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Overview of Climate Change Policies and Prospects for Carbon Markets in China

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China has made remarkable progress in economic and social development in the first decade of the 21st century; however, it has also become the largest carbon emitter since 2007. In a bid to achieve a low carbon economy, China has to take bold policies and measures to decouple its economic growth with carbon emissions. However, sole reliance on administrative tools has proven to be insufficient, and alternative policies are needed to control the rapid CO_2 emissions growth. To this end, China has taken steps forward to implement pilot emissions trading schemes in some regions to pave the way for a national scheme.

This paper will first present the profile of Chinese GHG emissions and investigate the drivers of the rapid carbon emissions growth. We will then describe China's engagement in international climate negotiations, how it committed to curb CO_2 emissions, and policies and measures that China put in place to achieve mandatory energy and climate goals domestically. We will finally look more closely into the emerging domestic carbon markets in China.

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Introduction

Climate change emerged as one of the greatest challenges to the sustainable development of human society and now stands at the heart of scientific and political preoccupations. There is consensus that comprehensive action should be taken swiftly to avoid catastrophic consequences caused by rapidly rising temperatures, and to achieve sustainable development. Most countries have started to engage in the formulation of strategies and implementing measures, adaptive to national circumstances, on the path toward a low carbon economy. This global exploration will by no means reach meaningful achievements without considerable effort from China, the world's largest energy consumer and greenhouse gas (GHG) emitter. China has been gradually adopting policies to control its GHG emissions growth. However, the country is still in a stage of rapid economic development, industrialization and urbanization and policies addressing climate change should be embedded into overall socio-economic development planning.

A carbon market, which is considered by many economists the route to achieve emission reductions most cost-effectively, is the main economic instrument chosen to address the negative 'externality of excessive GHG emissions' (Delbosc et al., 2009). In practice, emissions trading schemes (ETSs) are already in operation in several locations around the world, with the largest in the European Union (EU), or are set to begin, such as in California in 2013 and Australia in 2015, and are expected to emerge in the Canadian province of Québec, in the Republic of Korea, and several other regions. According to Kossoy et al. (2012), the transaction volume of the global carbon market amounted to 10.3 billion tons of carbon dioxide equivalent (CO_2e) and the value reached US$176 billion, a sixteen-fold increase in value from 2005.

Market-based tools have also begun to appeal to the Chinese government, who has previously relied heavily on "command and control" regulations to tackle energy and environmental issues. The development of carbon markets in China now receives particular attention from the international community, which is keen to follow the development of a cap-and-trade system in a country not bound by any absolute reduction commitments, and to see what role it will play in China's transition to a low-carbon economy. Although operational or planned carbon trading systems in other parts of the world will provide useful experiences and lessons, the development of a Chinese domestic carbon market must fit in China's specific national context. In turn, the establishment and operation of the ETS scheme will likely encounter a number of challenges common to any ETS, as well as some unique to the world's largest developing country.

1. Chinese GHG Emissions Landscape

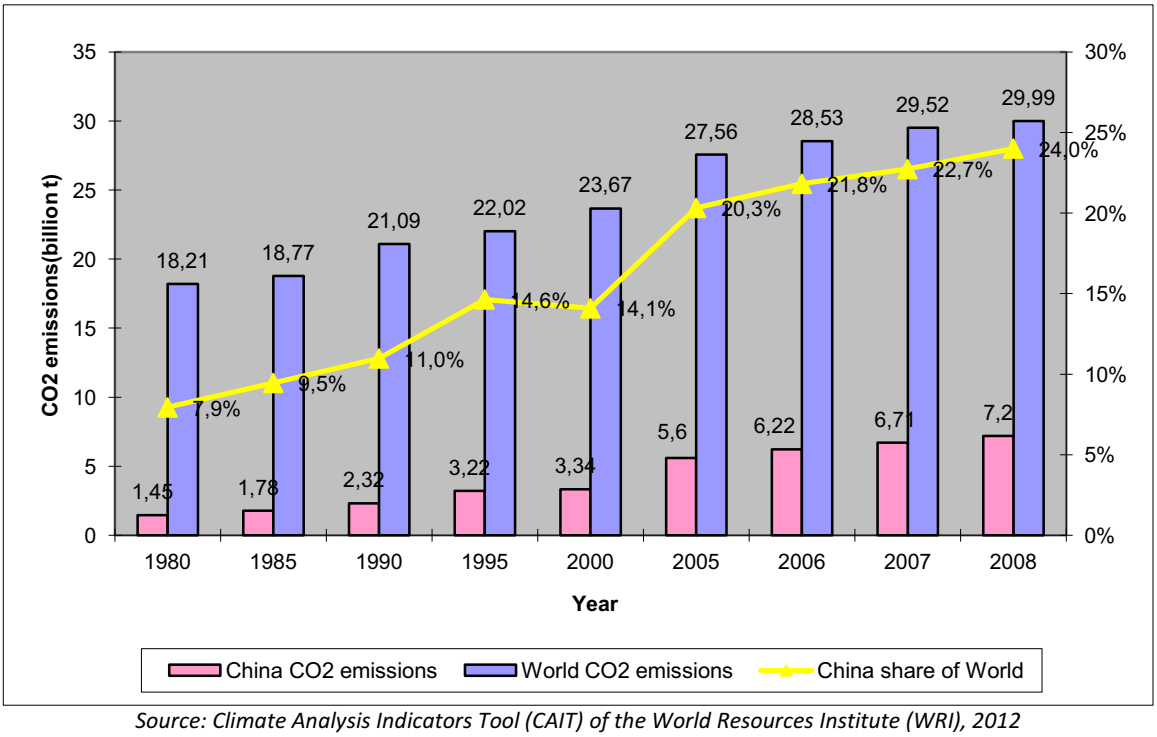
1.1 Historical evolution of China's GHG emissions in China

- ### CO_2 emissions evolution in China

China, as a non-Annex I Party to the United Nations Framework Convention on Climate Change (UNFCCC), is not obligated to report its GHG emissions on an annual basis. To date, the only national inventory of GHG is that of 1994 and was incorporated in China's Initial National Communication on Climate Change submitted to UNFCCC in December 2004. China is now finalizing the Second National Communication on Climate Change, which will update national emission data for the year of 2005. The Communication is expected to be submitted to the UNFCCC in 2012.

Due to lack of official emissions data other than that for 1994, we therefore use estimates from the Climate Analysis Indicators Tool (CAIT)[1] of the World Resources Institute (WRI) to draw an overall picture of carbon emissions in China. In the absence of complete time series data for non-CO_2 gases, we present here the evolution of national total CO_2 emissions (excluding Land Use, Land-Use Change And Forestry (LULUCF)) and China's share of the world's total from 1980 to 2008 (see figure 1). In general, CO_2 emissions make up around 80% of China's total GHG emissions (see table 1). Figure 2 highlights the growth rates of CO_2 emissions and energy use in China from 1990 to 2005.

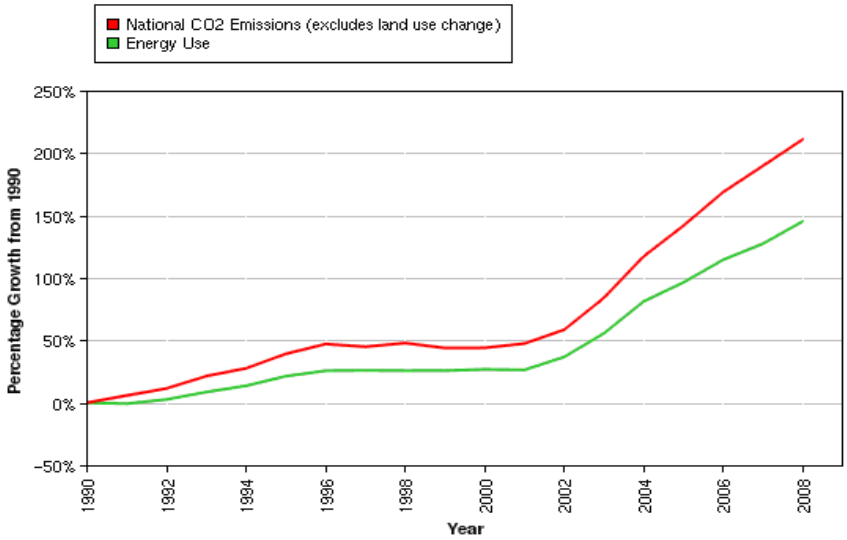
Figure 1 - China CO_2 emissions profile and global share from 1980 to 2008



Source: Climate Analysis Indicators Tool (CAIT) of the World Resources Institute (WRI), 2012

[1] The national total CO_2 emissions in the CAIT include CO_2 emissions from fossil fuel combustion-drawing from estimates by the IEA, and cement manufacture-drawing from the Carbon Dioxide Information and Analysis Center (CDIAC).

Figure 2 - Growth trends of CO_2 emissions and energy use in China from 1990 to 2008



Source: Climate Analysis Indicators Tool (CAIT) of the World Resources Institute (WRI), 2012

China's CO_2 emissions, excluding LULUCF, amounted to 7,200 million tons in 2008 and accounted for about 24% of the global total. As figure 2 illustrates, while the national CO_2 emissions in 2008 were more than twice their 1990 levels, this growth occurred principally between 2002 and 2008 with a slight decrease during 1996-2000. National CO_2 emissions have been evolving at the same pace as total primary energy consumption: the essential driver of CO_2 emissions. Although China tops the list of annual CO_2 emitters, its emissions per capita at 5.4 tons in 2008 were below the world average, less than one-third those of the U.S. (18.6 tons) and about two thirds of the EU-27 (8.0 tons).

- ## Overview of estimates of GHG emissions in China

Although making up the bulk of the national GHG inventory, CO_2 is not the only gas to be blamed for causing change in the world's climate system. Five other GHGs are also recommended by the Intergovernmental Panel on Climate Change (IPCC) for conducting national GHG inventories. China has chosen however to report only N_2O and CH_4 emissions, alongside CO_2 emissions, when compiling its first national GHG inventory. Table 1 shows estimates of overall GHG emissions in China from all sectors and gases according to various international and domestic sources. In 2007, the Chinese government tentatively estimated the overall GHG emissions of its economy for the year of 2004 at about 6100 $MtCO_2e$, consisting of 83% of CO_2 emissions, 12% CH_4, 5% N_2O and less than 1% of the other three GHGs[2].

[2] The estimation results are included in China's National Climate Change Programme published in June 2007.

Table 1 - Estimates on China's GHG and CO_2 emissions

Estimate reference	Year	Total GHG emissions excluding LULUCF (Mt CO_2e)	National total CO_2 excluding LULUCF(Mt)	Part of CO_2 in total GHG inventory
First national communication	1994	4057	3073	76%
Climate Analysis Indicators Tool (CAIT)	1995	4662	3223	69%
China's tentative estimate	2004	6100	5063	83%
International Energy Agency(IEA,2011)	2005	7527	5871	78%
Climate Analysis Indicators Tool (CAIT)	2005	7242	5600	77%
Netherlands Environmental Assessment Agency(NEAA)	2005		5570	
Yan et al.(2010)	2007	7456	6499	87%

Note: 1.Estimates by Yan et al. (2010) only takes into account direct GHG emissions. Other indirect sources such as N_2O from cropland are not included

2. Similar to estimates from CAIT, NEAA's estimate only includes CO_2 emissions from fuel burning and cements production

Souce: Chaire Economie du Climat based on different estimates

- **Discrepancies regarding GHG emissions in China**

As Table 1 illustrates, the definition of an accurate total of China's GHG emissions has long been a challenge. International sources generally show China emitting more GHGs than national estimates, and the difference can be as significant as 1000 $MtCO_2e$ or more. These discrepancies can be partially attributed to strong growth in energy use from 2004 to 2005 in China, but also reflects inconsistencies between energy consumption data from the national statistical system, used by national experts for estimation, and that compiled by the International Energy Agency (IEA) (used by international institutions).

More recently, Guan et al. (2012) carried out a study compiling CO_2 emission inventories for China using two sets of energy datasets from China's National Bureau of Statistics, namely its national energy use, and that of individual provinces, which are not consistent. The study concluded that the aggregated emissions of all Chinese provinces in 2010 is 1.4 billion (or 20%) tons higher than the inventory based on national top-down dataset. However, some national experts[3] questioned this result as the methodology applied does not reflect significant differences in the calorific content of China's various grades of coal, and their preliminary calculations suggest that China's current emissions may be 10-20% less than the result applying the IPCC methodology.

Such differences trigger much expectation around the release of China's second national GHG inventory. This official communication is not only required for a robust assessment of China's intensity-based targets achievements, but it will also lay the ground for further domestic efforts around Monitoring, Reporting, and Verification (MRV) issues.

1.2 Drivers of carbon emissions growth in China

- **Causes of emissions growth in China**

China has experienced substantial growth in GHG emissions in recent years and is now the world's top annual GHG emitter. To help investigate the causes of CO_2 emissions growth, carbon emissions

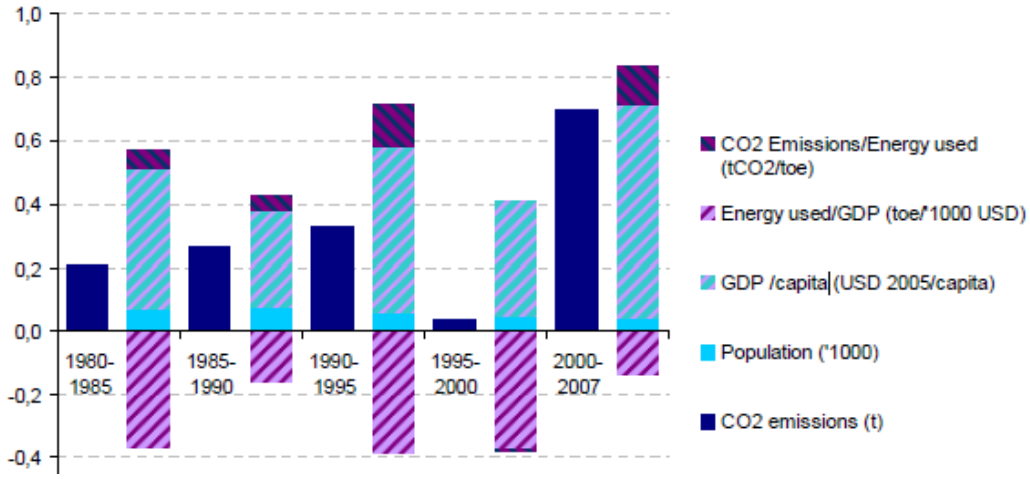
[3] See http://www.pointcarbon.com/news/1.1920402

can be divided into the following four drivers: population, per capita GDP, energy intensity of the economy, and the CO_2 content of the energy (Kaya, 1990). The relationship can be expressed as:

$$CO_2\_emissions = population \times \frac{GDP}{population} \times \frac{energy\_use}{GDP} \times \frac{CO_2\_emissions}{energy\_use}$$

By analysing the four factors, Delbosc (2011) concludes the growth in total CO_2 emissions in China from 1980 to 2007 is largely triggered by the increase of per capita GDP (accounting for 70% growth), but is nearly inelastic to population growth (see figure 3).

Figure 3 - Drivers of CO_2 emissions growth in China from 1980 to 2007



For each period, the evolution of CO_2 emissions (expressed as a difference of natural logarithms) is showed on the left whereas the impact of the evolution of its drivers on the same period is shown on the right.

Source: CDC Climat and the World Bank, 2011

- **Future trends of GHG emissions in China**

In the near future, China's emissions are projected to continue rising rapidly with a maintained need for economic growth and social development. While many factors may affect the trajectory of future emissions in China, the key determinants are the economic growth rate and the level of national efforts in cleaning its energy mix (see figure 3). Table 2 illustrates figures of the CO_2 emissions drivers in China and in other countries. Starting from a very low point of economic development, China's per capita GDP is still less than half of the world average, characterized by low energy efficiency or high energy intensity. Due to high reliance on coal, energy use in China is relatively more carbon intensive than in the US and EU since burning coal produces a higher level of CO_2 emissions[4] than natural gas and oil.

If we assume that the living standard in China will achieve the level of the EU, with current Chinese levels of energy intensity and carbon intensity of energy use, its CO_2 emissions would be 60145 million tons, more than 8 times of the current emissions. However, if China manages to achieve the same level of energy efficiency and technological improvements as in the EU, China's CO_2 emissions from fuel combustion would be 9567 million tons, holding population stable and social development

[4] Burning coal produces 3.96 tons of CO_2 per ton of oil equivalent (toe), natural gas 2.35 tCO_2/toe and oil 3.07 tCO_2/toe, according to BP Statistical Review of World Energy 2009.

comparable to the EU. Even in this case, the emissions would be 39% higher than the current level; however, as coal historically dominants the energy supply in China, cleaning the energy mix will require substantial technological improvements and financial investment to develop clean coal and non-fossil fuels (in particular renewable energies).

Table 2 - Comparisons of levels of CO_2 emission drivers in China and other countries

2009	CO_2 emissions/capita tons	CO_2 emissions from fuel combustion million tons	Population million	GDP/population in current US$	energy/ GDP MJ/$	CO_2 emission /energy use tons /TJ
World average	4.3	28999.4	6759.8	8591.1	8.76	57.0
U.S.	16.9	5195.0	307.4	45700.1	6.45	57.4
EU 27	7.2	3576.8	500.3	32625.2	4.25	51.6
China	5.1	6877.2	1338.0	3730.5	19.06	72.3
China to reach EU27 living standards	45.0	60145.5	1338.0	32625.2	19.06	72.3
China to reach EU 27 levels	7.2	9566.5	1338.0	32625.2	4.25	51.6

Source: IEA 2011, World Development Indicators 2012

Given these challenges, it is therefore unreasonable to expect China to put an absolute cap on the CO_2 emissions in the near or middle term, as addressing the carbon intensity of the economy is more relevant in China's current development phase. According to the 'China Energy and CO_2 Emissions Report for 2050' (ERI, 2009), led by the government think-tank Energy Research Institute (ERI) of NDRC, the growth of national GHG emissions will gradually slow down towards 2020 and is likely to peak around 2030 if appropriate policies[5] are put in place.

2. Chinese Climate Policies

2.1 Brief history of China's Climate Policies

- **Framework of climate policy making in China**

In order to better understand China's climate policies and its position in international negotiations, it is useful to examine the national context of Chinese climate policy-making. Originally, the Chinese Meteorological Administration (CMA), along with the Chinese Academy of Sciences (CAS) and the Ministry of Foreign Affairs (MFA), directed climate change coordination efforts to reflect China's initial perception of climate change as a scientific and international issue. As climate change evolved from a scientific topic into an issue also involving economic development and political negotiations, the State Planning Commission became the hub for climate change policies in China since 1998, before it was renamed the National Development and Reform Commission (NDRC) in 2003. This is because the NDRC holds the broad administrative and planning control over China's social and economic development.

[5] The key element of these policies is to consistently incorporate a 20% energy intensity reduction targets into the subsequent Five-Year Economic and Social Development Plans.

NDRC's climate responsibilities are entrusted to the Department of Climate Change, which is responsible for formulating key strategies and policies dealing with climate change, representing China in international climate negotiations, and coordinating the work of conducting national GHG inventories. Other ministries and government agencies participate in climate-related policies making by providing their corresponding expertise. For example, the Ministry of Environmental Protection (MEP) formulates concrete regulations and standards, the MFA assists the NDRC in international climate negotiations, the Ministry of Science and Technology (MoST) provides technical advices, and the CMA participates in the work of IPCC.

- **China's engagement in international climate negotiations**

China has been engaged in international climate change discussions since the early 1990s. It formally ratified the UNFCCC in 1992 as a non-Annex I country, and the Kyoto Protocol on August 30, 2002, as a non-Annex B country. In the following years, although global warming gradually received more attention in China as well as internationally, no compulsory climate goal was incorporated into China's economic and social development plan, i.e. the 11th Five Year Plan (FYP) for the period 2006-2010. Instead, the First National Assessment Report on Climate Change(NARCC)[6] was released in 2006, which assessed the impacts of climate change on the full range of China's sectors and put forward both mitigation and adaptation policies and measures.

Nevertheless, climate change has quickly become a much-talked-about topic in both the political and scientific spheres since 2007, and consequently rapidly emerged as one of the top priorities on the Chinese government's agenda. The cornerstones of climate-related policies in China were the National Climate Change Programme (NCCP), released in June 2007, and the China's Policies and Actions for Addressing Climate Change (CPAACC) in October 2008. Two progress reports of the CPAACC were published by the NDRC in 2009 and 2010 respectively. These national communications outlined China's efforts both to mitigate and to adapt to climate change, its long-standing positions in climate negotiations, and its consideration of integrating climate change into national economic and social development strategies.

Throughout various climate talks and negotiations, China has reiterated the principle of 'Common but Differentiated Responsibilities' that urges developed countries to bear primary responsibility for the historical concentration of GHGs in the atmosphere and thus take the lead in combating climate change. China also states that developed countries should provide financial resources, including the transfer of technology, for developing countries to adopt appropriate measures to mitigate and adapt to climate change. As a non-Annex I country, China was not bound by any emission reduction obligations under the Kyoto Protocol, nor was it willing to take commitments at odds with its need for unconstrained economic growth.

With the issue of climate change continuing to heat up on the international agenda and as the top annual GHG emitter, China has been under increasing pressure from industrialized countries to take on more mitigation responsibilities. More importantly, the adverse impacts caused by rapid growth in carbon emissions triggered wider discussion on the need for China's switch to a more environmentally friendly development pattern. In this context, the Chinese government has begun to consider the possibility of making firm commitments on climate change. A notable milestone is

[6] The Second NARCC was published in November 2011.

China's climate mitigation action outline submitted under the Copenhagen Accord, the core element of which was the voluntary pledge to reduce its CO_2 emissions by 40-45% per unit of GDP (i.e. carbon intensity) by 2020 compared to 2005 levels. This engagement reflects both China's long-held position to conserve its development rights by putting an intensity constraint on GHG emissions, and its willingness to make greater strides to reduce its carbon footprint.

China stepped up its efforts at the COP 17 in Durban, voicing its intention to be engaged in a post-2020 legally binding framework for emissions reduction under certain conditions. This is the first time that China mentioned a timeline for taking on future legally binding obligations to control its emissions growth, although contingent upon progress of international climate talks and China's domestic development by 2020. In the future, it is expected that China will consistently stick to the 'Common but Differentiated Responsibilities' principle in future climate talks.

2.2 From international commitments to national climate targets

- **The 12th Five Year Plan unveiled to make climate target domestically compulsory**

Apart from the carbon intensity target, China's 2020 pledges under the Copenhagen Accord also consist of increasing the share of non-fossil fuels in primary energy consumption to around 15% and forest coverage by 40 million hectares and forest stock volume by 1.3 billion cubic meters by 2020 from 2005 levels. Early 2011 witnessed the translation of these voluntary international commitments into domestic policies as they were integrated into the national economic and social development plan, namely the 12th Five-Year Plan (FYP), as the vehicle for the transition towards a low-carbon economy.

The Outline of the 12th FYP, released in 2011 to cover the period of 2011-2015, established the policy orientation of promoting green and low-carbon development, and expressly set out targets on energy intensity and carbon intensity among a range of sustainable development goals. In the meantime, compulsory goals are set for the share of non-fossil fuel in China's energy mix, forest coverage and forest stock volume. While objectives for carbon intensity and forest stock volume were the first-ever to be written in FYPs, the other goals follow up on and expand the ambitions of the 11th FYP (2006-2010). Table 3 illustrates the progression of energy and climate related targets in the 11th FYP, the 12th FYP and those for 2020.

While the two compulsory targets of a 17% carbon intensity cut and a 16% energy intensity cut are both intensity-based, NDRC is currently reported[7] to be working on a plan to put caps on total energy consumption and electricity consumption to facilitate the country's switch from energy-intensive growth patterns and to limit exposure to energy dependence risks. The caps, which were planned to be made official in the first quarter of 2012,[8] intend to restrict the national 2015 energy consumption to below 4.1 billion tons of coal equivalent (tce) and total electricity use to 6400 billion kilowatt hours (Kwh). The suggested target of 4.1 billion tce implies that China will have to rein in growth at 26.2%, or 4.7% annually during 2010-2015: this corresponds to a massive effort considering domestic energy consumption increased 37.7% over 2005-2010, or 6.6% annually.

[7] http://cdm.ccchina.gov.cn/web/NewsInfo.asp?NewsId=5818
[8] However, the caps were still not publically released until June 2012.

Table 3 - Key energy and climate indicators in the China's FYPs

Indicators	11th FYP (2006-2010) Target	11th FYP (2006-2010) Result	12th FYP (2011-2015) Target	13th FYP (2016-2020) Anticipated target	Nature of target
Energy Intensity (% reduction in five years)	20%	19.1%	16%	Not yet available	mandatory
Carbon Intensity (% reduction in five years)	NA	20.5%(according to ERI research)	17%	40-45% vs 2005	mandatory
Non-fossil fuels in primary energy consumption	9%[2]	9.6%[2]	11.4%	15%	mandatory
Forest coverage	Up to 20% from 18.2%)	20.36%	21.66%	23%	mandatory
Forest stock volume	NA	13.7 up from 12.5billion m^3	14.3 billionm^3	15 billion m^3	mandatory
Annual GDP growth rate	7.5%	11.2%	7%	Not yet available	expected
National energy consumption[3]	NA	3.25 from 2.36 billion tce[1] (+6.6% annually)	4.1 billion tce (+4.7% annually)	Not yet available	under discussion
National electricity consumption[3]	NA	4192 from 2494billion Kwh (+10.9% annually)	6400billion Kwh(+8.8% annually)	Not yet available	under discussion

Note: 1. *tce* stands for metric tons of coal equivalent, unit used by China to unify energy statistics. 1 tce equals to 29.31 GJ or 7 million kcal at low heat value.

2. The target was set for renewable energy instead of non-fossil fuel, and was outlined in 'the energy development plan for the 11th FYP period'-released in 2007, instead of the Guideline of 11th FYP-released in 2006.

3. Cap on total energy consumption and electricity consumption were not identified in the 12th FYP, but is under discussion and is expected to be soon released by the NDRC (see more details below)

Source: data compiled from FYPs and government reports

It is anticipated that the target distribution system, used for other mandatory targets, will be applied to the energy consumption cap as well. In other words, the cap will be broken down and assigned to individual provinces and counties. However, local governments may show resistance to the limits imposed on their energy consumptions. The energy consumption indicator is indeed more challenging to achieve than an energy intensity target, which can be managed through expanding the GDP basis accordingly. Whether caps on energy use should be made binding in the near future for each province, however, remains a debate; still, limiting energy use is seen by many experts as a first step towards the implementation of an allowance-based market mechanism in China.

- **Decentralization of carbon intensity and energy intensity targets**

The Outline of 12thFYP lays out only national goals and an overall framework. It is up to individual ministries or the State Council to draft and implement concrete policies and measures to achieve these goals. The State Council published the "Comprehensive Working Plan for Energy Conservation and Emission Reduction for the 12th FYP Period" (hereafter the Energy Conservation Plan) in September 2011, and then endorsed the "Working Plan for GHG Emission Control" (hereafter the GHG Control Plan) on January 14, 2012. The GHG Control Plan is the first national policy document specifically dedicated to GHG emissions mitigation in China.

The GHG Control Plan outlines both overall requirements and specific policy measures to be implemented and allocates emission intensity target to each province, autonomous region, or municipality. Table 4 presents emission intensity targets at the provincial level as well as energy intensity targets assigned by the Energy Conservation Plan. China's 31 provinces were divided into 5

groups based on carbon intensity cut targets, taking into account the economic development level of each region. Almost all provinces receiving higher targets than the national average had a GDP per capita greater than 30 000 yuan (2009) and provinces with targets less than 11%, had GDP/capita less than 20 000 yuan (Guérin et al., 2012).

Table 4 - Carbon and energy intensity targets at provincial level for 2015/2010

Provinces/municipalities	Carbon Intensity reduction target 2015/2010(%)	Energy Intensity reduction target 2015/2010(%)	Provinces/municipalities	Carbon Intensity reduction target 2015/2010(%)	Energy Intensity reduction target 2015/2010(%)
Guangdong	19.5	18	Hubei	17	16
Tianjin	19	18	Hunan	17	16
Shanghai	19	18	Chongqing	17	16
Jiangsu	19	18	Shaanxi	17	16
Zhejiang	19	18	Yunnan	16.5	15
Beijing	18	17	InnerMongolia	16	15
Hebei	18	17	Heilongjia	16	16
Liaoning	18	17	Guangxi	16	15
Shandong	18	17	Guizhou	16	15
Fujian	17.5	16	Gansu	16	15
Sichuan	17.5	16	Ningxia	16	15
Shanxi	17	16	Hainan	11	10
Jilin	17	16	Xinjiang	11	10
Anhui	17	16	Tibet	10	10
Jiangxi	17	16	Qinghai	10	10
Henan	17	16	**National average**	17	16

Source: Energy Conservation Plan and the GHG Control Plan

The same distribution work has been done or is being carried out for other mandatory targets, such as forest coverage and sinks increases, and renewable energy share in the national energy mix. The performance-based appraisal mechanism set the fulfillment of these targets as one of evaluation criteria for local governors' political achievements, which will consequently affect their political career and promotion opportunities. This system of accountability will help to enforce the implementation of energy saving and emissions reduction policies.

In 2012, governments at the provincial level are allocating provincial targets to cities, counties and townships located within their administrative borders. Being assigned the highest emission and energy intensity reduction targets as China's most populous and economically important province, Guangdong has distributed the 19.5% goal to 21 individual cities in its jurisdictions.[9] In addition to the intensity target breakdown, the Guangdong Development and Reform Commission also suggested a CO_2 cap at 660 Mt and energy consumption cap at 350 million tce in 2015, as the first-mover in China to regulate absolute CO_2 emission and energy consumption. The cap was determined on the basis of Guangdong's CO_2 emissions in 2010 (510 million tons), the 19.5% intensity target and its predicted economic growth.

[9] http://epaper.21cbh.com/html/2012-03/13/content_19687.htm?div=-1

2.3 Climate policies and actions to ensure mitigation achievement

- **Climate and energy related policies throughout 2011-2015**

To address both the economic development and climate change challenges, climate policies must accommodate with the GDP growth priority but also drive it to be less carbon intensive. In line with the core principle of promoting economic prosperity, policies in four fields are prioritized to control emissions: accelerate the adjustment of industrial structure, promote energy conservation, develop low-carbon energy sources, and increase forest carbon sinks. Most of the policies and measures for 2011-2015 under the four pillars show a continuation and expansion of those defined during the 11th FYP period. They send a clear signal on the need to transition to a low carbon society (see table 5).

In terms of adjusting the sectoral structure, a more ambitious goal was set for the growth of the service industry: 4% growth in GDP share from 2011 to 2015 (while only 2.8% increase was reached during 2005-2010), and the number of sectors enforced to eliminate backward production technology and facilities increased from 12 to 19. With regards to energy savings, the number of firms brought under a national absolute energy-saving program was increased tenfold to hold more enterprises accountable for energy efficiency and conservation tasks.

Renewable energy development has been a key element of energy policies in China. In December 2011, the National Energy Bureau published "the roadmap for Renewable Energy development during 12th FYP period",[10] which calls for a total of 4800 million tce capacity of non-fossil energy to be built by 2015. Efforts should be strengthened to integrate wind energy into the electricity grid, raise requirements for wind energy technology and quality, perfect subsidy system for solar energy, promote the application of distributed solar electricity generation, and reinforce renewable energy use in rural areas.

It should be noted that policies and programmes listed in the below table are not exhaustive as some of the national programmes have been replicated at the provincial level, and provinces also have the option to initiate innovative programs specific to the region. On the contrary, programmes aimed at improving industrial structure, enhancing energy efficiency or promoting renewable energy may overlap to some extent, making it complex to evaluate the effects of individual programs. For example, closure of a small state-owned power plant may be counted in the energy efficiency performance of the owner (under the 1000 Energy-Consuming Enterprises Programme), but also be counted as a sectoral adjustment accomplishment. Nevertheless, this overlap will not lead to double-counting of the national target achievement, which is evaluated by top-down national statistics rather than the sum of achievements of each programme.

[10] http://news.xinhuanet.com/fortune/2011-12/15/c_111247883.htm

Table 5 - Main climate and energy related policies throughout 2005-2015 in China

Policy pillars	Main policies and programmes	Explanations
Sectoral structure adjustment	Raise the contribution to the GDP of service industry and new strategic industries	- GDP contribution of the service industry rose to about 47% in 2015 up from 43% in 2010. - Seven new strategic industries specified in the 12th FYP include advanced materials, information technology, innovative equipment manufacturing, biotechnology, etc.
	Inhibit excessive growth of energy-intensive and emission-intensive industries	- Reinforce the entrance standards for energy-intensive industries by imposing taxes and raising safety, energy and environmental standards - Restrict the export of energy-intensive products - Prevent shift of polluting and backward production facility to central and west China
	Phase-out of obsolete production facilities	The Ministry of Industry and Information Technology (MIIT) allocated tasks of eliminating outdated and polluting capacities to provinces and will assign concrete tasks of eliminating outdated capacities to individual enterprises and release the list of enterprises subject to public supervision in 19 sectors.
Energy conservation and energy efficiency improvement	Ten Key Energy Conservation Programmes to save the equivalent of some 300 million tce during 2011-2015	The billion dollar effort to provide financial incentives to promote a wide range of energy saving projects (coal industrial boilers or kilns, waste heat recovery/waste power recovery, petrochemical conservation or substitution, electrical machinery energy saving system and energy system optimization).
	Top-1000 Energy Consuming Enterprises Programme in 11th FYP, extended to 10,000 Enterprises Program in the 12th FYP	This programme involves initially the top 998 most energy-intensive enterprises in 9 industrial sectors, which accounted for 43% of the nation's total CO_2 emissions in 2006. The extended 10,000 enterprises programme in fact covers more than 17,000 top emitters representing two thirds of China's total energy consumption. They are required achieve an absolute energy-saving target of 250 Mtce by 2015.
	Promote energy efficiency improvements in other sectors	Standards and detailed actions will be set for the building, transportation and rural energy use sectors.
	Foster market-based mechanisms	Promote energy service companies (ESCOs), energy cap and trade trading, trading of energy conservation certificate
Energy mix	- Develop hydropower taking into account environmental protection, safe nuclear power. - - Promote wind, solar, biomass and geothermal energy adapted to local conditions. - Increase use of natural gas and clean coal.	The "renewable energy law", enacted in 2006 and amended in 2009, introduced a series of incentivizing polices: a provision for renewable portfolio standards (also called 'mandated market share'), feed-in tariffs for biomass, 'government-guided' prices for wind power, an obligation for utilities to purchase all renewable power generated, new financing mechanisms and guarantees (e.g. exempts renewable energy projects from local income taxation), and other market-enhancing provisions.
Forest coverage and sequestration	Afforestation programs , forestry conservation programs and restoration of desertification land	A range of indicators were set for 2015 in terms of land acreage dedicated to forestry and increase of restored desertification, wetland, and natural forestry conservation area.

Source: compiled by the author from government laws, guidelines and plans

- **Strengthen institutional capacity**

Despite the fact that central and local governments have incorporated climate targets into national and provincial 12th FYPs and gradually promulgate relevant actions and programs, long-term and institutional signals would not be established without further climate change legislation. To accommodate this need, in August 2009 the National People's Congress (NPC) Standing Committee passed the "resolution on actively responding to climate change" which called for incorporating climate change-related legislation into the legislative agenda. NDRC was entrusted to coordinate the

formulation of the climate law to consolidate various emissions policies and guidance. NDRC commissioned several research institutions to draft proposals for the climate law, including China University of Political Science and Law (CUPL), Chinese Academy of Social Sciences (CASS), and Chinese Academy of Sciences (CAS). Several institutions drafting in parallel proposals for environmental legislation under comprehensive coordination of NDRC was the first of its kind in China.

The legislative research project, undertaken by the CUPL, received financial support from the Energy Foundation of the U.S., and the kick-off meeting was held on July 12th 2010.[11] In parallel, the CASS started working on another project, supported by the Swiss Embassy, and circulated the draft version (1st) of China's first law to tackle climate change in a consulting seminar to gather public opinion in March 2012.[12] According to Point Carbon,[13] this proposal covers a wide range of climate-related issues and sets provisions for establishing a mandatory national ETS; however, it does not propose specific cap for GHG emissions. Still, it is too early to pin down the accurate contents of future climate legislation by merely referring to these proposals. The institutions commissioned to draft proposals on climate change legislation are now seeking inputs from stakeholders and will submit final versions to NDRC later this year. NDRC will probably consolidate these proposals to formulate a final version to present to the State Council and subsequently to China's legislative body (NPC) for endorsement.

- **Enhance the MRV system and statistical transparency**

The inclusion of climate targets into the 12th FYP and subsequent target allocation to provinces and companies necessitates establishing and improving statistical and monitoring systems for GHG emissions at national, sub-national and company levels. A robust and transparent MRV system for emissions will lay the foundation for tracking national, provincial as well as company-level progress towards their respective targets. In addition, a strong MRV system is one fundamental infrastructure for setting and operating an ETS that we will fully elaborate later in this paper. However, China has substantially less experience collecting and reporting GHG emission data compared to energy-related data, which is more sophisticated as it was first initiated in 1952. As a consequence, the GHG Control Plan requires the inclusion of GHG emissions measurements into the government statistical indicator system and the National Bureau of Energy is developing CO_2 reporting requirements by in-depth study of the European system as well as the American Environment Agency (EPA)'s GHG reporting rules (Seligsohn, 2010).

At the national level, only one GHG inventory for 1994 was made public. The second for 2005 is presently being finalized. In the future, it is likely that China will update and submit national inventories more frequently, even on a biennial basis as outlined in the Copenhagen Accord, assuming a replicable and updatable system is created with the assistance of developed countries[14]. However, calculating GHG inventories at provincial and local levels is much more complicated as the geographic boundaries are not always evident when energy-related data derives in part from

[11] http://www.gov.cn/gzdt/2011-07/14/content_1906678.htm
[12] http://www.ccchina.gov.cn/cn/NewsInfo.asp?NewsId=31473
[13] www.pointcarbon.com/China drafts first climate law, eyes ETS 10 Mar 2012 19:23
[14] China received US $ 5.35 million support from the United Nations Development Programme (UNDP as implementing agency for the Global Environmental Facility (GEF)) Preparations for the second national communication (GEF, 2010).

bottom-up data from local facilities and enterprises. In this regard, the NDRC has published guidelines for compilation of provincial GHG inventories in November 2011, and initiated the work on the compilation of local GHG inventories[15]. These guidelines will standardize calculation methods, determining sources to be reported and specifying data sources in a bid to make local inventories comparable and transparent. Finally, emission accounting and verification rules will also be defined for key sectors and firms.

Although far from being solid, China's ability to monitor, report and verify GHG emissions has developed substantially since 2005 and the Nation's Statistics Indicator, Monitoring and Examination (SME) system provides a solid framework in this sense, according to a report by the Climate Policy Initiative (Hogan et al., 2012). The SME system was developed to track both national and local performances against requirements in specific policies and programs including energy-related goals. General guidelines for the SME system to measure, report and verify energy intensity data and track mitigation actions was released by the NDRC in 2007, according to which the NDRC thereafter announces each province's energy conservation progress on an annual basis. All energy audit efforts will surely help establishing a robust MRV for GHG but a shift in methods is required to move from energy to carbon accounting and improvements are needed to strengthen data accuracy and verification.

2.4 China on track to meet the climate targets?

- **Energy intensity evolution in China**

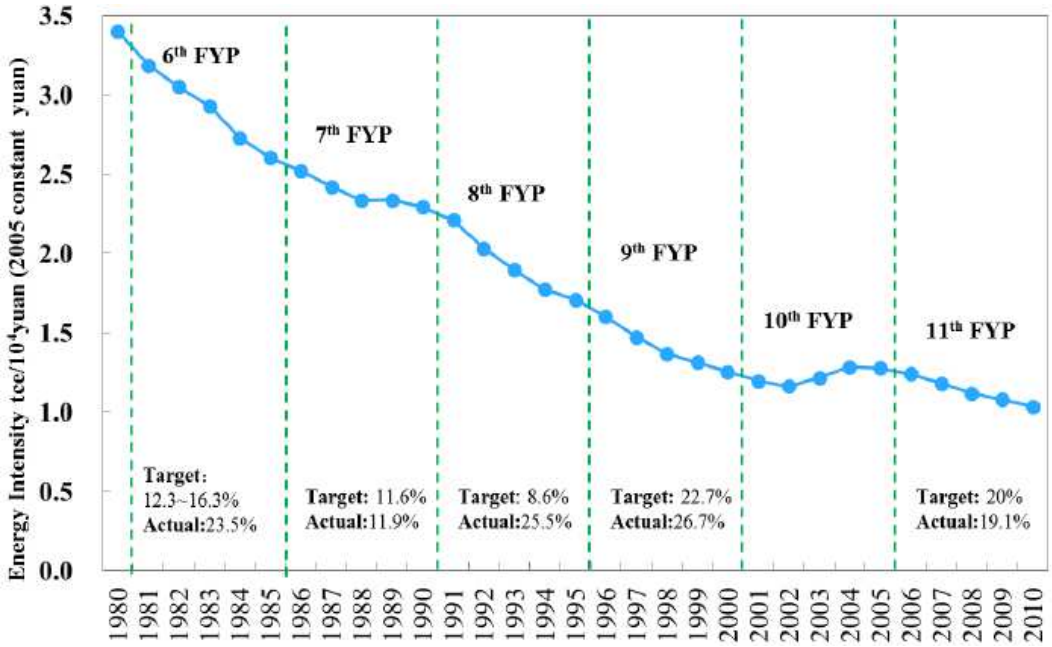
Figure 4 illustrates China's continuous decline in energy intensity despite an important increase in energy demand (figure 2), from the onset of the economic reform in 1978 up to 2000. As a result, the energy use per GDP in 2000 was nearly two-thirds less than it was in 1980. Ma et al. (2007) conducted a decomposition study to examine drivers for the decline in energy intensity and concluded that technological change was the dominant factor bringing down energy intensity while structural change at the industry and sector (sub-industry) level actually increased energy intensity over the period of 1980–2000. Consequently, the energy intensity target was removed from the 10th FYP.

However, as the Chinese economy moved into an intensified phase of industrialization and urbanization from 2001 onwards, energy intensity began to rise from 2002. In response, the government re-incorporated an energy efficiency target into the 11th FYP and plotted out a diverse range of energy conservation, energy efficiency improvement and renewable energy promoting policies during 2006-2010, which enabled it to reverse the upward trend of energy intensity that it had experienced in the 5 years previous to 2006. At the end of 2010, China achieved a 19.06% reduction in energy intensity against the 2005 level, missing the 20% target defined in its 11th FYP. According to the NDRC, this energy intensity improvement represents energy savings of 630 Mtce against the baseline, and a CO_2 emissions reduction of 1460 Mt during the 5 years of 2006 to 2010. Climate Policy Initiative at Tsinghua University (2011) concluded that energy efficiency improvement

[15] Source: Sun Cuihua and Wang Shu, Template for Organizing Framework for Scoping of PMR activities. In addition, capacity building programs for conducting local-level and provincial GHG inventory are supported by the US Energy Foundation and US EPA.

was the main driver of CO_2 emissions abatement (about 87% contribution) while energy mix was a less significant contributor.

Figure 4 - Energy Intensity evolution during the FYP periods from 1980 to 2010



Note: data are collected from FYPs; energy consumption per unit of GDP is calculated based on 2005 constant prices.

Source: Climate Policy Initiative at Tsinghua (2011)

Although China almost achieved its energy intensity target under the 11th FYP, this did not come without difficulty, especially in 2010 when several provinces were still far short of their goals. Missing the assigned targets would negatively affect local officials' job evaluation and career promotion opportunities under the target accountability system. Under this pressure, some local governments adopted political intervention measures such as rationing power to industries, residential buildings and traffic lights and even hospitals in some cases[16]. As these kinds of irrational blackouts and enforced power cuts disrupted industry production and people's lives, on November 23, 2011, the General Office of the State Council released an urgent notice[17] that called for an immediate restoration of electricity supply to affected residents and key electricity users and prohibited local governments from illegally interfering with power generation and grid dispatch. This experience suggests that traditional administrative measures have been exhausted: local governments had no alternatives to electricity cuts. This reminds policy makers of the need for longer-term and sustainable mechanisms to a low-carbon economy.

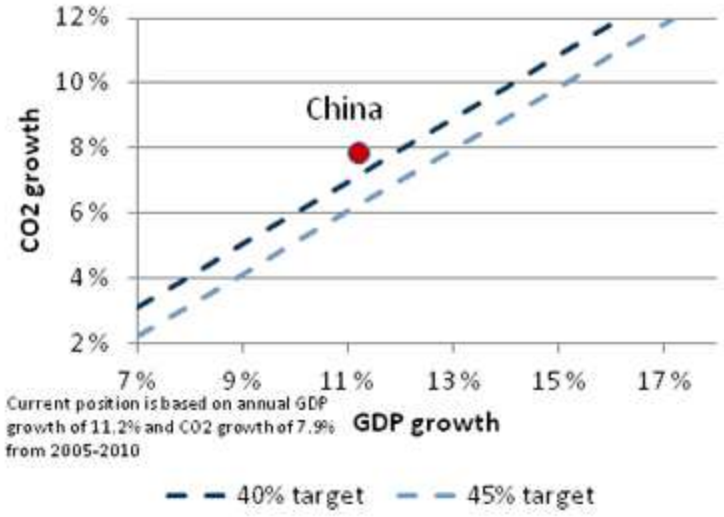
- ## 2015 and 2020 climate targets: difficult to achieve?

Carbon intensity reductions are expected to bend China's emission curve in the next decade, although the rate at which total carbon emissions will continue to rise is largely dependent on GDP growth speed. Chai et al. (2011) plots China's emissions trajectory (see figure 4) and indicate that, if China's annual CO_2 emissions growth rate stabilizes at 7.9% (based on data from 2005-2007), it has to

[16] For more information, please see http://finance.sina.com.cn/focus/jpxcxd/
[17] The notice is available at: http://www.gov.cn/zwgk/2010-11/23/content_1751457.htm

reach an economic growth rate of about 13% annually to achieve the 45% target, while 12% GDP growth will be sufficient to meet the 40% target. If China strictly follows the expected 7% annual GDP growth defined in the 12th FYP, CO_2 emissions growth should be limited to 3.1% on a yearly basis and as low as 2.3% respectively for the 40% and 45% reduction scenario. The red point in Figure 5 indicates that the current development path, with GDP growth at 11.2% and CO_2 emissions at 7.9% during 11th FYP will not allow China to meet the upper range of its climate ambitions.

Figure 5 - China's position towards target reaching (2011-2020)



Source: Point carbon analysis (2011)

Chai et al. (2011) examine the possibility of China reaching the target relying solely on cleaner energy sources, concluding that a 15% share of non-fossil fuels in the overall energy mix in 2020, combined with average GDP growth rate achieved in the 11th FYP period, will make the 40% target achievable, while meeting the 45% target will require substantial additional efforts.

Reports from the Climate Policy Initiative (2011) point out that it will be challenging for China to meet its climate and energy related targets. The 4 trillion yuan economic stimulus package that the government initiated in 2008 in response to the global financial crisis maintained high economic growth rates and provided strong support to energy intensive industries. At the same time, many of the "low-hanging fruits" in energy efficiency savings have already been picked. For example, the replacement of small plants has nearly reached saturation and will offer very limited room for improvement in the next 10 years. The marginal costs of energy conservation and emission reductions will continue to rise, making the targets under the 12th FYP more difficult to achieve.

When we look at the energy intensity performance of China in the starting year of the 12th FYP period, the data released by the National Bureau of Statistics indicates that China only drove down the energy intensity by 2.01% in 2011, falling short of its 3.5% annual goal for 2011-2015. This is largely attributable to fast growth of overall energy consumption at the rate of 7%, with carbon-intensive fossil fuels (especially coal and natural gas) responsible for the bulk of the growth. In view of such a weak start, China has no alternatives but to reinforce its efforts in the next 4 years to meet the carbon and energy intensity targets.

3. Carbon Market Insight in China

China is very familiar with carbon markets as it hosts the largest number of Clean Development Mechanism (CDM) projects, accounting for nearly 60% of Certified Emission Reductions (CERs[18]) issued as of June 1, 2012. In addition, China also sourced carbon credits to the global voluntary markets, although with very limited volume. However, China has participated exclusively as a credit supplier to the international carbon market; no carbon price exists domestically to address the negative externality of excessive GHG emissions. As China committed to slash the carbon emissions of its economy under the Copenhagen Accord and then the 12th FYP, putting a price on carbon would be a major step to help the country curb its carbon emissions cost effectively and genuinely shift to a low-carbon economy.

3.1 From intention to determination: China's move towards carbon emission trading

- **China needs market mechanisms to control emission growth**

At the early stage, establishing a domestic carbon market in China was called on by some experts for the reasons that China should avoid losing pricing power in international carbon markets as it did in the international oil market, especially when the carbon market is predicted to double the size of the vast oil market in the next decade, and that China, as a sole carbon credit supplier, is ceding its low cost abatement opportunities to western countries[19]. However, these arguments are not the principal factors to drive policy makers to consider including ETS into its policy toolbox to address the exposure risk to energy shortage and environmental problems (including carbon emissions).

More importantly, policy makers began to realize that although command-and-control regulatory approaches indeed largely contributed to energy conservation achievements in the past, their full potential had been tapped, and that fulfilling more strict energy and emissions reduction targets would require additional policy measures. In effect, Chinese policymakers have been eyeing a domestic ETS for more than 2 years. The NDRC expressed as early as 2009 its intention to test carbon emission trading in specific regions or sectors (People Press, 2009), and reiterated several times it interest in integrating market-based instruments into its future pollution-control policies. The blackout of electricity supply in some regions in 2010 in a hurry to fulfill their year-end energy intensity targets catalyzed the government's determination to roll out more economic policies to create a long-term signal to achieve energy conservation and emission reductions in a cost-effective way. A cap-and-trade mechanism appealed to the Chinese government as an instrument combining both control and incentive. It provides flexible options in companies' strategies to control energy use and carbon emissions. Over the long term, an ETS will create a price lever to incentivize companies with low abatement costs, while restricting the development of higher-polluting companies.

In short, China embraced the idea of employing new economic instruments impelled by the necessity to lessen the heavy dependence on traditional administrative policies and to form a comprehensive system of policy measures to cope with climate change.

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[18] CERs are the carbon credits generated under the CDM.

[19] For example, see http://www.china5e.com/show.php?contentid=127868 and http://finance.sina.com.cn/g/20100209/17037396275.shtml

- **Carbon tax versus ETS: which is possible in China?**

At the early stage, a carbon tax and an ETS - the two principal economic instruments in addressing environmental problems, both appeared in the authorities' toolbox and were debated for their applicability in China. Within the ETS itself, disagreements also arose regarding whether to pilot ETS on a sectoral basis or regional basis (China Daily, 2010).

Some experts[20] claimed that in a country where market fundamentals are poor and legal frameworks weak, it would be very challenging for the government to establish an effective carbon trading market. They argued that China should start with carbon tax, a mechanism the government is more familiar with and is relatively easy to operate. As early as September 2009, a report released by the Research Institute for Fiscal Science of Ministry of Finance, suggested levying a carbon tax in China in 2012-2013 following the reform of fuel tax and resource tax. According to this report, a carbon tax at 50～200 yuan/t will generate limited negative impacts on GDP (0.51%～0.01%) while other experts recommended a lower rate at 20 yuan/t. The report was revised and suggested a lower initial tax rate to only 10 yuan/t starting between 2013 and 2015 and gradually increasing to attain 40yuan/t in 2020.

Generally, there is significant public resistance to new taxes. It was later made clear that emission trading was favored by government officials as a market-based tool to help China achieve climate targets.[21] August 2010 saw the official plan designating a total of 8 cities and 5 provinces[22] as the first batch of pilot low-carbon development zones in China. Under this program, local authorities are required to submit their individual low-carbon design plans for 2011-2015 and implement measurement and reporting of GHG emissions data. Setting an absolute cap on carbon emissions for 2015 and 2020 is recommended by the NDRC and carbon trading is encouraged as part of the overall development strategy in the low-carbon pilots.

The 12th FYP, ratified in March 2011, dedicates for the first time a separate chapter to the issue of climate change, and is the first official government document that explicitly identifies a carbon trading market as a major policy measure to help achieve the energy and carbon intensity reduction targets.

3.2 How a carbon market would look like and progress in China?

China does not presently have the fundamentals to build a national carbon cap-and-trade scheme at this stage, as clearly stated by the government (State Council Information Office, 2010). Nevertheless, China indeed announced its intention to phase in a national carbon emission trading

[20] See http://www.eedu.org.cn/ditan/ShowArticle.asp?ArticleID=58449

[21] However, introducing a carbon tax in China has not been completely withdrawn. For example, a NDRC official recently indicated at a conference that a carbon tax could be introduced in parallel with ETS if regulators of pilot ETSs hand out too many permits for free. And there are still ongoing independent or government-commissioned research projects in this regard.

[22] The 5 provinces selected include Guangdong, Liaoning, Hubei, Shaanxi, Yunnan and 8 cities are Tianjin, Chongqing, Shenzhen, Xiamen, Hangzhou, Nanchang, Guiyang, Baoding.

system as early as 2015[23]. Whether such a national scheme would come into reality or be effective, will largely depend on the pilot experiences with regional ETSs anticipated from 2013. In addition, the government is also looking to the voluntary carbon market to assist the early development of market infrastructure, pilot activities and data collection. As identified in the GHG Control Plan, testing pilot ETSs and making use of voluntary carbon market are the two streams of China's exploration of domestic carbon markets.

- **Mandatory carbon market: starting from pilot regions?**

The success of Special Economic Zones (SEZs[24]) gave rise to the Chinese government's preference in experiencing a new policy/program first in limited size before rolling out to larger geographic boundaries or the national level. Carbon emission trading follows the same lines, especially at a time when market infrastructures, specific to carbon markets as well as the market economy system in general, are far from mature in China. Although much debate had been made on which regions would be qualified for piloting emission trading[25], it was only in October 2011 that the call for establishing pilot ETS was made official with the NDRC issuing the "Notice on Carrying out the Work of Pilot Carbon Emission Trading". The Notice requires authorities in 5 cities(Beijing, Tianjin, Shanghai, Chongqing, and Shenzhen[26]) and two provinces (Guangdong and Hubei) to formulate ETS oversight guidelines, determine overall targets based on local GHG inventories, draw up allocation rules, establish registry and governance systems, and develop market infrastructure.

The local Development and Reform Commissions (DRC) in the 7 regions, which are the local-level counterparts of the NDRC, are entrusted to coordinate the draft of overall ETS design and implementation plan in their administrative jurisdictions. Local DRCs have mobilized a wide range of expertise, including research institutes, consulting companies and local environmental exchanges, to be involved in drawing up local ETS plans. It should be noted that nearly all local environmental exchanges are involved in the design process and some are even leading the work of formulating local ETS proposals. As future trading platforms, having environmental exchanges design trading rules may cause conflicts of interest; however, the practice is common in China[27]. When completed, the draft plans will first be approved by local DRCs and provincial/municipal governments before being submitted to the NDRC for examination. It is likely that several rounds of revision will take place before any of these plans are formally approved by the NDRC for implementation.

As the Notice was quite general in its content and that no additional guidelines have since been produced to guide the design process, local authorities have much scope for adapting ETS proposals

[23] Source: Sun Cuihua and Wang Shu, China Organizing Framework under the World Bank's Partnership for Market Readiness, 2011.It should be noted that the date of 2015 for national scheme and 2013 for pilot schemes are only indicative and are very likely to be put off.

[24] The first batch of special economic zones (SEZ) were designated to test China's Economic Reform and Open Policy before rolling out to the whole nation. SEZ enjoys more free-market orientated policies and flexible governmental measures.

[25]In September 2010, a top official from NDRC stated wealthy regions with per capita GDP above $10,000 would be encouraged to start the pilot emissions trading first. And later in April 2011, it was reported that 6 regions would appear on the list of ETS pilot regions.

[26] While Beijing, Tianjin, Shanghai and Chongqing are the four municipalities of provincial level, Shenzhen is a city located in Guangdong Province but with a particular status as China's first special economic zone.

[27] For example, environmental exchanges in Tianjin, Shanghai and Shenzhen were designated as the leading institutions in developing local ETS plans.

to local circumstances. An absolute cap is required by the NDRC, though MRV protocols for some key sectors will be unified at the national level. Most design features, including sectors to be covered, allowances allocation method, banking and borrowing provisions and utilization of offset, are at the discretion of local DRCs. Given the limited time left to start pilot trading and shortage of technical knowledge at national as well as local level, the two streams of top-down and bottom up work are being carried out in parallel, with the central government making overall guidelines on MRV and other aspects requiring national coordination, and local stakeholders formulating proposals for local ETS implementation. The two streams are interactive and would merge at some point in the future to ensure the operation and integrity of local ETSs and to provide common infrastructure for a potential national system.

- **Voluntary market: how could it be useful?**

In view of the poor capacity for emission trading, China is also looking into the voluntary carbon market, which emerged in early 2009 (see box 1). Although the voluntary market remains small in size compared to regulatory market, it can serve the national climate policy and help build a domestic carbon market through the early development of market infrastructure, pilot activities, and data collection (Guigon, 2010).

Box 1 - Voluntary Emission Reduction Initiatives in China

Several VER initiatives were launched starting from in 2009 to test the ground for fostering mitigation activities in the agriculture and forestry sectors.

- The Panda Standard (PS), China's first third-party standard for domestic offset projects, was undertaken by the China Beijing Environment Exchange (CBEEX) and BlueNext in late 2009 and aims to establish itself as a broadly accepted initiative and official tool to serve China's climate mitigation efforts, should a carbon scheme emerge in the future. As the first transaction, 16 800 PS credits-to-be issued from the Bamboo Forestation Project in Yunnan province, were acquired by state-owned Franshion Property Company at 60 yuan [28]/t CO_2e in March 2011.
- The China Green Carbon Foundation (CGCF) operates under the administration of the State Forestry Administration (SFA) and mobilizes enterprises, organizations and individuals to voluntarily take part in tree planting and forest protection activities by giving donations to the Foundation. It claims[29] to have completed several forest planting projects to offset emissions from several conferences.
- Several other voluntary projects have also been initiated in China, including those coordinated by the U.S. Environment Defense Fund (EDF) on household biodigesters and soil fertilization in rural areas. In these cases, the credits buyers are large American corporations, rather than domestic entities (Lin et al, 2011).

With growing interests in voluntary carbon trading, the NDRC has initiated the formulation of the "Measures for management of Voluntary Emission Reductions Transactions in China" (hereafter the

[28] 60 yuan equaled to about 0.11€ according to the exchange rate in March 2011.

[29] For example, the total emissions of the UNFCCC Tianjin Conference were offset by the CGCF forestation project in Shanxi, and the carbon footprint of the 2012 China Green Annual Conference was compensated by CGCF forestation project in Inter Mongolia (http://nmsgjhc.com/Article/ShowArticle.asp?ArticleID=536).

VER Measures) since 2009 in a bid to bring transparency and credibility to the nascent domestic voluntary carbon market. As such, China is the first country intending to regulate voluntary carbon transactions, thus generating a government label on voluntary credits.

Initially, the VER Measures are intended to stipulate officially recognized voluntary trading products, eligible trading places, new methodology application procedures, accreditation process for validation and verification bodies, and registry systems[30]. Along with the steady advancement of pilot ETS program and the EU's ban on CERs from CDM projects registered after 2012 (except from Least Developing Countries) to be used with the bloc's EU ETS, China began considering new options for those Chinese CDM projects no longer eligible to the European scheme. Later, it was revealed[31] that the NDRC wanted to enable CERs from China-based CDM projects as eligible offsets under the forthcoming pilot ETSs.

The interim VER Measures were officially published on June 21, 2012. Credits complying with the VER Measures will be called China Certified Emission Reductions (CCERs) and the entire approval process resembles that of the UN offset mechanism, i.e. CDM, with the NDRC acting as the CDM Executive Board (EB) to approve methodologies and projects registration as well as host national registry for issued credits.

- ***Project eligibility***

Four kinds of projects are eligible to request for registration at the NDRC: VER CCER projects using methodologies registered with the NDRC; CDM projects already approved by the NDRC but not yet registered with the CDM EB; CDM projects which had previously generated emission reductions prior to registration with the EB (e.g. pre-CDM credits); registered CDM projects yet not being issued CERs.

The project starting time should not be prior to February 16th 2005. The interim VER Measures recognize all 6 of the approved GHG under the UNFCCC as eligible gases to earn emission reduction credits. At the moment it is unclear whether projects no longer eligible under the EU ETS (e.g. projects destroying HFC-23) and those previously receiving NDRC approval but rejected by the EB, would be eligible to generate CCERs for the domestic market. How voluntary initiatives/standards (e.g. the PS) would qualify for the so-called CCERs also remains still unclear.

- ***Eligible Methodologies***

The VER Measures require all projects aiming to obtain CCERs to use methodologies approved by the NDRC. Certain existing CDM methodologies are going to be pre-empted upon assessment by experts. For a new methodology aiming to request approval at the NDRC, the relevant project design document must also be submitted along with the methodology. After reception of the submitted documents, the NDRC will commission experts to conduct technical assessment, which should be completed within 60 working days. Following experts' review, the NDRC shall deliver approval to qualified methodologies within 30 working days.

[30] See http://www.21cbh.com/HTML/2010-9-21/xNMDAwMDE5ODYxNw.html
[31] See http://www.pointcarbon.com/news/1.1860172.

- ***Project registration***

While foreign as well as national entities and individuals would be allowed to buy CCERs, only business entities registered in the P.R.C are authorized to apply for VER projects registration. Central-level, large state-owned enterprises (SOEs)[32] supervised by the State-owned Assets Supervision and Administration Commission of the State Council (SASAC)[33] are allowed to directly apply for projects registration at the NDRC, and other business entities must first get approval from relevant provincial DRCs.

Similar to the CDM process, projects must also be validated by a validating entity[34] accredited by the NDRC before requesting registration. The VER Measures also define the documents that should be submitted for project registration (see Annex 1). After reception of the submitted documents, the NDRC will commission experts to conduct technical assessment, which should be completed within 30 working days. Following experts' review, the NDRC shall deliver registration decision to qualified projects in no later than 30 working days.

- ***CCERs issuance***

To request for CCER issuance, verification must be carried out by a verifier accredited by the NDRC and the verification report, along with the monitoring report, be submitted to the NDRC. Project validation and verification are allowed to be carried out by the same entity expect for those with annual emissions reductions more than 60k tCO_2e. After reception of the submitted documents, the NDRC will commission experts to conduct technical assessment, which should be completed within 30 working days. Following experts' review, the NDRC shall issue CCERs to qualified projects in no later than 30 working days.

- ***CCERs transactions***

Transaction of CCERs will be restricted to trading places recognized by the NDRC, and their trading systems should be connected to the national VER Registry to track real time transfer of CCERs. Entities aiming to hold CCERs transactions should submit application documents to the NDRC via the provincial/municipal DRC, and only Chinese-funded entities registered in the P.R.C with registered capital more than 100 million RMB ($15.7 million) are allowed to apply to become trading places. Other requirements for applicants include: a satisfactory trading and clearing system with effective trading rules, a suitable risk control system, and suitably qualified and experienced employees.

In short, the VER Rules are expected to target project-based carbon markets in China and to give a particular focus on future offset mechanism under a pilot or potential national cap-and-trade scheme, rather than a 'pure' voluntary system. Therefore, the VER Rules are of great importance in assisting and accelerating ETS development in pilot regions and to promote the establishment of a national

[32] This also includes their subordinate and holding companies. The SOEs list eligible to directly request for project registration at the NDRC is attached at the end of the Measures (in total 43 SOEs).

[33] SASAC is a special commission of the PRC directly under State Council. SASAC consolidates the management of 117 (number to date) central-level, large state-owned enterprises (SOEs). It is responsible for supervising and managing the SOEs, guiding the share reform and restructuring of SOEs, appointing top executives of the key enterprises and evaluating their performances and drafting laws related to SOEs regulation.

[34] The NDRC has not given out the list of accredited validators and verifiers. The VER Measures outline the documents and application process for entities aiming to become recognized validators and verifiers.

carbon market. They are especially important in establishing the trading framework, streamlining the trading process, and fostering a registry at the national level in the early stage of carbon market development in China.

3.3 Status of carbon market development

- **Features of the seven pilot regions**

The seven regions for pilot ETSs were selected to reflect both potential for emission reductions and diversity in terms of economic and social development (see table 5). These regions can be classified into 3 groups: those with high GDP/ capita and low energy intensity (Beijing, Shenzhen and Guangdong); those having high GDP/capita and middle level of energy intensity (Tianjin and Shanghai); and finally those less wealthy but are more energy-intensive economies (Hubei and Chongqing). All 7 pilots have been assigned energy intensity and carbon intensity targets higher than or equal to the national average. In Beijing and Shanghai, industry now constitutes a lower proportion of economic activity; the other regions still rely heavily on the secondary sector. Within the industry sector, the proportions of power generation, cement and steel manufacturing, the three sectors mostly likely to be covered by an ETS, in regional carbon inventories are varying (see figure 6).

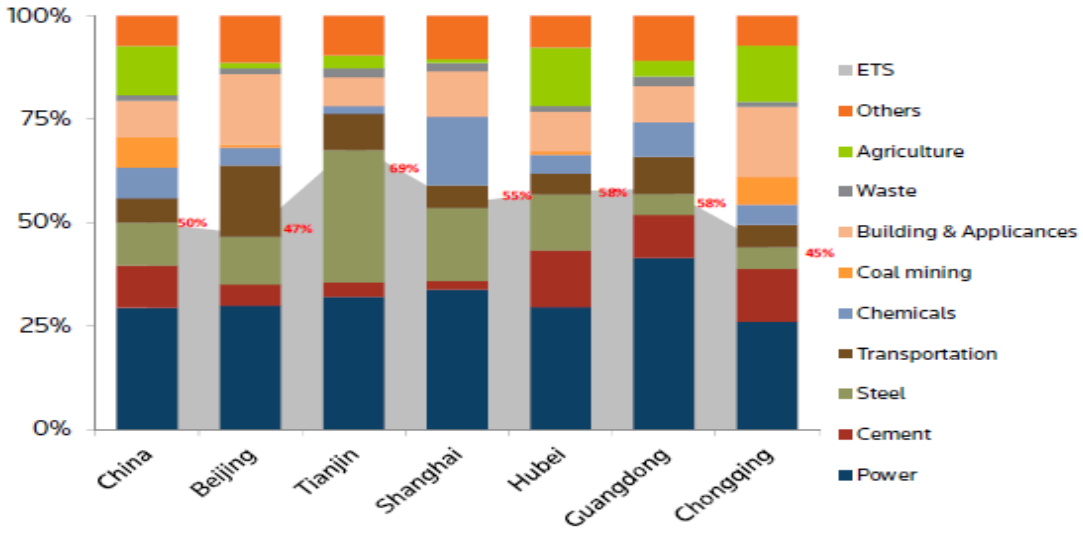
The design of carbon markets and other energy and carbon emission policies should be tailored to reflect these diversities. Pilot experiences in areas with different social and economic contexts will provide China valuable learning for a scheme to be implemented at the national level.

Table 6 - Economic features, energy intensity and targets for 2015 of the 7 pilot regions

Province/ City	GDP 2010 (Bln yuan)	Population 2010 (Mln)	GDP per capita 2010 (1000 yuan)	Energy intensity in 2010(based on 2005 constant prices) (tce/Mlnyuan)	Energy intensity decrease in 2010 from 2005 (%)	Secondary sector's share of economy (%, 2010)	Energy intensity target (%, 2015/2010)	Carbon intensity target (%, 2015/2010)
Beijing	1411.4	19.6	75.9	58.2	26.6	24	17	18
Tianjin	922.4	13	73	82.6	21	52.4	18	19
Shanghai	1716.6	23	76	71.2	20	42.1	18	19
Hubei	1596.8	57.3	27.9	118.3	21.7	48.7	16	17
Guangdong	4601.3	104.4	44.7	66.4	16.4	50	18	19.5
Chongqing	792.6	28.9	27.6	112.7	21	55	16	17
Shenzhen	958	9	106.4	51.3	13.1	47.5	19.5	21
PRC	**40120.2**	**1341**	**29.9**	**103**	**19.1**	**46.8**	**16**	**17**

Sources: China Statistical Yearbook 2011, Statistical Yearbook of Guangdong Province

Figure 6 - Share of CO2 emissions by sectors in pilot regions



Note: * Shaded areas represent the share of the power, steel, cement sectors in each region.
** Some data are from McKinsey 2009 report.

Source: Point Carbon- Carbon Market Monitor

- **Degrees of readiness in the pilot regions**

Although in all seven jurisdictions, the ETS preparation work is now in full swing and some regions have already submitted to the NDRC rough ETS design proposals[35], very limited information has been revealed about the contents of ETS design proposals and implementation plans. Therefore, the discussion below mainly drew from reports and unofficial statements from experts involved in the design process; and moreover, information presented here should not be regarded as the final features of pilot ETSs in China, which are still in their infancy. As of the time of writing, only the Beijing DRC has publically released the draft design proposal for its pilot ETS (see box2). Progress was reported in Shenzhen[36], Tianjin and Shanghai although Guangdong was the most active advocate for launching China's first pilot ETS[37]. As illustrated by table 7, most of these regions' plans are still in their infancy, grappling with the key problems of setting a carbon trading scheme, and much work remains to be done before a clear understanding of what will take place can be known.

Although none of these regions have officially designated the sectors to be included under their ETS designs, emission intensive industrial sectors are most likely to be brought under an ETS scheme. Big emitters may vary among jurisdictions (see figure 5) but the power sector is poised as one of the natural candidates for ETS participation, notably due to the high level of consolidation[38] and relevant basis of a data reporting system. Regarding eligibility of offset projects, the VER Rules foresee that pilot regions may elect the kind of CCERs to be allowed under their ETSs. In addition, the NDRC would also permit pilot ETSs to use local offset types. To date, Chongqing is the sole region that has clearly

[35] The design proposals at this stage would likely set the overall framework to foster efforts around detailed market design at a later stage.
[36] Shenzhen is said to have submitted detailed implementation plan for local ETS; however, at this stage, this piece of information can't be confirmed.
[37] http://www.chinanews.com/cj/2011/09-22/3344789.shtml
[38] China's power generation capacity is highly concentrated on the five largest state-owned power generation enterprises- China Datang Corporation, China Guodian Corporation, China Huadian Group, China Huaneng Group, and China Power Investment Corporation.

announced the kind of local offset projects (i.e. forestry projects) it intends to use under its local cap-and-trade system.

Table 7 - Status of advancements in the ETS preparation work in the seven regions

Province/city	Sectors likely to be covered	Number of emitters to be covered	Status of development(as of may 2012)	Possible carbon trading platform
Beijing	power, heating, manufacturing and public buildings sectors	About 400-500 companies emitting on average above 10,000 tons CO_2 per year from 2009 to 2011	Release of design draft in March 2012 Now in the process of developing implementation specifications for each aspect of the ETS	China Beijing Environment Exchange
Tianjin	5 key sectors	120 companies with more than 10,000 tce annual energy consumption	Pilot design draft submitted to NDRC	Tianjin Climate Exchange
Shanghai	Energy intensive sectors including power and non-industry entities	380 entities emitting more than 10,000 tons yearly	Pilot design draft submitted to NDRC	Shanghai Energy & Environment Exchange
Hubei	No information available	More than 100 most carbon intensive companies	To finalize the rules and complete work collecting data from emitters in October or November 2012	Hubei Carbon Exchange to be established mid-2012
Guangdong	power, building materials and chemical sectors, probably extend to business entities	No information available	Kick-off meeting on market design held in September 2011; Basic GHG inventory was completed, next steps are to determine caps and allowance-to be finished before March; To initiate voluntary trading in 2013 as a test for compulsory market starting in 2014.	Guangzhou Carbon Emission Exchange(to be operational in June 2012)
Chongqing	Electrolytic aluminum, ferroalloys, calcium carbide, cement, caustic soda, and iron and steel	Enterprises with annual emissions beyond 20,000 ton CO2	The implementation plan has been recently completed and will be soon submitted to NDRC. Explicitly state the use of forestry carbon credits as eligible offset.	Chongqing Carbon Exchange(about to be launched)
Shenzhen	No information available	Overall cap set at 100 million tons to cover 600-1200 entities as emissions source are diverse in Shenzhen	Pilot implementation plan submitted to NDRC in November 2011; To complete emissions monitoring of covered entities by mid-2012 and allocate quota on the second half of 2012; Trading is planned to start end 2012 or beginning 2013.	China Shenzhen Emission Exchange

Source: compiled from Draft Design on Beijing Emissions Trading and various reports[39]

Beijing was the first to release design features and set an implementation timetable for a pilot ETS, it need not necessarily be the first to have an operational mechanism. Carbon Market Monitor (Point Carbon, 2012) suggests that Shenzhen and Shanghai will be the first to establish operational ETSs due to their being financial centers with greater political flexibility. Beijing is not expected to be among the first ones due to its high political sensitivity, nor does Tianjin. Chongqing and Hubei will

[39] Due to lack of official communications, status of progress of ETS preparation in different regions can only be obtained from news reports, see for example the report "2000 companies to be included in the Beijing, Tianjin and Shanghai ETS schemes" at http://www.21cbh.com/HTML/2012-5-14/wNNDE3XzQzMzAwNQ.html

probably come last as rapid economic growth remains a top priority in these regions. Many experts are not optimistic about any of these regions having an operational ETS by 2013 considering all the missing pieces and pending questions remaining before a scheme can come into force.

Box 2 - A glance at the Beijing pilot ETS draft design

In March 2012, the Beijing DRC released the draft design for an ETS scheduled to start in 2013, as first-of-its kind among the seven pilot provinces and municipalities. About 400-500[40] entities emitting at least 10,000 t CO_2 per year over 2009-2011 will appear on a mandatory list for capping emissions. Although sectors to be covered are not explicitly specified in the draft, power, heating, manufacturing and public buildings sectors are required to submit their historic emissions data, making them the most likely candidates.

The programme will cover only CO_2 emissions (no other GHG) in the first stage (2013-2015) and absolute emissions caps will be set for all the covered entities. Most of the permits are to be freely allocated to emitters, leaving about 15% of the overall quota for auction. Allocation would take place in December 2012 for 2013 allowances based on average reported emissions during 2009-2011, and in May 2014 and 2015 based on the previous year's emissions due to be submitted by March each year. Banking would be authorized until 2015 while borrowing is not permitted. Compliance instruments include two types of allowances: CO_2 emission permits and eligible CCERs as offsets: carbon credits generated from GHG emission reduction activities regulated by the VER Rules.

The draft also designates the China Beijing Environment Exchange (CBEEX)[41] as the trading platform and over the counter transaction (OTC) would also be allowed. In terms of tradable products, it is largely acknowledged that only spot contracts will be authorized and other carbon derivatives are unlikely to exist at least in the testing phase[42]. The proposed draft anticipates active government intervention by introducing a price control mechanism through which the Beijing Government could auction and purchase allowances when carbon prices are considered too high and too low.

The proposal also signals the formation of three "alliances" to foster relevant stakeholders' involvement to help prepare the Beijing ETS pilot. The first alliance groups major emitters, the second financial institutions, and the third consulting firms and verification agencies.

With regards to the implementation timeline, the draft proposal indicates program design to be finalized and market infrastructures ready by end 2012 to enter the initial implementation stage beginning 2013. Market oversight and other supporting regulations are going to be promulgated in 2013, paving the way for a full operation phase in 2014.

[40] The number of 600 is not indicated in the draft design and was pointed out by a senior official from Beijing DRC in an interview with China Daily : see http://www.ccchina.gov.cn/cn/NewsInfo.asp?NewsId=32078

[41] The draft design doesn't directly name the CBEEX, but CBEEX is the only exchange that meets the requirements outlined in the draft design.

[42] This can be largely attributed to China's government being unfamiliar with financial derivatives. Futures trading is allowed in only a handful commodities and in November 2011, the government issued regulations to restrict futures trading only on exchanges with a license issued by the State Council. This tightened financial regulations thus sparked concerns on the liquidity of China ETSs as it provides little interest to financial participants.

- **A national scheme: visible in the near future?**

An ETS implemented at larger geographic boundaries usually improves the cost-effectiveness of the scheme as more low-cost mitigation options are available and carbon leakage is minimized. If a carbon market is to accelerate the transition to a low-carbon economy in China, a national ETS is needed. China has confirmed its intention to launch a national ETS as early as 2016, taking stock of the experiences from the 7 pilots. However, some official sources indicate that this timeline is ambitious. A national scheme may not be likely before 2020, when China would agree to take on legally binding climate commitments.

The ongoing efforts around the development of carbon markets in China have built new capacities that could be applied to a national scheme.

The experience has helped mobilize both domestic and international expertise. The NDRC has initiated a legislative process that could provide the legal and institutional framework for the development of a domestic ETS in China. It is working to unify at the national level standards, guidelines and detailed regulations of an MRV system for pilot ETSs. The requirement of the 17,000 energy intensive enterprises falling under the '10000 energy consuming enterprises programme' to report their annual energy consumption and emissions data will provide a strong MRV foundation for a national scheme. The VER Rules and the relevant Registry establishment will provide the common infrastructure and rules for a national domestic offset program.

3.4 Challenges in establishing successful carbon markets in China

Notwithstanding the progress in domestic carbon market readiness, it is unlikely that pilot ETSs will be implemented by 2013 and a national ETS by 2015[43]. Some of these challenges are common for any kind of mandatory carbon market (e.g. data collection and the MRV), while others are specific to China, (e.g. deregulation of power price and poor fundamentals of market mechanisms). In March 2012, a NDRC official indicated that an additional year would be required to launch each of the pilot ETSs and the national scheme.

- **Fundamentals of market economy in China**

According to Han et al. (2012), the most critical issue in the establishment of a functional carbon trading scheme in China lies in how to operate a strong market-based instrument in a system without a mature free-market. Although China has come closer to a real market economy since the market-oriented reform starting in 1978, it still differs from mature free-market economies because of its heavy government intervention and a large share of state-owned enterprises.

China's previous experience with emissions trading demonstrates its vulnerability. In the early 2000s, several SO_2 emissions permits trading programmes were piloted in China. The pilot scheme in Jiangsu province covered 196 power plants and the city of Taiyuan allocated SO_2 emissions permits to the top 45 emitters, responsible for 99% of total SO_2 emissions in the urban area of the city. However, very limited transactions were announced after the launch of these programmes and the few symbolic ones were basically matched by local governments. In the end, the 'SO_2 pollution permit',

[43] The timetable was given by NDRC officials in several occasions but without official announcement.

designed as a tradable product, became part of the administrative system of local environmental protection bureaus. Tao et al. (2009) attributes these failures to the profound shortcomings of China's market systems: a 'state-led' pseudo-market instead of a full and 'autonomous' market.

Experiences and lessons from SO_2 trading will have fundamental implications for a domestic carbon market: even if an appropriately designed carbon market is established, traditional corporate behaviors and resistance to active participation could prevent any substantial trading from taking place (Han et al., 2012). It is possible that large-scale carbon trading schemes in China are unlikely in the near future or even that any carbon trading scheme might be implemented administratively.

- **Deregulation of power price**

In China, nearly all power generators are state-controlled. Both wholesale and retail electricity prices are regulated directly by the NDRC in order to stabilize electricity supply. In other words, electricity prices are fixed by the central government while fuel prices, especially price of coal, have been widely liberalized. It is thus impossible for the power sector to pass through the added cost of carbon allowances to end-users under the current price-control system. Introducing the power sector into an ETS in China therefore would encounter much opposition from power enterprises if they perceive carbon allowances as an additional cost for power generation, especially for coal-fired plants who claim their benefits very marginal due to gradually rising price of coal. Without reform in the electricity pricing system in China, a cap-and-trade scheme's purpose of incentivizing emission reductions through carbon pricing signals would be undermined if the power sector is covered in an ETS. However, a NDRC official clearly stated that electricity supply security and price stability would remain the main focus[44], thus complicating the efforts in designing efficient ETSs in China.

Another obstacle for the power sector to deliver expected emission reductions under a potential ETS is the inefficient plants dispatch system: dispatch in China is driven by local mandates on generation time, rather than on the basis of the operating costs of plants[45] (IEA et ERI, 2012). Although the trial of more rational dispatch of power plants has been carried out in 5 provinces starting in 2008, the process of expanding it to national level may face barriers. The key challenge will be the compensation of the plants that would be dispatched less and thus receive less revenue under a new dispatch method.

- **Monitoring, reporting and verification (MRV) system**

In a typical cap-and-trade scheme, historical emissions data provide the basis for determining allowances for regulated emitters. But collecting reliable information can be difficult. In the case of the EU ETS, where the data collection system is more advanced in Europe, only four of the EU member states met the deadline for notifying National Allocation Plans (NAPs)[46] to the European Commission before commencing the first phase in 2005 (Ellerman et al., 2010). In China, the GHG

[44] http://www.pointcarbon.com/news/1.1915861

[45] The running hours of each plant is determined by local governments' annual plans, and thus not enabling plants dispatch to achieve least-cost electricity generation within the regions.

[46] NAPs are plans that set out each Member State's allocation of CO_2 emission allowances under the EU ETS. NAPs fix both the total of emission allocations available in each member state and the allocation made to each installation covered by the scheme.

emissions database is extremely poor at national, regional and company levels. Reliability of data will be a major issue.

Complete, transparent and accurate data are essential for securing confidence in an ETS. China still lacks fundamental legislation and guidelines on MRV procedures that companies must follow to measure and report their emissions and third-party auditors to carry out verification. There are concerns that in the absence of an enforced legal framework, it will be difficult to ensure the accuracy of collected data due to the cost it may imply for the covered entities under a carbon trading system.

The importance of a robust MRV system has impelled the NDRC to unify MRV guidelines at the national level. China is now formulating emission accounting guidelines for 6 key sectors: power, cement, iron and steel, chemicals, non-ferrous metals and aviation. The government issued an order[47] in May 2012 to require all of China's 117 central-level state-owned enterprises (SOEs) to report their CO_2 emissions annually starting from this year, as well as for 2005[48]. On May 29th 2012, the "Beta version of GHG emissions calculation tool for Chinese coal fired power plants", developed by the WRI in partnership with China Electricity Council based on WRI's GHG Protocol, was launched. This is a considerable step forward to GHG accounting as coal-fired power plants are responsible for over 80% of total electricity generation and 45% fuel-combustion CO_2 emissions in China. However, it remains unclear to which extent this tool will be embraced by the Central Government.

Most of the seven pilot regions have now moved into the process of gathering historical emission data. The Guangdong government, for example, has just launched a study on building emissions baselines for facilities in 5 major sectors likely to be introduced under the local ETS: power, cement, iron and steel, petrochemicals and large public buildings[49]. Lack of emissions data is a problem common to other pilot regions, as collecting them remains a sensitive issue and time-consuming process. It is very likely that the seven regions will not have collected enough data for a January 2013 start date.

- **Coordination among different institutions at national and local level**

At the national level, although the Climate Change Department of the NDRC is given full responsibility for climate-related issues, including the establishment of domestic carbon market, other departments within the NDRC share in the responsibility, and may even determine the success of the ETS. Carbon trading will likely have implications for stabilization of local prices, especially in the case of a regulated price system for the power sector. However, current discussions around ETS are essentially climate-oriented with limited assessment of ETS impacts on cost and social development. The Department of Social Development, the Department of Industry and Department of Price may not support an ETS in China until they perceive ETSs as an effective tool to drive energy efficiency improvement in industry and that they will not have negative influence on social price stabilization. The Ministry of Industry and Information Technology will also play a key role to centralize economic activity and energy consumption data.

[47] See http://www.pointcarbon.com/news/1.1910936

[48] These enterprises have already been required to report their energy use, energy efficiency and emissions of some air pollutants since 2008.

[49] See http://www.pointcarbon.com/news/1.1914260

Consequently, large coordination efforts among the Climate Change Department and other NDRC departments or other Ministries is imperative for the success of a domestic trading scheme. The same kind of coordination will be also needed amongst local institutions implicated in the pilot ETSs.

At the provincial level, the inclusion of state-owned enterprises regulated by the Central Government presents another potential obstacle. Amongst them are some of the top emitters (e.g. in the power sector). Excluding them will undermine the effectiveness of an ETS. However, local authorities do not have the same authority to regulate these enterprises as other companies within its jurisdictions. As a result, additional coordination would be needed between National and local DRCs and the SASAC.

Given the coordination challenge, some experts suggest a more effective approach may be to launch a national ETS from the 17000 energy intensive enterprises falling under the '10 000 energy consuming enterprises programme' as an alternative to regional pilot ETS approach. Together, these enterprises account for over half of national CO_2 emissions. They are assigned energy conservation targets and are required to report their annual energy consumption and emissions data. Under this approach, governance and emission reporting would be centralized, and therefore coordination work would be minimized.

- **Conversion of intensity target to absolute cap**

In an ETS with free allocations, the starting condition is determining an absolute cap and setting allocations for participating entities. It was previously debated in China whether an emission cap for ETSs should be absolute or intensity-based, the first of which guarantees the environmental certainty of a scheme while the latter ties emissions to GDP growth. The NDRC requires pilot ETSs to have absolute caps in spite of the fact that only carbon intensity targets are mandatory for local governments. In contrast to the EU ETS, a constant or decreasing cap will not be accepted by China, since it would not allow for emissions growth to accommodate economic development needs. As a result, local authorities are challenged to determine caps for targeted entities to achieve both equity and efficiency. For the equity concern, economic growth projections need to be reasonable to leave room for companies to grow. For the efficiency concern, higher emission allowances will not induce emitters toward ambitious emission reduction activities.

- **Registry functionality**

Registries record the allocation, transfer and surrender of allowances, and are thus an essential infrastructure for an ETS. As the CO_2 permits or credits only exist immaterially in the electronic accounts in registries, the security of registries is a critical issue.

In the EU, each member state established an individual National Registry complying with the guidelines in the EU ETS Directive. All National Registries are connected to the Community Independent Transaction Log (CITL), which currently automatically checks, records, and authorizes all transactions of EU ETS-compliant instruments[50] that take place between accounts of the EU ETS participants. From mid-June 2012 onwards, all of the EU ETS participants' accounts will be migrated from National Registries to a single Union Registry (UR) to accommodate changes for the third phase of the EU ETS (2013-2020), in particular with regards to auctioning and centralized governance at EU

[50] These instruments include EUA *(*European Union Allowances), CER from CDM project and ERU (Emission Reduction Units) from Joint Implementation projects.

level. In addition, the UR will reinforce measures for market integrity in the wake of allowances theft from national registry accounts in early 2011.

Regarding registry establishment in China, the NDRC entrusted the ERI to draw up proposals on the establishment of a national registry to record issuance, transaction and surrender of CCERs that will come with the release of the VER Rules. However, the government has not yet announced any plan to provide basic provisions to guide registry development in pilot ETS regions. In the absence of top-level regulatory framework, local governments commissioned various institutions to design a registry for local ETSs[51]. Consequently, there are potential risks that local registries are not compatible and cost is likely to be significant to carry out amendments to link them to a future national registry. Another concern is about how project-based national registry (like the one ERI is developing) will connect with regional ETS registries. Market supervision including security enforcement is another factor to be fully taken into consideration as China draws lessons from the EU ETS.

[51] For example, in the $750,000 technical assistance of Asian Development Bank (ADB) for designing the Tianjin Emission Trading Scheme, one of the three main objectives is to develop technical specifications for ETS and emission allowance registries. In addition, ADB will provide supplementary grant to recruit a software vendor for the delivery of a trading platform and registry.

Conclusion

The inclusion of carbon intensity targets into the Chinese 12th Five-Year Plan for national social and economic development (2011-2015) is a strong signal of China's intention to transition to a low-carbon economy. To promote more profound energy conservation and emission reduction activities, the scope of the policy measures implemented under the 11th FYP period were expanded and implementation will be enforced. Although these traditional command-and-control regulatory approaches will remain the fundamental policy measures in the years to come, their negative impacts – such as the extreme measures adopted in some regions to fulfill the year-end energy intensity target - have demonstrated their limits.

In this context, policy makers are considering the use of other kinds of policy measures, of which emissions trading is explicitly defined in official documents. China aims to establish a national carbon emission trading system by 2016 drawing upon experiences from carbon-trading pilots to be initiated in seven provinces and cities from 2014 and by regulating the voluntary carbon market. The seven regions are now preparing design and implementation plans of experimental ETSs.

Notwithstanding significant progress, various obstacles remain and are likely to delay the launch of functioning pilot regional ETSs and a national ETS. The largest concern is about the feasibility of a pure market-based tool applied in a system with an immature market economy and in which participants are generally resistant to trading. Although the power sector is generally regarded as a natural candidate for ETS participants, the current price-control system for the power sector will undermine the effects of an ETS as power price is not authorized to reflect additional carbon cost. In addition, extensive capacity building work is also needed for the MRV, including the design of an effective and robust registry system. Coordination among government agencies will be crucial, therefore requiring comprehensive assessment of the impacts of ETSs on social price stabilization and industry production cost. An effective ETS is unlikely without these obstacles overcome. Quite apart from these issues, the prospect of a national carbon emission market in China remains uncertain, dependent on progress in international negotiations and domestic capacity building. However, the clear assertion of China's willingness to be engaged in a legally binding framework for emissions reductions post-2020 does open the door for a possible national ETS in the future.

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Annex 1 List of documents needed for requesting project registration at DRCs

1. Project registration application letter and application form;
2. Project description;
3. Business license of the applying entity;
4. Approval document on the feasibility report, project approval document or project registration document;
5. Project environmental impact assessment report ;
6. Project energy conservation assessment and review opinions;
7. Documentary evidence of project starting date
8. Project design document applying methodology(ies) registered at the NDRC
9. Project validation report

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