3 Banking and borrowing

Banking is a common feature of emissions trading programs. It means that participants can carry forward unused allowances from one trading period to the next. Banking enables actors to hedge against future price uncertainty, and to implement a more rational time path of abatement investments resulting in lower overall compliance costs. It also affects the price of allowances allowing for long-term expectations to be reflected in the current price (Burtraw et al. 2013; Zetterberg et al. 2013). Allowances will lose their value at the end of each trading period if banking is not allowed. Thus, unused allowances would be offered at low cost. This can suppress the price, as happened at the end of the EU ETS’s first trading period. It can also serve as a private reserve of allowances that can be used for compliance when costs rise which may help to smooth price fluctuations over time.

Similar to banking, borrowing allows allowances from future periods to be used for compliance today. In EU ETS, participants are required in compliance cycle by April every year to surrender allowances to cover their emissions from the previous year. As new allowances are issued annually at the end of February this means that two years of allowances are available at the date of submission. This effectively allows for one-year-ahead borrowing (Lars Zetterberg et al. 2014).

Banking is suggested for national ETS in China. As we have discussed above, Chinese companies are not familiar with trading and they are facing with many uncertainties during the beginning phase. Allowing banking and borrowing would somehow fasten a belt their involvement and bring more confidence for enrolling in future carbon market in China.
3.7 The issue of carbon leakage

3.7.1 What is carbon leakage

The concept of carbon leakage, carbon emissions arising as a result of the relocation of production outside of regions applying carbon abatement policy measures, is now well established in the academic literature and is recognized by policy makers. Carbon leakage has the potential to reduce the effectiveness of climate policy at the global level, while at the same time damaging local economic prospects; it therefore presents an argument against stricter unilateral measures to reduce greenhouse gas emissions. In developing policy aimed at reducing greenhouse gas emissions, policy-makers also need to consider the impact on carbon leakage and consider remedial policy measures to mitigate this risk.

3.7.2 How to identify risk of leakage

Two main types of tests are used to check if the carbon leakage risk factors of a
particular sector are in a range that would indicate leakage risk: i) Quantitative tests use factors, or surrogates, that can be quantified and result in a number that can be tested against benchmarks. It contains two main categories, Carbon-related risk tests and Trade exposure-related risk tests; ii) Qualitative tests are used to cover criteria that are deemed representative, but for which figures, or surrogates, cannot easily be calculated, or for which there are no readily available data which seem to more flexible, but they are inherently subjective in nature tests are currently identified (Andrei Marcu et al. 2014). The figure 3.8 provides an overview of the quantitative risk tests currently used in various schemes.

3.7.3 Sectors at risk

Carbon leakage is sector specific, only some production processes are sufficiently carbon intensive to cause firms to relocate production processes, equally if a product is not easily tradable the production process is likely to remain close to the final market. In 2009, the EC undertook an impact assessment of a shift from the 20% GHG emissions reduction target to a 30% reduction. As part of this, the EC assessed whether sectors would be at risk of carbon leakage (Hector Pollitt et al. 2012; EC, 2009; EC, 2011b). The impact assessment suggested that sectors might be at risk of carbon leakage based on the following criteria:

i) The sum of direct and indirect additional carbon costs for an energy-intensive industry sector would lead to a cost increase of at least 5% of its GVA and the sector has a trade intensity (total value of exports and imports divided by the total value of its turnover and imports) exceeding 10%;
ii) The sum of direct and indirect additional costs induced by the implementation of the directive would lead to a cost increase of at least 30% of its GVA or,
iii) The sector has a trade intensity (the total value of its exports and imports divided by the total value of its turnover and imports) exceeding 30%.

The following shows the sectors with the highest carbon cost per unit of GDP (table 3.11), which may give a hint on which sectors may face strong risks of leakage.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Carbon cost per unit of GDP</th>
<th>Trade intensity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacture of fertilizers and nitrogen compounds</td>
<td>70.2</td>
<td>27.4</td>
</tr>
<tr>
<td>Manufacture of lime</td>
<td>65.2</td>
<td>2.6</td>
</tr>
<tr>
<td>Manufacture of cement</td>
<td>45.5</td>
<td>6.8</td>
</tr>
<tr>
<td>Manufacture of coke oven products</td>
<td>41.4</td>
<td>30.0</td>
</tr>
<tr>
<td>Aluminum production</td>
<td>14</td>
<td>35.9</td>
</tr>
<tr>
<td>Manufacture of other inorganic</td>
<td>11.9</td>
<td>31.7</td>
</tr>
<tr>
<td>basic chemicals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------</td>
<td>------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Manufacture of refined petroleum products</td>
<td>11.7</td>
<td>16.1</td>
</tr>
<tr>
<td>Manufacture of basic iron and steel and of ferroalloys</td>
<td>10.6</td>
<td>32.3</td>
</tr>
<tr>
<td>Manufacture of paper and paperboard</td>
<td>10.2</td>
<td>25.7</td>
</tr>
<tr>
<td>Manufacture of flat glass</td>
<td>8</td>
<td>21.0</td>
</tr>
</tbody>
</table>

Source: EC, 2009

Due to the lack of data, further study on examining sectors at risk of leakage in China has not be carried out here. Yet, the discussions concerning carbon leakage provides an interesting angle to address competitiveness issues for future carbon market.
4. Environmental governance in China and feasibility to establish national ETS

4.1 Chinese political system

4.1.1 Central governance

China’s leading political institutions include the Communist Party of China (CPC) and its military, the People’s Liberation Army (PLA); the State, led by the State Council, to which the Party delegates day-to-day administration of the country; and the National People’s Congress (NPC), China’s unicameral legislature. On paper, the NPC has broad powers whose most significant power is its ability to initiate and shape legislation. NPC deputies are expected to approve all budgets, agency reports, and personnel appointments put before them. In practice, the NPC is controlled by the Communist Party and it is able to exercise little of its constitutionally mandated oversight over the state and the judiciary. The NPC’s weakness is closely related to the way of electing its officials. Usually, the Party nominates 20% to 50% more candidates for available positions and all deputies are elected from those nominees (Jiang Jinsong, 2003).

The CPC has been in power in China for 65 years. The members of the Communist Party’s seven-man Politburo Standing Committee and 25-member Politburo have been regarded as China’s highest decision-making bodies. Party committees are embedded in the State Council, ministries, and government departments at every level. While powerful Communist Party bodies that exist in parallel to the State bodies set policies at all levels and make major decisions, the State system implements and executes policy (State Council Information Office, 2007).

According to the constitution, the Politburo Standing Committee and Politburo derive their power from the Central Committee, whose full (205 members) and alternate members (171 members) together “elect” the Politburo, Politburo Standing Committee, and Party General Secretary, and “decide” on the composition of the Party’s Central Military Commission (State Council, 2002). When it comes to the word “elect” in China, it is unlike the election mentioned in European political system. In China, it is the incumbent top officials who would provide a list of nominees, and the Central Committee then ratifies it. The latter, in practice, was made up of leaders from the provinces (41.5%), central ministries (22.6%), the military (17.5 %), central Party organizations (5.9%), and state-owned enterprises, educational institutions, “mass organizations” such as the Communist Youth League (12.4%) (Tony Saich,
The Central Committee, in turn, is elected by the approximately 2,000 delegates to Party National Congresses, which are held every five years. In the years between Party Congresses, there will be plenary session at least once a year that enables the Central Committee to meet, to set the direction for the country in a specific area, while also approve major personnel decisions (Carl Minzner, 2011). In October 2010, for example, the Fifth Plenum of the 17th Central Committee discussed and approved a draft of the 12th Five-Year Plan for China’s economy, covering the years 2011 to 2015. At annual sessions, NPC deputies almost always vote to approve the reports, laws, and candidates put before them, usually by overwhelming margins. NPC delegates do occasionally push back, however. At the March 2013 session of the NPC, 25% of deputies withheld their support from the Supreme People’s Court’s report to the Congress, and nearly 22% withheld their support from the Ministry of Finance’s budget report. In China, the Congress does not pass spending bills. Rather, it votes to approve the budget presented by the Minister of Finance. The power of individual NPC deputies to exercise oversight is largely restricted to the right to submit proposals advocating for reforms or demanding better implementation of laws or regulations, to which officials are required to respond in writing. In spite of the annual plenary session (10 days long), much of the NPC’s work is undertaken by its Standing Committee, which currently has 161 members and convenes every two months (Susan V. L. and Michael F. Martin, 2013).

4.1.2 Provincial governance

Provincial leaders are powerful players in the system. Six of them, all Party Secretaries, sit on the Party’s Politburo, making them among the 25 most powerful officials in the country. China’s governance structure is a hierarchy, implying that local governments should implement decisions made by the central government. Yet, how far local governments go in this respect depends on their motivations, capacities and constraints. Local political leaders’ performance is evaluated by higher levels of government. Economic growth of the region governed by these leaders is a key indicator, which means that boosting the local economy is a main route for being promoted to higher levels (Zhong Yang, 2003).

Top leaders at provincial level consist of the candidate pool for the top political office. When taking about the chance of being a top politician in China, there are two aspects which will need to be taken into consideration: the performance at his position and the connections with top politicians. The former is measured by provincial economic growth, while the latter centers on past joint work in the same branch of government. Ruixue Jia et al.(2013) found a positive correlation between promotion and growth that is robustly stronger for connected provincial leaders than for unconnected ones. This evidence indicates that performance and connections are complements in the Chinese political selection process.
Such characteristics of promotion in Chinese political system exerts a profound influence on provincial governors’ behaviors. Regional competition is very strong, and every province is eager to serve as an engine of growth. Decentralization of the fiscal relationship between the central government and local governments incentivizes localities to compete with one another. Local officials who preside over growth can expect promotions (Brandt & Rawski 2008), and thus few have an incentive to moderate growth or to undertake measures with higher upfront investment costs and longer-term returns, even if those returns are substantial. This has a tendency to create disincentives in for example, energy efficiency investments, as most energy efficiency measures are characterized by high up-front costs. While returns on investment are often substantial, they only can be realized in the long term (Xuan Xiaowei and Kelly Sims Gallagher, 2014).

4.1.3 Other players

Big Enterprises. Big Chinese state-owned enterprises (SOEs) play an essential role in the political system there. Unlike many western countries, many strategic fields such as oil, electric power, finance, and telecommunication are controlled by the government. SOEs in these fields have emerged as global powerhouses in recent years. Three Chinese SOEs are among the top 10 firms on the Fortune Global 500 list for 2012 (Global 500, 2012). The leaders of such firms, and indeed all Chinese SOEs, are assigned to their jobs by the Party’s Organization Department and thus may move back and forth between jobs in business and government, and have a formal place in the Chinese political system. In the 17th Central Committee, 22 SOE bosses were alternate members of the Party’s Central Committee, and 1 was a full member (Susan V. L. and Michael F. Martin, 2013). Besides, SOEs have bureaucratic rank in the system which also gave them power to influence policymaking (Cheng Li, 2012). This will be further discussed below. Leaders of the top private enterprises are also in the game since they own tremendous assets, economic might and technical knowledge of their industries and global markets.

Top research institute. China has over 400 think tanks, with 6 Chinese think tanks ranked among the top 100 globally according to University of Pennsylvania global rankings in 2013. China’s academic community also includes more than 1,100 degree-granting institutions. Many of them are public policy research institutes in China, and it will be interesting to find out that they center at Beijing and Shanghai (University of Pennsylvania, 2012). Those institutes make their influence felt in the policy process in part by accepting commissions from the Party or state to write reports on policy issues, and by self-generating reports that they submit to policymakers. Attached experts, on the one hand, often serve as formal and informal advisors to official bodies. On the other, they play an important role in informing the outside world about Chinese policy discourse through media or meetings. Moreover, 32 universities in China have quasi ministerial bureaucratic rank (Ministry of
Notably, these ranks are measured by the number of members of the current Communist Party Central Committee that can be counted among their alumni.

**Media.** Media in China is under control. Television is the most tightly controlled. China Central Television (CCTV), which operates multiple channels on multiple platforms, serves as a tool of the Communist Party, relaying Party-approved messages to China’s citizens. Big publications like *People’s Daily* also serve as the Communist Party media outlets. These publications put a provocative spin on Party-approved news, expose scandals, and report on policy debates, even though they may share the same owners as staid Party papers and are also subject to Party Propaganda Department censorship. When there is control, there are also anti-voices occur. The *Southern Metropolis News* and *Southern Weekend*, for example, are both known for their daring investigative journalism. Since 2007, authorities have further adapted traditional censorship, licensing, and propaganda controls for use in new technological arenas such as the internet, social-networking websites, and mobile text messaging (Carl Minzner, 2011). These controls are not absolute. One more impressive evolution in recent years is the emerging of the explosive Weibo, a micro-blog service alike Twitter. Empowered citizens to share news and views directly with each other, and thus put pressure on the traditional media to cover stories. Some micro-bloggers have millions of followers and the power to change the terms of public debate with a single post. Yet there are still intervene from authorities. In the wake of the scandal involving the former Party Secretary of Chongqing, they boasted of deleting 210,000 Weibo posts and making six arrests for online “rumor mongering” (Liu Yang, 2012).

### 4.2 Environmental policy creation and implementation

In general, the backbone of China’s environmental policy-making system consists of the Committee of Environment and Resources Protection under the NPC, together with the State Environmental Protection Administration and relevant ministries State Council. The Committee of Environment and Resources Protection in the NPC shoulders responsibilities of the design of environmental laws and regulations. The Ministry of Environmental Protection (MEP) who replaced the former State Environmental Protection Administration (SEPA), other related ministries such as the National Development and Reform Commission (NDRC), and local governments are responsible for daily environmental administration.

The government and environmental-related departments play an essential role in environmental decision-making in China. This is because, during the policy-making process, it is the governments and relevant environmental departments that primarily propose the regulatory document draft and then communicate with other ministries or departments so as to reach a consensus. The final version, as "formal document", then will be issued by the NPC or signed by the head of government. Environmental laws
and policies formulated by the central government are implemented by local governments through a series of specific measures and programmers. The formal document serves as an important channel in China through which policy information is transmitted downwards from the central to local governments (Lindsay, Scott William Charles, 2012).

Figure 4.1 Partial Structure of China’s administrative system

![Diagram of China’s administrative system]


Figure 4.1 is the key to understand the formulation and implementation of laws and policies in China. Governmental units above township level are interconnected both vertically (functional) and horizontally (geographical). Every unit within the administrative systems has to report both to an upper-level department of the same function as well as the government of a geographical area. The Guangdong Environmental Protection (EP) Bureau, for example, reports to its upper-level functional department, MEP, and supervises the work of EP Bureaus of counties and districts within the Guangdong province. Also, it is part of the People’s Government of Guangdong Province and, thus, falls under the jurisdiction of the provincial government. Such an arrangement gives rise to conflicts between policy and practice.
(S. Tsang and A. Kolk, 2010). The ministries and authorities lay in vertical lines coordinate according to function while those in horizontal lines are exercised by territorial governments. Yet, higher priority for area controls over functional controls makes territorial governments more powerful since the economic reforms after 1978. Nevertheless, it is a very complex structure and web of authorities and responsibilities overall, which leaves much room for political interference as conflict and divergent views seem built into it. Therefore, there are Chinese saying which may indicate the complexity of monitoring and implementing central policies at local levels. One of which is “There are policies from above and counter measures from below” (McBeath, 2007).

4.3 Bureaucratic influences

4.3.1 Bureaucratic competition

A related governance issue in China is unproductive competition among official entities. It is not uncommon in China for multiple entities to attempt to assert jurisdiction over the same issue, competing with each other for budget resources, power, and recognition from higher government officials. A government restructuring carried out in March 2013 attempted to address some of the most glaring cases of overlapping jurisdiction, combining multiple competing maritime law enforcement agencies under a single organization, the State Oceanic Administration for example. However, bureaucratic competition may still be a problem because while the State Oceanic Administration reports to the Ministry of Land and Resources, operational control of the Administration’s maritime law enforcement forces was assigned to the Ministry of Public Security (Xinhua News, 2013).

Although China is effectively a one party state, multiple coalitions, factions, and constituencies exist within the political system. Former Party General Secretary Jiang Zemin, for example, was known for promoting and relying upon a group of officials he had known from his days as Mayor and then Party Secretary of Shanghai, who also shared his interest in fast-paced economic growth and breaking down ideological barriers to the growth of the private sector (Susan V. L. and Michael F. Martin, 2013). There is also competition within the party and the state based on bureaucratic constituencies, too. The Ministry of Industry and Information Technology backs industry, for example, against the Ministry of Environment, which seeks to rein in industrial pollution.

4.3.2 Bureaucratic rank

Another phenomenon called bureaucratic rank also exists in Chinese political culture. Systems of ranks that identify the relative importance of people, official agencies,
public institutions, state-owned corporations, and geographic units have been observed. The administrative rank of each government unit reflects its power and status. The highest ranking units under the State Council are the comprehensive commissions, such as the National Development and Reform Commission. These units formulate policies that cut across economic sectors and geographic regions. A provincial government has the same administrative rank as a ministry. Following the ministry rank are, in descending order, the vice-ministry and bureau. A bureau is equivalent to the rank of a department within a provincial government. Among the rules that govern rank in China is that entities of equivalent rank cannot issue binding orders to each other (Qian Haoping, 2012). Often, they cannot even compel coordination, although Party entities and security agencies have more clout in that respect than other entities. An entity of lesser rank seeking to coordinate with an entity of higher rank faces a daunting challenge. Another unfavorable influence of rank is that, state-owned enterprises sometimes outrank the Party and state leaders in the geographic jurisdictions in which they are based, making it impossible for the local government to issue binding orders to them.

It can also impede effective regulatory oversight when regulators share the same bureaucratic rank as entities they are charged with regulating. One example is that the China Banking Regulatory Commission (CBRC) who is the banking regulator at province level shares the same rank with China’s five largest banks (ICBC, Agricultural Bank of China, Bank of China, China Construction Bank, and Bank of Communications) resulting in resistance from the banks’ provincial branches to the provincial CBRC’s oversight (21st Century Business Herald, 2006). State-owned enterprises (SOE) also have an administrative rank in China. An SOE supervised by a state industrial bureau will generally outrank one supervised by a provincial industrial bureau. The rank of an SOE reflects the political and social status of its managers and workers, and is also related to the salary and fringe benefits it offers. A higher rank of an SOE also means greater bargaining power with other governmental units. In 2000, a central government commission issued trial “basic norms” requiring large and medium-sized state-owned enterprises to give up administrative rank. Yet, only several provinces such as Guangzhou and Shanghai showed interest in applying it. Many others were unwilling to give up the array of privileges that accompany administrative rank. According to a 2012 article in China’s respected Southern Weekend newspaper, officials with the rank of full ministers are assigned a car costing up to $71,000, with a full-time driver; provided state funds for the purchase of residences and given access to exclusive health care, including single-person VIP hospital rooms and so on (Qian Haoping, 2012).

### 4.3.3 Corruption

Corruption is widespread in many regions around world, and China is one of them. Bribes explicitly provided in exchange for permits and jobs, privileged opportunities offered to officials or their extended families to acquire corporate shares, stock, and
real estate, and exemption of friends, relatives, and business associates from enforcement of laws and regulations. A 2011 report released by China’s central bank estimated that from the mid-1990s to 2008, corrupt officials who fled overseas took with them $120 billion in stolen funds. In a 2012 report, Global Financial Integrity, a Washington, DC-based research and advocacy organization, estimated that total illicit financial flows out of China in the decade from 2001 through 2010 amounted to $2.74 trillion (BBC, 2011; Global Financial Integrity, 2012). The State President Xi Jinping in 2012 identified corruption and graft within the Party as “pressing problems.” Xi Jinping began his first year in power with an anti-corruption campaign that netted several high-ranking officials, but corruption remains endemic (CNN, 2012). It has been regarded that the Party’s insistence on supervising its own conduct, rather than accepting supervision from outside, has been part of the reason that corruption has flourished. The Party’s corruption-fighting agency, the Central Discipline Inspection Commission, is frequently politically motivated when carrying out investigations (Carl Minzner, 2011, Steve Tsang, 2010).

4.3.4 Impacts on environmental governance

The bureaucratic rank, bureaucratic competition and phenomenon of corruption, all exert impressive impacts on environmental governance in China. On the one hand, they bring about authority overlap among ministries and departments which make relevant governance less efficient. On the other hand, as economic development were the prior pursuit for the government, stronger voice has been given to stakeholders who are more fond of this pursuit, therefore influence the processes of environmental law formulation and implementation. The phenomenon of corruption also makes China’s weak judicial system more vulnerable to political influence.

This can be well illustrated by China’s energy governance. The Ministry of Energy (MOE), founded in 1988, was the key authority for energy governance in China. It aimed to consolidate the functions of ministries such as the Ministry of Nuclear Energy and the Ministry of Water Resources. However, MOE was abolished in 1993. One reason was that it had overlapping authority with the State Development and Planning Committee (now the National Development and Reform Commission, the NDRC). The other reason was its failure to carry out its mandate since interests of key energy stakeholders were too strong for MOE to overcome, especially after state-owned energy companies took over the management and production functions from the previous industrial ministries in the restructuring at that time (Garrison, 2009).

Things have not become better after 2000. The Energy Bureau under the NDRC was supposed to act as the central player in energy policy-making in China since 2003. However, according to the administrative ranking system, the Energy Bureau was lower than the ministry or vice-ministry-level agencies which resulted in its lack of actual power as MOE to coordinate policies among various stakeholders. In order to
deal with this problem, the State Energy Office (SEO) which had the same rank as NRDC was established in 2005 (Tsang and A. Kolk, 2010). While the key energy agency has been leveled up in terms of administrative rank and thereby had a stronger voice to negotiate with other agencies such as NDRC who tends to fight for energy industry, the problem of authority overlap still existed. Both the SEO and NDRC had direct control on the Energy Bureau. When SEO and NDRC failed to reach a consensus, administrative functions and responsibilities for the Energy Bureau would be highly unclear. NDRC’s control on national oil companies also reduced the administrative power of SEO when planning for energy consumption and reserves (see figure 4.2).

![Figure 4.2 China’s energy governance between 2003-2008](source: Tsang and A. Kolk, 2010.)

Restructuring again has taken place. A more direct and clear structure has been formed in 2008 (see figure 4.3). The establishment of Ministry of Energy has been opposed, as NDRC do not want to be deprived of a large piece of its portfolio and control by a new ministry. As a compromise, the National Energy Commission (NEC) directly under the State Council was established to be in charge of drafting energy development strategies. The National Energy Administration under NRDC who is also directly controlled by NEC is responsible for handling daily work such as managing the energy industries, drafting energy plans and policies, and negotiating with international energy agencies. NDRC remains important in energy industry for having rights to approve major projects and control the pricing bureau (Downs, 2008; Garrison, 2009).
4.3.5 Bureaucratic capacity for carbon trading

Carbon trading, as a strong market-based instrument, was born in free-market economies. However, China’s economy is a mixed one of free market and command economy where private capital has huge scope to invest in those most profitable lines of manufacturing or service provision. Whether a carbon trading scheme can function well without a mature free-market economy, is the most fundamental question that China needs to ask itself.

After more than three decades of market economy-oriented reform, on one hand, China today is closer than ever to a real market economy. On the other hand, it still differs from a mature free-market economy in several substantial ways, including heavy government intervention, the significant share of the state-owned enterprises, as well as a non-liberalized price control system and distortions within the financial sector, not to mention widespread corruption and a culture of distrust in business. These all would have profound implications on the operation of a carbon market, even with good rules and design. From the interview with staffs in Shenzhen Emission Exchange (2015), it is believed that the success or failure of China’s efforts to build a carbon market may ultimately come down to enforcement.

The Communist Party’s control of all levels of government continues to undermine confidence in the rule of law and interfere with the development of an independent judiciary. Under the government of Xi Jinping, China has talked about the need for economic “rebalancing” (the shifting of power and wealth from state-owned enterprises and local governments to the household sector), but real changes in power relationships have been hard to detect. China’s weak judicial system remains vulnerable to political influence.
Regulatory reform has progressed gradually in China. However, bureaucratic hurdles still add to the cost of completing licensing requirements. The government provides large fossil fuel and electricity subsidies and also funds significant agricultural subsidies. Export taxes, subsidies to state-owned enterprises, and other measures restrict trade. The government still tightly controls the financial system. State-owned enterprises benefit from greater access to capital and lower financing costs, but small and medium-sized companies continue to suffer from the lack of access to credit.

In addition, key commodity prices in China, including electricity prices, are actively regulated by a central authority. Since the prices of emission permits are supposed to be reflected in commodity prices, will permit prices under the Chinese ETS actually follow market fluctuations? They are more likely to reflect political judgments, which are a source of price distortion. Therefore, reform to mitigate administrative control on those key commodity prices is needed.

4.4 Legal foundation

4.4.1 Environmental policies

The real reform and opening-up for the establishment of China’s environmental legal framework started from the formulation of the first Environmental Protection law in late 1979 and formal promulgation in 1989. In 1988, the Commission to National Environmental Protection Bureau (NEPB) gained independent status from the Ministry of Urban-Rural Construction and Environmental Protection and reported directly to the State Council (Zhang Zhongxiang, 2011).

Three basic policies for environmental protection have been established during this decade: "Integration of pollution treatment and prevention with emphasis on prevention ", "polluters’ responsibility in pollution treatment", and "strengthening environmental management". To strengthen environmental protection, the central government promulgated the "Decision on Environmental Protection Work" in 1984, which stipulated funding sources for environmental protection (NBS, 2009).

In 1992, China’s participation in the United Nation Conference on Environment and Development in Rio de Janeiro triggered a number of changes domestically. First, China formulated “Ten Measures for Environment and Development” and took the lead to issue China’s Agenda 21. Officials began to incorporate sustainable development into their planning process. Strengthening of environmental protection was listed as one of the top ten priorities for national development. In 1998, in order to strengthen and expand the jurisdiction of NEPB, it was promoted from sub-ministry level department to ministry-level agency and renamed as State Environmental Protection Administration (SEPA). However, it was found to be handicapped in many situations due to its limited authority as the duties of
environmental protection were spread among various ministries and departments, with overlapping responsibilities that were not clearly defined. To overcome this situation, SEPA was upgraded to the Ministry of Environmental Protection (MEP) in 2008 who can directly participate in the decision-making and law-making process of the state.

In order to promote sustainable development, the State council decided to further strengthen the environmental protection targets for 2010 and 2020: to stop the trend of ecological deterioration in key regions by 2010; to improve environmental quality and the state of the ecology significantly by 2020. In 2005, “Notification on the Immediate Priorities for Building a Conservation-oriented Society and Several Opinions on Accelerating the Development of Circular Economy”, the “Decision to Publish and Implement the Interim Provisions on Promoting Industrial Restructuring”, and the “Decision to Strengthen Environmental Protection by Applying the Scientific Approach of Development” was issued subsequently which implied serious political will from the central government to protect the environment.

If previous environmental protection targets seem to be very broad and unclear, the government for the first time set quantitative targets for resources and environment in its 11th Five-Year Plan (2006-2010), such as the reduction of energy consumption per unit of GDP by 20% relative to 2005 (Yong and Gang, 2008). “Measures on Open Environmental Information (for Trial Implementation)” came to be effective in 2008 which enable the public to access environmental information and also regulate relevant disclosure by both governments and enterprises (PRC, 2007a). This was one big step towards information transparency and public involvement. Yet there is still long way to go for real achievements.

4.4.2 Climate policies

In 1988, under the direct leadership of the Environmental Protection Committee of the State Council, a National Coordination Group on Climate Change (NCCCC) was set up, with its office in the China Meteorological Bureau. The Group was to facilitate the formulation of China’s position for the upcoming international climate negotiations.

Between 2000 and 2007, coal consumption doubled in China (Turner, 2010). During the eight years of this period, climate change emerged gradually in national polices, no longer merely as part of an international negotiation process. In 2001 China embarked on the period of the 10th Five-Year Plan (2001–2005), the first Five-Year Plan where climate change was mentioned. It was also mentioned in two of the specialized Five-Year Plans for the period. While the Environmental Five-Year Plan confirmed the country’s international dedication, the Meteorological five-year plan specified that the country’s meteorological staff should continue to support climate-change decision-makers, and also strengthen their own knowledge (NDRC 2001a). In a similar vein, the National Medium- and Long-Term Plan for Science & Technology Development (2006–2020) declared international cooperation and
domestic research on various aspects of climate change in China as a priority (State Council, 2006).

Yet another development came with the integration of the Clean Development Mechanism (CDM) under the Kyoto Protocol into Chinese jurisdiction, which allowed GHG-mitigating actions to be implemented within China. The authority overseeing CDM projects in China were instituted in 2004 and the State Council adopted rules for CDM administration the following year. In 2005 the Renewable Energy Law was adopted, promoting the expansion of renewable energy such as solar, hydro and wind power, with admiring the advantages of reducing local environmental pollution and availability of the energy source rather than cutting emission.

Interest in the issue of global warming increased gradually within the Chinese bureaucracy and decision-making bodies from 1988 onwards, but it was not until 2007 that the National Climate Change Program made climate change a national policy issue. In 2007, the same year as China became the largest GHG-emitting country and the IPCC released its 4th assessment report, climate change became a domestic policy issue in its own right. The National Leading Group on Climate Change (NLGCC), headed by premier, was established by the State Council in the same year and replaced NCCCC. The restructuring of the NLGCC, directly under the State Council, China’s highest political organ, was a premonition of the growing importance climate change would come to have (PRC, 2007b). Also in 2007, the National Climate Change Program, a 60-page document, was issued by NDRC, covering five aspects: GHG mitigation; adaptation; climate change science and technology; public awareness on climate change; and institutions and mechanisms (NDRC, 2007). It is worth nothing that NLGCC is a decision-making and coordinating group. The actual energy conservation is implemented by the NDRC while that of emissions reduction is left to MEP. The Mid- and Long-Term Plan for Renewable Energy issued in 2007, put forward a goal of increasing the share of non-fossil fuels in the primary energy consumption to 15 % by 2020 (NDRC, 2007b). The Law on Energy Saving was revised the same year and made energy conservation a national policy (Jiang et al. 2009).

There also have seen a dramatic rise in the activity level of lower-level governments in low-carbon projects. In 2007 most of the province governments established climate-change task forces and developed province-level policies on climate change (Qi et al. 2008). Moreover, climate-related activities conducted in China with foreign participation have increased significantly since 2007. In 2010, the Climate Group surveyed cities that had started low-carbon activities. At least 18 cities had embarked on low-carbon projects, many in cooperation with both foreign NGOs and Chinese universities and scientific institutions (Climate Group, 2010). The Chinese central government also has amassed a portfolio of bilateral collaboration on climate-change work, including the EU–China Partnership on Climate Change, a climate-change partnership with the Australian government and the US–China
The year 2009 saw further expansion of climate-change policies in China. Prior to the 15\textsuperscript{th} UNFCCC COP in Copenhagen (COP15), China’s State Council adopted the country’s first carbon-specific goal: to lower its carbon intensity by 40–45\% by 2020 compared to 2005 levels. The term ‘low-carbon’ began to appear in official statements, reports and policy texts. In 2008 China’s first carbon exchange was set up in Tianjin, with more exchanges established in the following years. Then in 2010 the government announced five provinces and eight cities for low-carbon pilot projects. Shenzhen, both a low-carbon pilot city and a pilot for carbon trading, set up a carbon exchange in 2010 with British funds (Caixin Weekly, 2011).

The most recent elaboration of China’s climate-change policies came with the 12\textsuperscript{th} 5-year plan (2011–2015), published in 2011. Among main aims of the 12\textsuperscript{th} 5-year plan is to reduce carbon intensity by 17\% by 2015, as against 2010 levels. The plan further stipulated that a trial carbon market would be implemented during the plan period; resource taxes would be improved and standards established for energy conservation (Iselin and Stensdal, 2012).

Still, it seems that GHG mitigation issues have not been very high on the political agenda in China as problems related to reducing common air pollutants such as SO\textsubscript{2}, NO\textsubscript{x} and PM\textsubscript{10} were seen as more imminent (Cai et al., 2008). Till the 11\textsuperscript{th} Five-Year Plan, the word for climate change has been put on the table in domestic part in 2006. The reason for the late emerge is well illustrated in the speech to the UN by the former President Hu Jintao in 2009: "Climate change is an environment issue, but also, and more importantly, a development issue … Without common development, particularly the development of developing countries, there cannot be a broad and solid basis in the long run for tackling climate change" (China embassy, 2009). Economic consequences of emission reduction commitments have been crucial considerations in China’s climate policy-making. The late action also owed a large debt to other consideration (Song Ligang and Wing T. W. 2008). For instance, minister of NDRC thinks that the country has low per-capita emissions and moreover the CO\textsubscript{2} emissions included in Chinese production for export should be taken into account, as they partly result from relocation of manufacturing to China. For example, in 2007, China’s emission created by manufacturing goods exported to the US was 1.4 billion tons of CO\textsubscript{2}. Yet, only 39 million tons emissions were embodied in manufacturing goods exported to China from the US (Crooks and Romei, 2009). Similarly, Yan and Yang (2009) estimated the amount of CO\textsubscript{2} embodied in China’s foreign trade during 1997-2007, and found that 10.03\%-26.54\% of China's CO\textsubscript{2} emissions was produced for export purposes, while CO\textsubscript{2} emissions in China's imports accounted for only 4.4\% in 1997 and 9.05\% in 2007.

In spite of these concerns, the progresses China has made since 2007 for formulation climate change policies are not ignorable. Attitudes from government and researchers
towards climate change issues have shifted to a more positive side. These changes provided sturdy signal for the low-carbon development of this country and paved the way the further growth of carbon markets there.

Table 4.1 Changes in Chinese climate-change policies 1988–2011

<table>
<thead>
<tr>
<th>Former belief</th>
<th>Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate change is a foreign policy issue</td>
<td>Climate change is primarily a domestic issue</td>
</tr>
<tr>
<td>Climate change is a scientific issue</td>
<td>Climate change is a development issue</td>
</tr>
<tr>
<td>Economic development outranks other policy goals</td>
<td>Climate change is taken into consideration when the future direction of China’s economic development is decided</td>
</tr>
<tr>
<td>Climate change is a matter to be dealt with by developed countries</td>
<td>Great expansion of domestic policies: mitigation/energy restructuring, adaptation &amp; capacity building, awareness efforts</td>
</tr>
<tr>
<td>Natural science research on possible consequences for China, strengthen climate-change observations</td>
<td>Expanded areas of research: in disciplines (natural sciences and other fields, such as economics) - and in research topics (future scenarios, adaptation issues, mitigation models etc.)</td>
</tr>
</tbody>
</table>


4.4.3 Energy policies

In the early 1980s, China experienced acute energy shortages. Since then the growing energy use is accompanied by energy shortages as well. Therefore, the fundamental aim of China’s energy policies is to guarantee the growing domestic demand and promote energy-use change of this country, mainly through energy laws, specific conservation plans, implementation of new technologies, research and development, and policies that favor energy efficiency standards and labeling.


To address energy shortage matters, the Government has adopted the principle of “equal treatment to development and conservation with immediate emphasis on the latter”, making conservation of strategic importance to energy policy since 1980s. The Energy Conservation Law helped to regulate energy conservation activities, promote energy-saving efforts in society more broadly, increase energy efficiency and protect the environment (State Council, 2005). It also led to the formulation and implementation of over 164 state energy savings standards which do contributed to the reduction of carbon emission. From 1980 to 2002, China was successful in reducing energy use per unit of GDP at an annual rate of 5% (National Bureau of
Yet, energy intensity started to increase by 3.8% per year on average in the period 2002-2005, resulted from the unbridled development of energy intensive industries. Since then, the government intensified efforts to promote the use of a mix of regulatory and policy tools to restructure energy intensive industries. In 2005, NPC adopted the Renewable Energy Law, which set out duties of the government, business and other users in renewable energy development and utilization. It also included a series of measures and goals, relating to mandatory grid connection, price management regulation, differentiated pricing and special funds (S. Tsang and A. Kolk, 2010). In 2006, the State Council issued the “Decision to Strengthen Energy Conservation”. In the same year, NDRC set two quantitative development goals in the 11th Five-Year Plan (2006-2010): to double per capita GDP of the country by 2010 (compared to 2000) and decrease the energy consumed per unit of GDP by 20%, targeting an annual savings rate of 4%.

In line with this target, the government raised electricity prices for eight energy-intensive industries. Tax rebates were abolished since 2007 for 553 so-called “high energy-consumption, highly polluting, resource based” products. Different tariffs (from 5-10%) were imposed on 142 export goods classified as energy intensive and heavy polluting such as steel and iron products. Moreover, quotas have been allocated to all provinces and major State-owned Enterprises (SOEs) to achieve the 20% reduction target. Provincial governments then distributed these quotas among their prefectural governments and provincial SOEs. Quotas are also passed on to county-level governments. For example, the Shandong provincial government signed accountability contracts with 17 city governments and 103 energy-intensive enterprises in the province. Failure to reach the emission-reduction target means that city governments and enterprises would be vetoed from any awards and that SOEs leaders would not be entitled to any annual rewards (NDRC, 2007).

4.4.4 Legal foundation for carbon trading in China

The concept of carbon trading was introduced in China in 2004, together with the adaptation of CDM. However, until the 12th FYP released in 2010, carbon emissions control in China had not been integrated into explicit environmental or resource use targets. As the first official government document that explicitly identifies carbon trading markets as one of the major measures for achieving the energy and carbon intensity reduction targets, the 12th FYP for the first time gave a dedicated chapter for the issue of climate change (Yuan and Zuo, 2011).

In late November 2011, the State Council Information Office released a White Paper on China’s Climate Change Policies and Actions. In the White Paper, the government outlined in more detail its plans for “gradually establishing” a carbon market:
“China will, drawing on the experience of the international carbon emissions trading market while taking into consideration its actual conditions, gradually promote the establishment of a carbon emissions trading market. The country will further reform the price formation mechanism of carbon emissions trading by standardizing voluntary trading in emission reduction and discharge rights, gradually establish trans-provincial and trans-regional emissions trading systems, so as to give full play to the fundamental role of the market mechanism in optimizing the allocation of resources, and realize the objective of controlling greenhouse gas emission at minimum cost.” (State Council, 2011).

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>·China endorsed the implementation of CDM in China. The NDRC issued a white paper with CDM guidelines.</td>
</tr>
</tbody>
</table>
| 2005 | ·Carbon trading under the CDM begins in China, administered at the national level by the NDRC.  
·China started to implement the 11th FYP, in which a 20% energy intensity reduction was set as compulsory target. |
| 2007 | ·The NDRC issued China’s first National Climate Change Program, laying out policies and actions to cope with climate change. |
| 2008 | ·Establishment of environment and carbon exchanges, including the Tianjin Climate Exchange, China Beijing Environment Exchange, and Shanghai Environment and Energy Exchanges. |
| 2009 | ·In the lead-up to COP15, China committed to a 40-45% carbon intensity reduction by 2020 compared to 2005 levels. |
| 2010 | ·The NDRC initiated low-carbon development pilots in five provinces and eight cities.  
·Carbon trading was mentioned in the “Decision for Enhancing the Cultivation and Development of Novel Strategic Industries” by the State Council.  
·The Shenzhen Emission Exchange was established.  
·The outline of the 12th FYP was made public, listing carbon markets as one of the key measures for reducing carbon and energy intensities and coping with climate change. |
| 2011 | ·The department of Climate Change under NDRC announced that pilot carbon trading markets will begin in selected cities and provinces, with the hope that actual trading will start as early as 2013.  
·The State Council issues the “Workplan for Controlling Greenhouse Gas Emission during the 12th FYP”. The need to establish carbon trading schemes was highlighted.  
·The NDRC officially approved carbon trading pilots in seven provinces and cities.  
·The State Council issued its second White Paper on climate change policy and actions prior to COP17 in Durban. |
| 2012/2013 | ·Pilot ETS started in Beijing, Shanghai, Tianjin, Shenzhen, Guangdong |
| 2014 | ·Pilot ETS started Chongqing and Hubei. |
4.5 Infrastructure capacity

4.5.1 Institutional framework

Under the State Council, there are a number of major institutions implementing China's environmental, energy and climate laws and policies: the National Development and Reform Commission (NDRC), the National Energy Commission (NEC), the Ministry of Environmental Protection (MEP), the State Electricity Regulatory Commission (SERC), the National Leading Group on Climate Change (NLGCC) and the State Council Energy Conservation and Emissions Reduction Leading Group (see figure 4.4).

MEP was formed in 2008 to replace the former State Environmental Protection Administration (SEPA), and it aims to prevent and control environmental pollution, protect nature and ecology, supervise nuclear safety, safeguard public health and environmental safety, and promote harmony between humans and nature.

NDRC is a macroeconomic management agency under the State Council. It studies and formulates policies for economic and social development, maintains a balance of economic aggregates and guides the overall economic system restructuring. NDRC is to “promote the strategy of sustainable development; to undertake comprehensive coordination of energy saving and emission reduction; to organize the formulation and coordinate the implementation of plans and policy measures for recycling economy, national energy and resource conservation and comprehensive utilization; to coordinate the solution of major issues concerning ecological building, energy and resource conservation and comprehensive utilization; to coordinate relevant work concerning environment-friendly industries and clean production promotion” (NDRC, 2009).

Although both MEP and NDRC belong to the State Council and are supposed to have equivalent administrative rank, they share unequal power. In sharp contrast with the expectations placed on MEP as the lead government agency in charge of assuring the health of the nation’s environment, MEP’s capacity to improve environmental conditions is limited, due to insufficient staff and resources and communication among environmental agencies. In essence, its administrative capacity is exceedingly weak. The fact that MEP lacks full cabinet status in the government makes it difficult to participate in critical environmental decision-making involving policy planning, coordination with other ministries and agencies, the setting of national environmental priorities, and in resolving environmental disputes (Zhang Zhongxiang, 2011). MEP has been mandated to develop and implement environmental policies, but it has not been given adequate policy tools, capacity or political strength to fulfill this
expectation. MEP cannot succeed in protecting the nation’s environment without the collaboration of other government bodies, as many environmental responsibilities are shared across agencies and levels of government. Instead of cooperating to promote good environmental outcomes, different governmental bodies tend to compete with each other for limited resources and influence (Mah and Hills, 2008). Thus, MEP often finds itself in conflict with the priorities of other institutions, but lacks adequate capacity to address this problem. The good news is, environmental protection has moved somewhat higher on the political agenda.

Figure 4.4 Key government structures for Environment, Energy and Climate Change

Source: Mah and Hills, 2008.
There are other limits on environmental governance capacity in a multi-level system. Environmental administration at the local level is susceptible to interference by local leaders due to the relationships between the vertical and horizontal lines which have been discussed in chapter 4.2. Lower level Environmental Protection Bureaus (EPBs) formally report to higher level EPBs (and ultimately to MEP), but the funding and supervisory functions are provided by the provincial or lower level administration.

The lack of sufficient financial resources for environmental administrations at the local level (and occasionally at the national level) to perform their required tasks is creating unfavorable incentives with harmful environmental impacts. Many EPBs have become dependent on the pollution levies they collect, which yield substantial revenues and are used to cover their operating costs. This means indirectly, that EPBs have an incentive to allow industries to pollute so that they can collect pollution fees. In China, the pollution levy system has served as the government’s primary policy tool but with limited effectiveness. Thus, incentive structures to promote sustainable development at the local level should be strengthened. Also, the central government should have a means in place to step in cases where local performance is inadequate or efforts to incorporate environmental considerations in local outcomes are non-existent (Tsang and A. Kolk, 2010; Garrison, 2009).

4.5.2 Infrastructure requirement for carbon trading

Carbon trading as a potential lucrative financial business opportunity has been one of the primary drives for the rapid establishment of many “climate exchanges”, “carbon exchanges” or “environment exchanges” in recent years in China. These include the Tianjin Climate Exchange (TCX), China Beijing Environment Exchange (CSEEX), and Shanghai Environment and Energy Exchanges (SEEX) established in 2008, the Shenzhen Environment Exchange in 2010 and so on (see table 4.3) In spite of these major exchanges, there are over 100 exchanges rather launched or under development, all aiming to trade carbon in the future market in China (SEI, 2012). Strong government support serves as a catalyst for the rapid development of the fundamental carbon trading infrastructure. All those exchanges are registered as corporate environmental equity trading platforms. One aspect shall be mentioned here is that, these exchanges have a strong government backing, either directly or indirectly. For example, the TCX, the first climate exchange in China, was set up as a joint adventure between the Chicago Climate Exchange, the municipal government of Tianjin and the asset management unit of PetroChina, the country’s largest oil and gas producer.

<table>
<thead>
<tr>
<th>Region</th>
<th>Trading infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shenzhen</td>
<td>China Shenzhen Emissions Exchange</td>
</tr>
<tr>
<td>Shanghai</td>
<td>Shanghai Environment and Energy Exchange</td>
</tr>
<tr>
<td>City</td>
<td>Exchange Name</td>
</tr>
<tr>
<td>--------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>Beijing</td>
<td>Beijing Environment Exchange</td>
</tr>
<tr>
<td>Guangdong</td>
<td>China Emission Exchange</td>
</tr>
<tr>
<td>Tianjin</td>
<td>Tianjin Climate Exchange</td>
</tr>
<tr>
<td>Hubei</td>
<td>Wuhan Optics Valley United Property Rights Exchange</td>
</tr>
<tr>
<td>Chongqing</td>
<td>Chongqing United Assets and Equity Exchange</td>
</tr>
</tbody>
</table>

Data source: FY, 2014.

In practice, as China moves towards implementing a mandatory cap-and-trade scheme, the Voluntary Emission Reductions (VERs) could be used by companies as a way to gain deeper understanding on emission trading. It has been reported that the Shanghai Environment and Energy Exchange has completed China’s first “Standard for Voluntary Carbon Emission Reduction”, approved by the NDRC in 2011. This is China’s own “carbon standard”, which standardizes carbon emission measurement, verification, sectoral benchmarks, etc. Despite all the efforts and promotion by the exchanges, so far these exchanges are not currently providing significant carbon trading services as their European counterparts do (Guoyi Han et al. 2012).

Despite the efforts of exchanges and other stakeholders, China lacks the capacity to implement carbon trading on a large scale. The research-and-development function of exchanges could support the necessary capacity-building that is now at a early stage. Without an established carbon trading business model at this time, exchanges have been searching for international funding and partnership opportunities with major international exchanges, and running international collaborative programs as well. For example, the TCX is working with the Asian Development Bank (ADB) to form its carbon trading platform (Liu, 2011).

The Chinese government said in October 2010 that it was building an updated national greenhouse emission database, the first publicly available database to include provincial level data since 1994. However, while this is a positive step, and China’s general stance toward measurement, reporting and verification (MRV) has also become more positive, there is still a need for legal frameworks to support MRV. On October 15, 2013, the NDRC announced GHG accounting methodologies and Reporting Guidance for ten sectors: power generation, power distribution, cement, steel, chemicals, aluminum electrolyte, plate glass, magnesium smelting, ceramics and aviation (NDRC, 2013).
5. Conclusions

It can hardly be denied that China has made impressive economic achievements during the past three decades. However, in line with the fast economic growth, China is also confronted with energy-related environmental problems: higher growth rate of energy consumption than production, increasing dependence on imports of oil, coal and ore, extreme weather events that affect energy supply, negative impacts on reducing energy intensity from economic structural changes, unpleasant PM$_{2.5}$ and acid rain from coal combustion, sharp increasing of CO$_2$ emission and so on.

Realizing these problems, Chinese government developed an ambitious set of policies, implemented through top-down command and control measures. However, the failure to regulate emissions and achieving relevant targets via conventional CAC approaches during the national 10$^{th}$ and 11$^{th}$ FYP forced the government to adapt to new approaches. This made emission trading being highlighted in China’s political agenda and provoked the need to “gradually develop a carbon trading market”.

Recommendations have been given for the design of China’s national ETS concerning the following components:

i) Emission cap. National cap is supposed to be set by central government. The centralized cap then can be distributed to each province according to their emission and production profiles. Targeting the absolute emissions rather than a output-based cap is suggested. Before peaking, it is supposed to have a growing cap with a decreasing annual growth rate. Instead of following the path of a 4% annual growth rate (GDP grows by 7%), the growth of emissions is supposed to slow down by years at a rate between 3% and 1%. Thereby, the emissions at 2020 would be 11.8 Gt rather than exceed 13 Gt. Proposed trajectory can be seen in figure 3.3.

ii) Scope and addressees. The coverage of gases only include CO$_2$ at the beginning phase, and gradually include N$_2$O for production of nitric, glyoxal and glyoxic acids and PFC for Aluminum production. Emissions from direct sources and indirect sources shall be covered, these include, a) Emissions from stationary combustion; b) Emissions from mobile combustion (transport fuel); c) Process emissions (including biological, physical or chemical processes that produce greenhouse gas emissions); d) Fugitive emissions (intentional or unintentional discharges, including equipment junction leakage, refrigerant leakage, anaerobic wastewater treatment). Sectors involving power generation, mining and processing of ferrous and non-ferrous metals, cement production, chemicals, and aviation are supposed to be covered by China’s national ETS. More sectors can be involved when the ETS developed. Besides, entities that exceed certain emission level, shall also be covered by the scheme since they
can be considered large emitters as well. The certain level could be 20,000 t CO$_{2}$e per year or even higher.

### iii) Allocation mechanisms

Allocation plans are suggested to be formed by provincial governments which later need to be approved by the NRDC at central level. As China’s national ETS will have an increasing cap, the amount of permits will also increase during certain time frame. Yet, the proportion of free allocation, either by grandfathering or benchmark, can be reduced gradually after the beginning phase. 100% of free allowances are suggested for the first 3 years after which can decrease with an annual rate of 3-5%, in line with an increasing share for auction. Going forward, benchmarking should be applied in more sectors. Table 3.5 suggests the way of calculating allocated allowance for participants in different sectors.

### iv) MRV

Annual reporting of CO$_{2}$ emissions is needed. Third-party verification is required. Proposed reporting requirements have been listed in table 3.9. The NDRC announced GHG accounting methodologies and Reporting Guidance for ten sectors: power generation, power distribution, cement, steel, chemicals, aluminum electrolyte, plate glass, magnesium smelting, ceramics and aviation. Companies that emitted more than 13,000 t CO$_{2}$e per year must report their future annual emissions of all six major GHGs. To ensure verification transparency, companies could be required to change their verifiers after a set of number of years.

### v) Enforcement measures

A strong enforcement mechanism in national ETS is suggested. 1-5 times of fine (or more) linking to average carbon price for non-compliance of MRV and exceeded emissions could be one part of the enforcement mechanism. The deduction of missing allowance and disqualification for preferential financial support for next 1-3 year(s) can be another part.

### vi) Supplementary approaches for market stabilization

Companies are allowed to use China Certified Emission Reduction (CCER) to settle allowances. The CCER is issued by NDRC. CCER can be used up to 5-10% of the total allowance allocated. Banking is allowed within trading period, borrowing is not. The Allocation Supply Reserve (ASR) and the Market Stability Reserve (MSR) can be developed to regulate permit and carbon price.

Looking into the future carbon market in China, maybe the most critical issues is the uncertainty about whether a carbon trading scheme can perform well without a mature free-market economy. Around the world, for all the existing carbon trading schemes (excluding offsetting mechanisms such as CDM), the mature free market economy has been the given condition.

China’s economy is neither a free market nor a command economy. As a mixture, China still differs from a mature free-market economy in western regions in several substantial ways, involving the heavy government intervention, the significant share and privileges of the SOEs, control for media, the price control system and distortions
within the financial sector, and a culture of distrust in business.

Decentralization of the fiscal relationship between the central government and local governments incentivizes localities to compete with one another. To the local officials, strong economic growth remains top priority. Conceivably, there is very strong resistance from the ground when it comes to develop governance systems and market infrastructure for regional and trans-regional ETS.

Bureaucratic competition and bureaucratic ranking bring about authority overlap among ministries and departments which led to inefficient environmental governance in China. The low efficiency exists in the administrative system for environmental creation and implementation, as governmental units above township level are interconnected both vertically (functional) and horizontally (geographical). The widespread corruption in China, on the other hand, makes the weak judicial system more vulnerable to political influence.

The developments of energy and climate polices in recent years serve as legal foundation for the further expansion of carbon market in China. Yet still, it seems that GHG mitigation issues have not been very high on the political agenda in China as problems related to reducing common air pollutants such as SO₂, NOₓ and PM₁₀ are seen as more imminent according to domestic views. More efforts to formulate emission trading related policies are required such as national standards, accounting system, and manual covering enterprise policies and procedure for emissions trading and so on.

China does already have some existing infrastructure in place for measuring pollution such as SO₂ and energy consumption, including a handful of designated third-party verification companies (determined by the NDRC). There is also rapid establishment of many “climate exchanges” or “environment exchanges” and China is building an updated national greenhouse emission database. Nevertheless, China still lacks enough third-party verification companies and advisory parties to support the growth of carbon trading. There is a shortage of technical knowledge and human resources. As interviewed, one of the staffs in Shenzhen Emissions Exchange indicated: “carbon trading is also a new business even for many of us who working on the ground”.

Increasing efforts are needed for developing frameworks to support MRV, especially for the development of facility level measuring devices or enterprise level systems to aggregate measurement data and convert into format for emission reporting. China has only started in 2012 developing the MRV framework for the implementation of a carbon trading scheme. This includes the development of national GHG inventories, monitoring and verification standards, the establishment of trading infrastructure at exchanges, and the regulatory framework.
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Declaration

Herewith, I declare that this thesis has been completed independently and unaided and that no other sources other than the ones given here have been used.

The submitted written version of this work is the same as the one electronically saved and submitted on CD.

Furthermore, I declare that this work has never been submitted at any other time and anywhere else as a final thesis.

Date:
Signature: