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The Emissions Trading System in the Context of Climate Change: China's Response

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Abstract

The Carbon Dioxide Emissions Trading System (ETS) refers to the trading of six major greenhouse gases (GHGs). It is an economic tool developed for the purpose of reducing GHG emissions cost-effectively. Carbon trading can be categorised into allowance-based transactions (or *cap-and-trade schemes*) and project-based transactions (or *credit schemes*). These schemes are regarded as one of the most cost-effective measures to combat climate change. Besides the European Union's ETS (EU ETS), several other ETSs operate or have been proposed across the world. These include but are not limited to Australia, Canada, South Korea, and the United States (US) as a whole as well as California as a US state.

Against this background, it is of great significance to focus on China's response to the ETS in the context of climate change because, as a major developing country and the largest GHG emitter, China plays a significant role in addressing global warming. This article focuses on the ETSs overseas; it discusses international experiences and implications for China's ETS; it explores the necessity of establishing a Carbon Dioxide ETS in China by discussing the country's external and internal pressures with regard to emissions reduction; it analyses the feasibility of establishing such an ETS in China by examining the existing policy support; it critically analyses past experiences, including what can be learnt from sulphur dioxide emissions trading, the Kyoto Protocol to the United Nations Framework Convention on Climate Change's Clean Development Mechanism (CDM), and voluntary carbon dioxide emissions trading; and subsequently points out key issues of a carbon dioxide ETS in China.

A. Introduction

The Carbon Dioxide Emissions Trading System (ETS) refers to the trading of six major greenhouse gases (GHGs). It is an economic tool developed for the purpose of reducing GHG emissions cost-effectively, and was initiated by, and developed based on, the three 'market-based' mechanisms: the Clean Development Mechanism (CDM), Joint Implementation, and Emissions Trading, as defined in the Kyoto Protocol[1] to the United Nations Framework Convention on Climate Change (UNFCCC)[2] as part of the response towards the mitigation of global warming. Thus, a new commodity was created in the form of emission reductions or removals. Since carbon dioxide is the principal GHG, people speak simply of *trading in carbon*. Carbon is now tracked and traded like any other commodity.

Carbon trading can be categorised into allowance-based transactions (*cap-and-trade schemes*) and project-based transactions (*credit schemes*). With the former, the governing body begins by setting a total cap on emission allowances. Subsequently, those allowances are allocated or auctioned off to individual regions, countries, or even firms. Members who do not have enough allowances in relation to their emissions must either make reductions or buy another member's spare allowances. Members with extra allowances can sell or bank them for future use. The European Union's ETS (EU ETS) is an example of such a trading system. These transactions may facilitate mandated participants to meet compliance requirements at the lowest possible cost. A project-based transaction may allow the buyer to purchase emission credits from a project that can verifiably demonstrate GHG emission reductions compared with the emissions that would have incurred anyway, by funding pre-approved emissions reduction projects in other countries.[3] The CDM of the Kyoto Protocol is the most notable example of such a project.

The ETS has been regarded as one of the most cost-effective measures to combat climate change. As set out in Article 17 of the Kyoto Protocol, emis-

1 Kyoto Protocol, opened for signature 11 December 1997, entered into force 16 February 2005, available at http://unfccc.int/resource/docs/convkp/kpeng.pdf, last accessed 20 December 2012.

2 United Nations Framework Convention on Climate Change, opened for signature 12 June 1992, entered into force 21 March 1994, available at http://unfccc.int/resource/docs/convkp/conveng.pdf, last accessed 20 December 2012.

3 Capoor & Ambrosi (2007:8).

sions trading establishes a system of emission rights trading whereby one so-called Annex I country[4] might directly purchase some of its rights to emit GHGs from another Annex I country. ETSs may be established as climate policy instruments at the national and regional level. The EU ETS is the largest of such schemes in operation. Besides the EU ETS, several other ETSs operate or have been proposed across the world. These include but are not limited to Australia, Canada, South Korea, and the United States (US) as a whole as well as California as a US state.

China also announced its plan to establish domestic carbon markets. As a major developing country and the largest GHG emitter, China plays a significant role in addressing global warming. With a view to reducing carbon emissions in a cost-effective manner, China approved mandatory cap-and-trade emissions trading pilot schemes in seven provincial regions by 2013, and will expand them nationally in 2015 in an effort to encourage carbon emission reductions. If the schemes are introduced in 2013, China could consider introducing a nationwide ETS in its next Five-year Plan, covering the period starting in 2016. In spite of the intention to launch the pilot schemes in 2013, making cap-and-trade a reality in China will be challenging. The key issues are still under discussion, including the future design of the pilot schemes, the timetable for implementation, obstacles and challenges to be addressed, and perspectives for a nationwide ETS.

Against this background, it is of great significance to focus on China's response to ETSs in the context of climate change. Therefore, this chapter aims to discuss ETSs in the context of China through a comparative study of international experience, and by analysing the feasibility and necessity of establishing a carbon dioxide ETS in China. To achieve this aim, this article is divided into four sections: B, C, D, and E. Section B focuses on ETSs overseas, and discusses international experiences and their implications for China's carbon dioxide ETS. Section C explores the necessity of establishing a carbon dioxide ETS in China by discussing the external and internal pres-

4 *Annex I countries* refers to the industrialised countries listed in Annex I to the UNFCCC, which committed to returning their GHG emissions to 1990 levels by the year 2000 as per Article 4.2(a) and (b). These countries also accepted emissions targets for the period 2008–2012 as per Article 3 and Annex B of the Kyoto Protocol. They include the 24 original Organisation for Economic Co-operation and Development (OECD) members, the EU, and 14 countries with economies in transition (Croatia, Liechtenstein, Monaco and Slovenia joined Annex 1 at COP3, and the Czech Republic and Slovakia replaced Czechoslovakia).

sures on the country with regard to emissions reduction. Section D analyses the feasibility of establishing a carbon dioxide ETS in China by examining the existing policy support, as well as critically analysing past experiences and lessons learnt from emissions trading of sulphur dioxide, the Kyoto Protocol's CDM, and voluntary carbon emissions trading. Section E points out the key issues of a carbon dioxide ETS in China.

B. International Experiences and their Implications for China

I. The EU

The EU ETS is a cornerstone of the EU's policy to combat climate change, and is its key tool for reducing industrial GHG emissions cost-effectively. The EU has allocated a market price to carbon emissions and has proved the possibility of trade in GHG emissions. This flexibility ensures that emissions reduction occurs in a cost-effective way.

Being the first and biggest international scheme for the trading of GHG allowances, the EU ETS now operates in 30 European countries[5] and currently covers over 11,000 installations in the energy and industrial sectors, which are collectively responsible for close to half of the EU's emissions of carbon dioxide, and 40% of its total GHG emissions.[6] It covers carbon dioxide emissions from installations such as power stations, combustion plants, oil refineries and iron and steel works, as well as factories making cement, glass, lime, bricks, ceramics, pulp, paper and board.

There have been three phases under the EU ETS to date since its launch on 1 January 2005. The first trading period (Phase I) ran for three years, to the end of 2007. This was a 'learning-by-doing' phase to prepare for the crucial second trading period (Phase II). Phase I successfully established the free trading of emission allowances across the EU, putting in place the necessary infrastructure and developing a dynamic carbon market. However, the environmental benefit of this phase may have been limited due to excessive allocation of allowances in some member states and sectors.

Phase II began on 1 January 2008 and ran for five years, until the end of 2012. The importance of this phase stemmed from the fact that it coincided

5 The 27 EU member states, plus Iceland, Liechtenstein and Norway.

6 For more details, see Emissions Trading Scheme (EU ETS), available at http://ec.europa.eu/clima/policies/ets/index_en.htm, 12 December 2012.

with the first commitment period of the Kyoto Protocol. For Phase II, EU ETS emissions were capped at around 6.5% below 2005 levels, to help ensure that each member state, as well as the EU as a whole, delivered on their Kyoto commitments.

As from the third trading period (Phase III), a single EU-wide cap will apply, and allowances will be allocated on the basis of harmonised rules. At the same time, in order to strengthen the system, a series of important changes will take effect to the way the EU ETS works. The most significant one is that the auctioning of allowances will become the basic principle for allocation. Member states will be responsible for ensuring that the allowances given to them are auctioned. The distribution of the auctioning rights to member states is largely based on emissions in Phase I, but part of the rights will be redistributed from richer member states to poorer ones to take into account the latter's lower per capita gross domestic product (GDP) and higher prospects for growth and, therefore, emissions.

In addition, as from 2013, the scope of the EU ETS will be extended to other sectors and GHGs. Carbon dioxide emissions from petrochemicals, ammonia and aluminium will be included, as will nitrous oxide emissions from the production of nitric, adipic and glyocolic acid, and perfluorocarbons from the aluminium sector. The capture, transport and geological storage of all GHG emissions will also be covered.

The EU also passed legislation to establish a scheme for GHG allowance trading within the European Community[7] Member states have to bring into force the legal instruments necessary to comply with the legislation. The relevant regulations in the legislation have been revised multiple times. When an international agreement is reached, the European Commission will submit a report to the European Parliament and the Council of Europe assessing the nature and implications of the measures set out in the international agreement, in particular with respect to the risk of carbon leakage. On the basis of the European Commission report, the Commission will then adopt a legislative proposal amending the present Directive, as appropriate. Moreover, the national laws, regulations and administrative provisions will have to be ready.

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7 Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a Scheme for Greenhouse Gas Emission Allowance Trading within the Community and amending Council Directive 96/61/EC, released on 13 October 2003, available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32003L0087:EN:HTML, last accessed 12 December 2012.

It is predicted that, under the EU ETS, emissions will be 21% lower in 2020 than in 2005.[8] Furthermore, the Commission sees the EU ETS as an important building block for the development of a global network of ETSs. Linking other national or regional cap-and-trade schemes to the EU ETS can create a bigger market, potentially lowering the aggregate cost of reducing GHG emissions.

In spite of this achievement, there are some people and organisations that have responded differently to the EU ETS. Firstly, the EU ETS needed to be supported by other policies regarding technology and renewable energy. Policy on technology is necessary to overcome market failures associated with delivering low-carbon technologies, e.g. by supporting research and development.[9]

Secondly, the EU ETS has been criticised for several failings, including over-allocation, windfall profits, price volatility, and generally for failing to meet its goals.[10] In addition, the scheme has been criticised for having caused a disruptive spike in energy prices.[11] It is said that the scheme does not correlate with the price of permits, and in fact the largest price increase occurred at a time when the cost of permits was negligible, i.e. March to December 2007.[12]

Thirdly, there was an oversupply of emissions allowances in Phase I. This drove the carbon price down to zero in 2007.[13] This oversupply reflects the difficulty in predicting future emissions, although a prediction is necessary to set a cap. Given the poor data regarding emissions baselines, the inherent uncertainty of emissions forecasts, and the very modest reduction goals of the Phase I cap (1–2% across the EU), it was entirely expected that the cap may have been set too high.[14]

Fourthly, there are some concerns that the EU ETS has brought about crime. In 2009, Europol informed that 90% of the market volume of emissions traded in some countries could be the result of tax fraud – more specifically, missing trader fraud – costing governments more than €5 billion.[15] In

8 For more details, see EU ETS, available at http://ec.europa.eu/clima/policies/ets/index_en.htm, last accessed 12 December 2012.
9 The Committee on Climate Change (2008:155).
10 Corporate Europe Observatory (2011).
11 Mufson (2007).
12 Ellerman & Joskow (2008).
13 The Committee on Climate Change (2008:140).
14 Ellerman & Joskow (2008).
15 Phillips (2009).

December 2011, in a trial involving evasion of taxes on carbon permits, a German court sentenced six men to jail terms between three years and seven years and ten months. Furthermore, cyber fraudsters attacked the EU ETS using a phishing scam, which cost one company €1.5 million.[16] In response to all of this, the EU revised the EU ETS rules to combat crime.[17]

The success and criticism of the EU ETS could have implications for the design of the Chinese ETS. There are other lessons to be learnt from the experiences of the first two phases of the EU ETS, such as –

- adequate preparation time is essential to implement a well-designed ETS
- the EU's adoption of the cap-and-trade approach to emissions control makes it the preferred approach for other countries wishing to eventually trade emission permits beyond their own borders
- a well-informed trading market requires verifiable emissions data being made available before emissions trading commences, and
- maintaining the relative scarcity of emission permits requires unlimited banking of unused permits, together with no forfeiture of those permits should a particular emitting facility close down.

The main lesson to be learnt from the EU ETS experience is that the relative scarcity of emission permits in a cap-and-trade system need to be maintained if an emissions market is to meet its overall objectives. This constitutes the primary principle, and the lesson should be applied to the Chinese ETS.

II. The United States

The US has also used market-based instruments to reduce emissions, which include, but are not limited to, the Regional Greenhouse Gas Initiative (RGGI), the Global Warming Solutions Act of 2006, and the Chicago Climate Exchange (CCX). According to estimates, some 67% of this €2 trillion (US $3.1 trillion) – equivalent to €1.25 trillion (US$2.3 trillion) – would be traded within the US ETS, while the second largest ETS, the EU scheme, would trade 9 Gt of carbon dioxide, equivalent to 23% of the global market.[18] Therefore, the US ETS is expected to play an indispensable role in the global carbon market, and it is necessary to review its experience and practice.

16 Phillips (2010).
17 EurActiv.com (2009).
18 See Point Carbon (2008).

The RGGI is a cooperative effort by ten north-eastern and mid-Atlantic US states to reduce carbon dioxide emissions from electricity-generating plants. It is a multi-state, cap-and-trade emissions programme with a market-based emissions trading system – the first of its kind in the US. The RGGI is designed to reduce carbon dioxide while maintaining the affordability and reliability of electricity. The programme also directly funds energy efficiency and cleaner energy programmes that will lower GHG emissions.

The RGGI's goal is to reduce carbon dioxide emissions from power plants in participating states through a mandatory cap-and-trade programme. To implement the programme, each RGGI participant state is obliged to enact agreed rules by way of state legislation or administrative regulations. The programme caps GHG emissions in ten states in the north-eastern US, and allocates the right to emit through the auction of allowances. The programme's first three-year compliance period began on 1 January 2009 and ended on 31 December 2011. Emission permit auctioning began in September 2008.

From 2012, the RGGI aimed to build on the success of its first three-year compliance period, and made key improvements as it entered its second three-year compliance period. On 17 January 2012, RGGI member states announced several actions to reduce the number of available emission allowances. Firstly, auctions in 2012 only offered allowances for 2012 and none from the next compliance period (2015–2017). Secondly, at least six states (Connecticut, Delaware, Massachusetts, New York, Rhode Island and Vermont) agreed to retire unsold allowances from the first compliance period, which could otherwise have been used in later compliance periods. With fewer total allowances available for auction, cumulative emissions will decline. Many states have faced an oversupply of allowances as emissions from power plants are approximately 30% less than the cap; this was due in part to the economic recession, as well as to investment in natural gas and renewable electricity generation.

Beyond withholding future compliance-period allowances and retiring unsold allowances, the RGGI might also consider additional measures to increase the market pressure on electricity generators to reduce carbon emissions. Tightening annual emissions caps may be an additional option identified by RGGI's first mandated programme review, which was completed in the summer of 2012.

The economic benefits from the RGGI's first compliance period were significant. An Analysis Group Report,[19] released in November 2011, estimated that the RGGI produced US$1.6 billion in economic value for its member states between 2009 and 2011. The proceeds from sales of RGGI allowances have funded energy efficiency improvement programmes, community-based renewable energy projects, and assistance to low-income customers, education and job-training programmes.

The State of California not only leads the nation in energy efficiency standards and environmental protection, it is also one of the larger emitters of GHG worldwide. In 2006, California became the first state in the US to create a legally binding programme to limit GHG emissions. The Global Warming Solutions Act of 2006, also known as the Assembly Bill (AB) 32, is an exceptional legislative example of addressing climate change and carbon emissions. It is a California state law that fights climate change by establishing a comprehensive programme to reduce GHG emissions to 1990 levels by 2020, by considering all sources throughout the state.

On 17 December 2010, AB 32 adopted a cap-and-trade programme to place an upper limit on state-wide GHG emissions. This programme, the first of its kind in the US, took effect at the beginning of 2012. It includes an emissions limit which will be reduced by 2% each year through 2015, and 3% each year from 2015 to 2020. At first, the rules of the programme were to apply to utilities and large industrial plants; from 2015, they would apply to fuel distributors as well, eventually totalling 360 businesses at 600 locations throughout California. Free credits are to be distributed to businesses that account for about 90% of overall emissions in their sector. Additional emissions have to be accounted for through the purchase of either allowances or credits. Offsets, i.e. actions such as the planting of trees that absorb GHGs, can also be drawn upon to account for up to 8% of emissions.

California is also the key to the Western Climate Initiative, the West's answer to RGGI, which aims "to design a regional cap-and-trade program that can deliver GHG emission reductions within the region at costs lower than could be realized through a California-only program."[20]

In the meantime, California will become the country's testing ground for cap-and-trade policy. The now defunct CCX was North America's only voluntary, legally binding GHG reduction and trading system for emission

19 See http://www.iclei.org/documents/USA/NEG-ECP_CCAP.PDF, last accessed 20 December 2012.

20 Franks (2011).

sources and offset projects in North America and Brazil. Although participation was voluntary, compliance with emission-reduction objectives was legally binding once a member joined. The CCX started trading in October 2003, prior to the commencement of trading in the EU through the EU ETS. The Exchange traded in emissions of six gases: carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, perfluorocarbons and hydrofluorocarbons. The CCX had more than 400 members, including corporations such as Ford, DuPont and Motorola; states and municipalities such as Chicago and Oakland; educational institutions such as the University of California, San Diego; and farmers and their organisations, such as the National Farmers Union and the Iowa Farm Bureau.[21] The CCX says its 450 members achieved reductions of 700 million t of GHG emissions over the seven-year life of the cap-and-trade programme. Some 88% of these reductions were achieved through direct industrial emission cuts, and 12% through offsetting.[22]

However, due to a lack of legislative interest, this pilot programme for the trading of GHGs in the US shut down. Although the nation's first experiment in carbon emissions cap-and-trade ended, its impact on the climate change industry will be felt for some time to come. CCX was a pioneer in establishing a cap-and-trade system. As the first such system established in North America, it gave companies the opportunity to gain experience and learn about emissions-reduction commitments and carbon trading. In addition, California's recent move toward mandatory emissions trading is reviving the market. RGGI officials are also involved in talks to reform their system. Furthermore, CCX officials state that, although they have closed their contractually binding trading platform, they aim to leverage their relationship with some of the nation's largest companies to revitalise the voluntary carbon market, while maintaining their dominant position as the largest host of trading in a variety of environmental commodities.

21 See Participants of Chicago Climate Exchange, available at http://en.wikipedia.org/wiki/Chicago_Climate_Exchange#cite_note-10#cite_note-10, last accessed 20 December 2011. See also the CCX Membership List, available at http://chicagoclimatex.com/content.jsf?id=64, last accessed 20 December 2011.

22 Gronewold (2011).

III. Other Countries

The success of the EU ETS has inspired other countries and regions to launch cap-and-trade schemes of their own. Australia also endeavours to take market-based initiatives in response to the challenge of climate change.

The Australian ETS was due to come into effect in 2010, but was delayed – the main reason being the expected increase in electricity, transport and fuel costs due to the introduction of carbon pricing. Australia's Parliament passed landmark laws to allocate a market price to carbon emissions, ensuring the start of a carbon tax on 1 July 2012, ahead of a full ETS from mid-2015. The Clean Energy Legislative Package includes four main Bills:

- The Clean Energy Bill (2011)
- The Clean Energy Regulator Bill (2011)
- The Climate Change Authority Bill (2011), and
- The Clean Energy (Consequential Amendments) Bill (2011).

This legislation has resulted in Australia becoming an example for many of the key players in the global carbon market, particularly in Europe and the United Kingdom, whose own carbon markets continue to suffer from apparent oversupply. Furthermore, it works towards linking Australia's carbon market with the EU ETS.

The carbon price is a central policy of Australia's Prime Minister, Julia Gillard, who is struggling in the polls and who has staked her government's future on a plan to price carbon emissions from Australia's top 500 polluting companies. The carbon price is the key measure to help Australia – which accounts for 1.5% of global emissions – to reach its target to curb emissions by 5% by 2020, based on levels in 2000. The Australian ETS would have forced up the price of emissions-intensive products such as coal-fired power, gas and, possibly, petrol and beef, thus encouraging people to use less of these commodities. The Australian ETS would probably not actually have discouraged consumption, however; rather, it would have forced consumers to pay higher prices.

Essentially, the Australian ETS works like this: the government sells carbon permits. Permit owners then have the right to emit a ton of carbon. For the first three to five years, an unlimited number of permits are sold at a fixed price (yet to be released). This effectively acts as a tax. After three to five years, the government will move from selling an unlimited number of permits to auctioning a limited number of them. The permits are sold to the highest bidders, who can then use them to emit carbon, or sell them on to

other parties. The price of carbon will vary depending on demand for emissions and the amount of permits auctioned each year by the government.

Like Australia, the Republic of Korea is also making advances in the trading system. On 2 May 2012, the South Korean National Assembly passed the Act on Allocation and Trading of Greenhouse Gas Emissions Allowances, with 148 in favour and three abstentions, showing remarkable political consensus.[23] Under this legislation, the ETS will commence on 1 January 2015 in South Korea for 60% of total GHGs.

C. Necessity of a Carbon Dioxide ETS in China

I. Internal Pressures: Unsustainable Development

Climate change has a different impact on every country, depending on its national circumstances.[24] China has the basic national circumstances described below.

1. Physical Features

China is located in eastern Asia on the western shores of the Pacific Ocean. It is the third largest country in the world, after Russia and Canada, with a total area of 9.6 million km^2. The country has a continental coastline extending over 18,000 km, and an adjacent sea area of 4.73 million km^2.[25]

China's terrain comprises a large variety of landscapes. There are extensive and densely populated alluvial plains in the east, while grasslands dominate the north. For 2005, China's grassland area was 400 million ha, most of which is cold high prairie and desert steppe, while the temperate grasslands in northern China are on the verge of degradation and desertification due to drought and environmental deterioration.[26] Southern China is dominated by hill country and low mountain ranges. The deltas of China's two major rivers, the Yellow River and the Yangtze River (Chang Jiang), lie in the east-central part of the country. Further west there are mostly mountains

23 Noh (2012).
24 Adapted from Jiang (2012).
25 PRC (2007:15).
26 (ibid.).

– the Himalayas being the most well-known example – with high plateaus and deserts. For 2005, China's total area of desertification was 2.63 million km^2, accounting for 27.4% of the country's territory.[27] Arable land only accounts for 14.86% of the total territory of China.[28] The national forest area for 2005 was 175 million ha, with a coverage rate of only 18.21%.[29]

2. *Population*

China has the largest population in the world. In 2005, the population of the mainland was 1.31 billion, accounting for 20.4% of world population.[30] Yet the excessive population-growth trend has been under effective control since the One Child Policy was introduced by the Chinese Government in 1982.

Along with industrialisation, China is seeing rural–urban migration: the urban population, which accounted for only 26.4% in 1990, had increased to 43% by 2005.[31] However, China is still at a relatively low level of urbanisation, with 750 million people living in rural areas, and an urban population accounting for 43% of the national population, which is lower than the world average.[32] However, the enormous population, together with increasing urbanisation, results in huge employment pressure for China, with more than 10 million new workers moving to urban areas each year.[33]

3. *Economic Development*

China's economy has been developing rapidly since the Reform and Opening Up Policy[34] proposed by Xiaoping Deng in 1978. Consequently, living standards have improved dramatically. Although great economic changes have taken place, China is currently at a relatively low level of economic

27 (ibid.).
28 CIA (2008).
29 PRC (2007:15).
30 (ibid.).
31 (ibid.).
32 See China Today.com (2001).
33 PRC (2007:15).
34 The nature of the economy has changed from a centrally planned system under rigid political control to a more market-oriented economy that has a rapidly growing private sector and is a major player in the global economy.

development. In 2005, China's per capita GDP was about US$1,714 (based on the exchange rate of the same year), which only accounted for about one fourth of the world average.[35]

Remarkable disparity in economic development exists among different regions of China. In 2005, the per capita GDP of the eastern areas of the country was US$2,877, while that of the western areas was US$1,136 – only 39.5% of the former. Shanghai (in the east) is experiencing particularly rapid economic development.[36] According to international standards on statistics, the per capita GDP in Shanghai in 2006 was over US$7,000.[37]

The income disparity between rural and urban residents is also significant. In 2005, the per capita disposable income of urban residents was US$1,281, while that of rural residents was only US$397, equivalent to 31.0% of the former.[38] Furthermore, poverty eradication is still a huge challenge for China. By the end of 2005, the poverty-stricken people in the country's rural areas numbered 23.65 million, with the per capita annual pure income less than ¥683 (less than US$100).[39]

4. Climate

In addition to China's extensive territory and complex topography, it has an extremely diverse climate, which ranges from tropical areas in the south to subarctic areas in the north. The northern zone, where Beijing is situated, has summer daytime temperatures of more than 30°C and winters of arctic severity, with the lowest temperature of -30°C in northernmost Heilongjiang Province. The central zone, where Shanghai is situated, has a temperate continental climate, with very hot summers and cold winters. The summer temperatures in the famous 'Three Ovens' cities along the Yangtze River – Chongqing, Nanjing and Wuhan – have been known to reach up to 40°C. The southern zone, where Guangzhou is situated, has a subtropical climate, with very hot summers and mild winters.

35 PRC (2007:16).
36 (ibid.).
37 According to the news conference of the Information Office of Shanghai Municipal Government, 7 February 2007.
38 PRC (2007:16).
39 (ibid.).

Moreover, most parts of China have a continental monsoon climate, with more drastic seasonal temperature variations. As a result, the winter temperature in China is 5–18°C lower than other areas on the same latitude, such as North America and western Europe.[40]

5. *Air Quality*

The air quality in the country is poor. Although the pace of worsening air quality in the cities has slowed, the overall pollution level remains high.[41] According to the *China Environmental Quality Communique* of 2006, 62.4% of the cities monitored had met the national air-quality standard of Grade II, while 37.6% were worse than Grade II. A total of 51 cities had air quality worse than Grade III, accounting for 9.1% of the total cities monitored.[42]

Air pollution leads to acid rain.[43] China is one of the world's countries that suffers from severe acid-rain contamination, which causes many environmental hazards, affects people's standards of living, and is harmful to their health. Central, southern, south-western and eastern China experience serious acid-rain impacts.

In conclusion, China is vulnerable to the impacts of sea-level rise, as it has a long continental coastline. Most of the relatively developed cities, including Shanghai, are situated along this coastline. Despite its huge territory, China still has a vulnerable ecosystem. This is due to the lack of arable land and forest, as well as the expansion of its deserts. The country is facing the challenge of reducing employment pressure caused by its huge population, coupled with increasing urbanisation. As the priorities for China at this stage are to reduce poverty and develop its economy, these goals will require more energy. This will inevitably lead to increased carbon emissions. China has relatively harsh climatic conditions, so inhabitants use more energy to maintain a relatively comfortable room temperature. Air pollution is a serious issue, and more efforts are needed to improve air quality. All of this clearly shows that China is under considerable pressure to reduce emissions without undermining its economic development.

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40 See China Today.com (2008).
41 According to PRC (1996–2008).
42 PRC (2006a).
43 Acid rain is caused mainly by sulphur dioxide and mono-nitrogen oxides from burning coal and oil.

6. Energy Requirements

The demand and supply of energy are affected by economic growth and the structural change of the economic sectors. China has had a very high economic growth rate since the implementation of its Economic Reform and the Opening-up Policy.[44] China's annual GDP growth rate has remained at approximately 10% throughout the eight-year period from 200 to 2010.[45] In particular, the GDP in 2007 reached ¥2.47 billion, showing an 11.4% growth rate.[46] Moreover, it is predicted that this growth momentum will continue.[47]

While China astonishes the world with its rapid economic development, the country is experiencing problems regarding energy and how to fuel its future economic growth. China will certainly require more energy: more electricity is required, for example, to advance industrial development and maintain living standards. Although the industrial structure has been improved through a series of policies that aim to restructure secondary industries and accelerate the development of tertiary industries, the ratio of secondary to tertiary industry remains seriously high in comparison with developed countries. In this scenario, great efforts should be made to optimise the structure of industry, on the one hand, and, on the other, to address the issue of increasing electricity and raw material requirements of the dominating secondary industry sector. Furthermore, as living conditions improve and urbanisation speeds up, more electricity will be required to maintain and raise living standards.

In addition, China's transportation sector is developing rapidly. In the early 1980s, private ownership of cars was very rare. This situation has changed as the country's economy has developed and rising incomes make

44 The programme of economic reforms in the People's Republic of China called *Socialism with Chinese Characteristics* started in December 1978 by pragmatists within the Communist Party of China led by Deng Xiaoping, and have been ongoing since the start of the 21st century. The goal of Chinese economic reform was to generate sufficient surplus value to finance the modernisation of the mainland Chinese economy; see http://en.wikipedia.org/wiki/Economic_reform_in_the_People's_Republic_of_China, last accessed 10 August 2012.

45 See Chinability, available at http://www.chinability.com/GDP.htm, last accessed 10 August 2012.

46 See the primary accounting of China's National Statistics Bureau, available at http://www.stats.gov.cn/english/, last accessed 10 August 2012.

47 (ibid.).

private cars more affordable to the growing middle class. According to a China National Statistics Bureau report, by 2001, China had 7.71 million private cars, a number which may increase to 140 million by 2020.[48] Under this scenario, the consumption of fuel for transportation will increase massively, together with the demand for energy, which will result in energy-related carbon emissions.

China has rich resources of coal, which is the country's main energy source. Historically, coal has supplied more than 70% of China's energy. It is reported that the share of coal in the country's primary energy mix was 76.2% in 1990, while the shares of oil, gas and hydro were 16.6%, 2.1% and 5.1%, respectively.[49] Coal combustion in China is responsible for 70% of its carbon dioxide emissions, 90% of its sulphur dioxide emissions, and 67% of its mono-nitrogen oxide emissions.[50] Thus, in facing the dual problem of drastic air pollution from coal combustion and international concerns regarding carbon emissions caused by coal use, China has realised that its long-term reliance on this resource is unsustainable. Hence, it began to reduce coal's dominance by increasing the share of other energy sources such as oil, nuclear, hydro, natural gas and other various forms of renewable energy. As a result, the share of coal in the total primary energy supply has gradually decreased.

Furthermore, low energy efficiency and high energy intensity, which are measured by the ratio of energy consumption to GDP, may compound China's energy problems. During 1977–1997, China's energy intensity declined by about 60%.[51] However, until 2002, China's percentage increase in energy consumption – with increasing efficiency – was lower in relative terms than its economic growth rate. Still, the energy efficiency is relatively low compared with international energy consumption per unit of GDP. The ratio in 2005 was 0.91, which is 2.4 times higher than the global average, 4.9 times higher than in EU countries, and 8.7 times higher than in Japan.[52] Furthermore, China's energy demands will continue to grow with advancing economic development. Accordingly, China has endeavoured to optimise its energy mix by developing low-carbon and renewable energy alternatives. However, due to its lack of clean technologies and the large amount of coal

48 See *China Daily*, 5 September 2004, China to Have 140 Million Cars by 2020.
49 PRC (2007:9).
50 Sinton et al. (2005:19).
51 Chandler et al. (2002:13).
52 Fu (2006:2).

reserves, in the short term, the country has not been able to completely change the fact that coal is the dominant primary energy resource.

Based on the above analysis, large demands for energy and the domination of coal will lead to increased carbon emissions in future in China. Despite China's increasing emissions, its historical and per capita GHG emissions are very low. According to a study carried out by the World Resource Institute, cumulative emissions in China accounted for 9.33% of the world total emissions during 1950–2002, and the cumulative carbon dioxide emissions per capita were 61.7 t over the same period, ranking China 92nd in the world.[53] Even when compared to earlier data, China's cumulative emissions remain relatively low. During 1950–2002, China contributed only 7.6% to worldwide cumulative emissions, while the US contributed 29.3%, and the 25-member EU 26.5%.[54] In addition, statistics from the International Energy Agency indicate that, per capita, carbon dioxide emissions from fossil-fuel combustion in China were 3.65 t in 2004, which is below the world average and equivalent to one third of the level in Organisation for Economic Co-operation and Development (OECD) countries.[55]

In conclusion, the rapid development of China's economy has resulted in massive GHG emissions which will continue into the foreseeable future. Despite enormous efforts to improve environmental quality in general and the capacity for cutting emissions specifically, it is difficult for China to shift to a low-carbon-consumption society in the short term due to the lack of clean technologies and funding in China. In terms of this scenario, international assistance and cooperation with regard to reducing GHG emissions are of great importance to the country.

II. External Pressures: Post-Kyoto Negotiations

China was not subject to a binding emissions-cut target in the first Kyoto period (before 2012).[56] However, national circumstances have resulted in a rapid growth in both its economy and its emissions. In order to reduce emis-

53 Baumert et al. (2005:13).
54 (ibid.:14).
55 See Statistics and Balance, International Energy Agency, available at http://www.iea.org/stats/index.asp, last accessed 10 August 2012. The OECD comprises mostly developing countries.
56 Adapted from Jiang (2012).

sions, China has been actively participating in the United Nations (UN) post-2012 negotiations as well as in other arenas in which key countries meet to discuss the mitigation of global warming.

Throughout these climate change negotiations, China's position regarding the post-2012 regime has been clearly expressed. Firstly, China acknowledges the major role of the UNFCCC in the international community to structure a post-2012 regime, and insists on "the principle of common but differentiated responsibilities".[57]Secondly, China advocates reducing emissions with technical and financial support from developed countries rather than accepting mandatory emissions cuts in any post-2012 regime. Thirdly, China recognises the urgent need to address climate change and is willing to enter a range of domestic commitments, provided that real action is taken by the developed countries. China announced at the Copenhagen Climate Summit[58] that it would reduce its carbon intensity by 40% to 45% by 2020, based on 2005 levels. This essentially means that China will continue to grow, but will do so more efficiently and in ways that will feature reduced emissions.

Based on their national circumstances and specific interests, the various countries have adopted different positions regarding the post-2012 regime. Three different positions (elaborated below) are held by the following three groups: the EU, the 'Umbrella Group' (a group of developed countries excluding the EU), and the developing countries.

1. The EU

The EU sees itself as a champion in the fight against climate change, leading the world in legislation, technology and action regarding energy-saving and

57 The principle of common but differentiated responsibilities informs in particular the UNFCCC and the Kyoto Protocol. The principle has emerged as fundamental to international environmental law, and was explicitly formulated in the context of the 1992 Rio Earth Summit. Indeed, Principle 7 of the Rio Declaration provides its first formulation, as follows: "In view of the different contributions to global environmental degradation, States have common but differentiated responsibilities. The developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command".

58 Hereinafter *Copenhagen*.

emissions reduction. The EU has committed to reducing its GHG emissions by 20% by 2020, compared with 1990 levels.[59] Furthermore, it was considering raising the 20% target to a 30% cut in carbon emissions if a legally binding treaty for the post-2012 era was concluded.[60] Although the EU has committed to battling global warming with a binding target beyond 2012, it is watching the moves of the US and the major developing countries. It believes that the shift in economic weight for developing countries, as well as for the US, could impact on future approaches to global warming. The economic growth of developing countries, combined with relatively low economic growth rates in the EU, implies that the latter's relative share in global GDP, global energy demand (from 16.6% in 2001 to 12.5% in 2030),[61] and global carbon dioxide emissions (from 14% in 2000 to 8% in 2050)[62] will decrease, while the shares of developing countries will increase. As countries such as Brazil, China, India, Japan, Russia and the US will be the leading economies of the future and should be part of new commitments to address global warming,[63] the EU has urged them to set emissions reduction targets. Moreover, the European Commission (EC) has proposed freezing new demand for CDM projects in 2012 unless the major polluters like China, India and the US set emissions reduction targets.[64]

2. The Umbrella Group

The Umbrella Group is a loose association of developed countries, which includes Australia, Japan and the US. These countries adopt similar positions regarding their reduction obligations in the post-2012 regime. Their medium-term emissions reduction targets for 2020 are low and are conditional upon the participation of the major developing countries.

59 Information Note on the UNFCCC, Council of the European Union, 15838/09 (11 November 2009), 2, available at www.consilium.europa.eu/uedocs/cmsUpload/ST15838_09.pdf, last accessed 8 August 2012.
60 (ibid.:6).
61 IEA (2004:59–80).
62 See EC (2005:35).
63 Perlot (2005:4).
64 See The World Bank (2008).

3. The US

The US is not only the largest and technologically most powerful economy in the world, but also possesses the largest share of historical emissions. Indeed, it ranks first in the world as regards per capita emissions levels. However, the economic growth of the US is not as rapid as that of the major developing countries such as China and India. The GDP growth rate in the US has been less than 3% for the four consecutive years from 2006 to 2009,[65] which means the increase in the demand for energy is lower than that of the major developing countries.

Despite its huge contribution to global carbon emissions, the US has not signed the Kyoto Protocol. The country has, however, become less negative as regards tackling climate change since President Barack Obama took office in January 2009. The Obama Government actively promotes new energy policies. The American Clean Energy and Security Act,[66] an energy bill that addresses climate change and establishes a version of a cap-and-trade plan for GHGs, was approved in June 2009. According to this Act, the US is empowered to impose carbon tariffs on imports from the countries that do not have limited emissions reduction targets. In spite of this active stance, the US still refuses to adopt the Kyoto Protocol. However, it has promised to commit to enhancing financial support for developing countries to address climate change in the context of mitigation actions by major developing countries being transparent.

4. Japan

Japan, one of the world's biggest emitters of GHGs, has a target under the Kyoto Protocol to cut its emissions by 6% from 1990 levels over the period 2008–2012. Meeting the Kyoto target may be difficult, however, as Japan's GHG emissions are set to rise over the next few years. With regard to the post-2012 regime, the Japanese Prime Minister stated that the country would assume responsibility for creating a post-2012 framework and setting a fair emissions reduction target for the world as a whole, including all the major polluter nations.[67] The 'sectoral approach' to reducing carbon emissions was

65 Trading Economics (2009).
66 American Clean Energy and Security Act of 2009.
67 Hatoyama (2009:3).

proposed.[68] Also, Japan seeks to design an emissions trading programme to help fight climate change after the Kyoto Protocol expires in 2012. Even though a target of reducing GHG emissions by 25% by 2020 against 1990 levels was announced in Copenhagen, it would be contingent on a deal involving all major emitters.[69]

5. Australia

Australia, with 0.32% of the global population, contributes 1.43% of the world's carbon emissions.[70] Hence, it is not surprising that Australia's per capita emissions are higher in comparison with those of other developed countries. Australia's per capita emissions in 2004 were 4.5 times the global average, just below that of the US.[71] Despite its large emissions on a per capita basis, Australia was granted a limitation of an 8% increase of the Kyoto target.[72]

The Australian Government moved to ratify the Kyoto Protocol in December 2007. It had committed to reducing emissions by 60% on 2000 levels by 2050, and has actively tried to achieve and even better this target.[73] Measures taken by the government include the Renewable Energy Target Scheme to ensure that 20% of Australia's electricity supply comes from renewable sources by 2020, and the Emission Trading Scheme to slow the rise of carbon emissions.

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68 The sectoral approach is to identify carbon-intensive industries such as power, steel, cement, transportation, and building and construction, and to set uniform, global efficiency norms and lower carbon-emission standards for each sector, which would add up to form a national target.

69 Hatoyama (2009:1).

70 Raupach (2007:3).

71 (ibid.).

72 The UNFCCC gives special consideration to some countries. Thus, Article 4, section 8(h) refers to "countries whose economies are highly dependent on income generated from the production, processing and export, and/or on consumption of fossil fuels and associated energy-intensive products". Australia belongs to this category as it is the world's largest coal exporter and is reliant on fossil fuel for transportation and energy.

73 See Ferguson (2008).

6. The Developing Countries

Copenhagen saw three demands from three groups based on their different interests:

- the Group of 77 (G77) and China[74]
- the Small Island Developing States (SIDS), and
- the Topical Forest Group.

7. The G77 and China

The G77 includes most of the developing countries. Their positions are consistent with China's in that they agree on long-term cooperative actions on climate change, mitigation of emissions, adaptation to the impact of climate change, and provision of financial and technological support to developing countries.[75] In addition, the G77 have stated that the developed nations should honour their commitment to establishing and accomplishing the medium-term emissions reduction targets. Moreover, concerns of the least-developed countries, SIDS and African countries should be considered.[76]

In addition, after China announced it would reduce its carbon intensity, India followed with an announcement of a 24% reduction by 2020.[77] India is regarded as another 'major emitter' due to its huge population and rapid economic growth, and is also the focus of negotiations to mitigate global warming for the post-2012 era. However, India does not consider itself a major emitter, arguing that neither the total volume of its carbon dioxide emissions nor its present per capita emissions serve to qualify it as such.[78]

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74 The Group of 77 at the UN is a loose coalition of developing nations, designed to promote its members' collective economic interests and create an enhanced joint negotiating capacity in the UN. There were 77 founding members of the organisation in 1964, but it has since expanded to include 134 member countries. China is not a member, although it does support the Group's claims.

75 CCTV.com (2009).

76 (ibid.).

77 Wiener (2009).

78 Saran (2008). Despite a population of 1.15 billion and a GDP growth rate of 8.5% in 2007, India's total emissions are 4% of the global figure. India emits about 1.1 t of carbon dioxide per capita, while the corresponding figure for the US is more than 20 t. Furthermore, India accounted for only 2% of the cumulative carbon dioxide emissions between 1850 and 2000.

India insists on the per capita standard, and emphasises the distinction between *lifestyle emissions* and *survival emissions* to address global warming issues.[79] Accordingly, India claims that it is not prepared to accept any limitation on its carbon emissions in the post-2012 period.

8. Small Island Developing States

Small Island Developing States (SIDSs) is another coalition of developing countries. It represents 43 developing island countries with low coastlines which are extremely vulnerable to sea-level rise caused by climate change. Facing this situation, they put forward Tuvalu's Proposals[80] at Copenhagen to call for a new, legally binding agreement to include commitments from the US. SIDS also brought up other issues, such as adaptation and finance, and claimed that global emissions should be reduced by 85% by 2050.[81]

9. Topical Forest Group

The Topical Forest Group is composed of rainforest countries in Africa and South America. These countries need the security of financial assistance to realise the objective of reducing deforestation by at least 50% by 2020.[82] They stress the responsibility of developed countries to provide financial support.

10. Summary of Key Points

It can be concluded from the above that, firstly, most countries worldwide have recognised the urgency of reducing carbon emissions and are involved in the post-2012 negotiations. Although these negotiations have not been concluded, most countries have set their individual numerical targets for

79 (ibid.:78).

80 Tuvalu called for a discussion on what form the final deal from Copenhagen would take. The small island states put forward a proposal for a new protocol – in addition to the Kyoto Protocol – to include the commitments from the US. The proposal also addressed other issues such as adaptation and finance.

81 UN News Centre (2009).

82 FRG (2009).

addressing emissions reduction beyond 2012. Moreover, they are taking on, or have promised to take on, measures to reduce their domestic emissions.

Secondly, the divisions between developing and developed countries, and between the EU and the US, originate in different national interests and are shaped by different national circumstances. This is the root cause of different positions regarding the post-2012 regime.

Thirdly, the positions of China and the US play a decisive role in designing a post-2012 framework. China functions as a model for other developing countries. When China leads, other developing countries tend to follow. In addition, the position of the US influences the stance of other countries with regard to their obligations in the post-2012 regime.

Finally, the critical factor impeding the post-2012 negotiations is the division between developing and developed countries, especially between the US and China. The major developing countries, which have relatively low historical and per capita emissions to date, are expected to produce substantial emissions in the coming decades due to economic growth. By contrast, the major developed countries, which are the main contributors to current global warming, will decrease their share in global carbon emissions due to their relatively low economic growth rates. In this scenario, most developed nations believe that, for the next global agreement to be meaningful, it has to contain GHG reduction commitments from China, India and the other large developing economies. The developing countries, however, are reluctant to commit to specific targets because of the restrictive effects such targets may have on their economic development. Consequently, although the developed countries under the Kyoto Protocol are urging China and the US to accept mandatory emissions cuts in a post-2012 regime, neither of these two countries are willing to move on the issue.

In conclusion, with China overtaking the US as the largest carbon dioxide emitter, it is urgent for China to find a way to meet the huge challenge of reducing its carbon emissions beyond 2012 without undermining its economic development.

D. Feasibility of a Carbon Dioxide ETS in China

I. Policy Support

Although China has been the largest emitter of gases responsible for global warming and climate change, it – like other developing nations – has not

been bound by the Kyoto Protocol to reduce gas emissions. However, addressing climate change is regarded as one of the most important, long-term strategies for China's economic and social development. Thus, the following goals regarding the control of GHG emissions until 2020 were put before Copenhagen as China's contribution to international efforts to address climate change:

- Reduce carbon dioxide emissions per unit of GDP by 40–45% by 2020 compared with 2005 levels
- Increase the share of non-fossil fuels in primary energy consumption to around 15% by 2020, and
- Increase forest coverage by 40 million ha and forest stock volume by 1.3 billion m^3 by 2020, compared with 2005.

China's attempts to address emissions have predominantly focused on administrative measures and legislation in areas such as energy efficiency and the feed-in tariff under its renewables law. Having adopted market mechanisms throughout its economy, China is now embracing carbon trading and is exploring provincial and/or city-based trading schemes.

Firstly, the ETS in China is supported by the latest of its five-yearly national socio-economic development plans. Faced with severe pollution, a predicted surge in urbanisation, and a struggle to ensure adequate energy supplies to fuel its rapid growth, China has outlined its intention to reduce carbon emissions in its 12th Five-year Plan,[83] which was endorsed by the National People's Congress on 14 March 2011. The Plan seeks to establish a "green, low-carbon development concept".[84] This is the first Plan to include a commitment to gradually introduce market mechanisms to control carbon pollution. China announced several new carbon and energy targets, namely to –

- increase the proportion of non-fossil fuels in energy consumption to 11.4% by 2015, from 2010 levels
- reduce energy consumption per unit of GDP by 16% by 2015, from 2010 levels, and
- reduce carbon dioxide emissions per unit of GDP by 17% by 2015, from 2010 levels.

83 Hereinafter *Plan*.
84 PRC (2011:29).

According to the Plan, China will establish low-carbon product standards, improve statistical accounting systems for GHG emissions, and introduce the "step by step establishment of carbon emission trading markets".[85] The use of market mechanisms to incentivise energy savings is included in the Plan.

The Plan also prioritises "strategic emerging industries" for industrial innovation and development,[86] which include –

- energy efficiency technologies, recycling and waste management
- advanced nuclear, wind, solar, smart-grid and biomass energy, and
- hybrid and pure electric vehicles.

Secondly, the Working Strategy on controlling GHG emissions was released in 2011 by the National Development and Reform Commission (NDRC), with a commitment to realising the reduction goal under the Plan and in which attempts to establish a carbon emissions trading market are addressed. The first requirement is to establish project-based, national, voluntary ETSs, and implement mandatory, cap-and-trade, carbon emissions trading pilot schemes. A second requirement is the enhancement of the establishment of the supporting system for carbon emissions trading is expected to be enhanced.

The NDRC also designated 13 areas to operate a variety of pilot schemes as part of the country's commitment to reduce its emissions. In July 2010, the NDRC issued a policy paper entitled *Notification on Advancing the Low Carbon Pilot Projects on Province and City Level*. According to this paper, pilot schemes were to be deployed in five provinces[87] and eight cities.[88] Each of these provinces and cities was expected to develop its own plan to reduce emissions, and submit a strategy for developing a lower-carbon economy, some of which were expected to include carbon trading schemes for inclusion in the Plan.

Relevant government officials in those provinces and cities have promised to research and develop a low-carbon development plan to accelerate the establishment of an industry structure featuring low-carbon emis-

85 (ibid.:30).
86 (ibid.:10).
87 Guangdong, Hubei, Liaoning, Shaanxi and Yunnan.
88 Baoding, Chongqing, Guiyang, Hangzhou, Nanchang, Shenzhen, Tianjin, and Xiamen.

sions, and to actively promote low-carbon lifestyles and consumption patterns to reduce carbon emissions.

The NDRC also required these experimental areas to –

- clearly establish operational goals and specify tasks and measures to control local GHG emissions
- establish statistics and management systems for GHG emissions
- explore a mechanism to promote energy conservation and emissions reduction
- develop the low-carbon industry and implement a target-related responsibility system to control GHG emissions
- explore effective government guidance and economic incentive policies
- study and apply the market mechanism to achieve the emissions goals
- follow closely the latest technological advancements in the low-carbon field
- actively promote the introduction, absorption and innovation of technologies, and
- conduct joint research and development on new technologies with overseas companies.

It can be observed that a favourable political environment has been created in China for reducing carbon emissions and establishing a national ETS, as these issues have been placed high on the political agenda.

II. Case Studies on Sulphur Dioxide ETSs

Sulphur dioxide is one of the pollutants responsible for acid rain, which can damage forests and acidify lakes and streams, rendering some of them incapable of supporting aquatic life. Sulphur dioxide air pollution also causes respiratory and other health problems. Initially, a cap-and-trade system was imposed on sulphur dioxide emissions in the US in the context of acid rain reduction, under Title IV of the Clean Air Act amendments of 1990.

China's 11th Five-year Plan (2006–2010) established a mandatory sulphur dioxide emissions reduction target of 10%. To encourage sustainable reductions in sulphur dioxide emissions, the Chinese Government proposed that a market-based sulphur dioxide trading system be used to complement command-and-control instruments. The introduction of such a trading system provides a market-based mechanism to manage sulphur dioxide emissions at the lowest economic cost. The government sets a national emissions

cap before establishing an emissions trading platform, based on emission allowances allocated to sulphur dioxide emitters. Emission sources with excess reductions can then trade their allowances. The trading system operates to identify least-cost emission reductions. This cap-and-trade system complements existing policy initiatives to reduce sulphur dioxide emissions. To date, the national sulphur dioxide ETS has not been set up, but pilot sulphur dioxide trading projects at the city and provincial levels in China have provided valuable lessons for developing a carbon trading scheme. Additionally, sulphur dioxide emissions were reportedly reduced by 29% in 2010, compared with 2005 levels.[89] Therefore, it is necessary to conduct a case study on a sulphur dioxide ETS in China.

After careful preparations, a tradable permit system targeting sulphur dioxide emissions was launched in 2002. However, the performance of the sulphur dioxide ETS was disappointing. Three factors could have led to this situation. Firstly, no working regulation or law deals with the right to emit sulphur dioxide. The legal and ownership issues concerning sulphur dioxide emissions reduction are still uncertain. This deficiency does not provide appropriate protection for the legitimate interests and rights of the relevant parties.

Secondly, the financial penalty for not reducing sulphur dioxide emissions is too lenient, so companies do not take any real action to reduce them. In most cases, ¥30,000 is the maximum that a local government can impose on a company that does not reduce its sulphur dioxide emissions as required. Most companies in this situation are more likely to pay the fine than reduce their sulphur dioxide emissions because, if the company pays, it may be allowed to emit sulphur dioxide without restriction.

Thirdly, the enforcement capability of the local environmental agencies is unsatisfactory: economic issues are often more of a concern to local officials than environmental issues.

To summarise, it is not surprising that the pilot implementation of a sulphur dioxide ETS has failed to yield the desired outcome expected of a market-based instrument. As some observers have noted, the local environmental agency is still struggling with basic issues such as how to ensure compliance with environmental requirements, and how to achieve regulatory

89 *Xinhua News*, 12 November 2011, China to Pilot Carbon Emission Rights Trading Scheme: Economic Planner, available at http://news.xinhuanet.com/english2010/china/2011-11/22/c_131263322.htm, last accessed 12 December 2012.

independence.[90] Domestic motivation and the basic institutional prerequisites require further examination.[91] As a result, the accomplishments achieved are not as inspiring as the lessons that can be learnt from the pilot.

III. CDM Experiences

As already mentioned, CDM is a voluntary, project-based carbon ETS for developing and developed countries.[92] The first CDM project in China, the Huitengxile Windfarm Project in Inner Mongolia, was registered by the CDM Executive Board in June 2005 with credits purchased by the Dutch Government. Since then, China has dominated the global carbon market by participating in CDM projects, and has become the largest beneficiary. Further implications for China will derive from the implementation of CDM projects over several years.

Firstly, whether the projects are voluntary or mandatory, the enthusiasm of participants is of great significance. Initially, Chinese enterprises knew little about the CDM and its implications. In 2000, Peking University's Guanghua Management College conducted a CDM-related survey by questionnaire which targeted Chinese enterprises.[93] The results showed that only a few Chinese enterprises knew about the CDM and that they were not concerned about its influence. The main reason for this lack of understanding at the time was that people did not know what benefits the CDM could bring them. Subsequently, China's potential to implement the CDM has attracted developed countries to conduct CDM capacity-building projects in China, which, to some extent, would promote the development of the CDM in China and enhance CDM-related training and education for Chinese Government officials and researchers. However, local private-sector players in the CDM, whose involvement was potentially major, were neglected. At that time, there were few capacity-building projects at an enterprise level, and cooperation and communication on concrete CDM projects was rare. Conse-

90 See Morgenstern et al. (2004).
91 See Bell (2003).
92 Adapted from Jiang (2012).
93 "Chinese Enterprises' Understanding of the CDM", translation of 中国企业对 CDM 的理解, available at cdm.ccchina.gov.cn/web/NewsInfo.asp?NewsId=41, last accessed 30 July 2012.

quently, most Chinese enterprises did not really understand the significance of the CDM, and thus did not participate in it.

Secondly, the government should pay attention to the scope of projects. The HFC-23[94] destruction projects were very popular in China because they had a short cycle time, they offered large volumes of credits for a low capital investment and low mitigation costs, and the additional assessments were relatively straightforward. In addition, it is estimated that China accounted for more than half of the global emissions of HFC-23.[95] Therefore, developing the HFC-23 CDM projects could bring more economic benefit to industries than would innovative technology to reduce HFC-23 emissions. Based on the above, most Chinese industries would rather apply for CDM projects with the current HFC-23 emissions level than reduce it. However, there is limited potential for these projects as a significant proportion of such projects is already in the CDM pipeline and, thus, cannot bring long-term benefits to China. Considering all of this, China began to attach great importance to the energy sector, primarily to renewable energy and energy efficiency.[96] The majority of registered and issued credits in China after 2007 began to be concentrated in this sector.

Thirdly, the measures for emissions trading play an important role in the carbon market. In 2005, the Chinese Government issued *Measures for the Operation and Management of CDM Projects in China*,[97] which is regarded

94 The compound HFC-23 (hydroflourocarbon) is generated as a waste gas in the manufacturing process of HCFC-22 (chlorodifluoromethane), which is a gas used as a refrigerant, as feedstock, and as a raw material for other products. It has a global warming potential 11,700 times greater than carbon dioxide. The UNFCCC and the Kyoto Protocol list HFC-23 as a major potential GHG, and one of the first types of projects established under the CDM was to invest in the destruction of HFC-23.

95 Ellis & Kamel (2007:10).

96 The Chinese Government issued *Measures for the Operation and Management of CDM Projects in China* in 2005. Article 4 of the Measures stipulates the following: "The priority areas for CDM projects in China are energy efficiency improvement, development and utilization of new and renewable energy, and methane recovery and utilization". In addition, the Chinese Government imposed different ratios of tax to encourage the energy sectors. Article 24 of the Measures stipulates that "(1) the Government of China takes 65 per cent CER [certified emission reduction] transfer benefit from HFC [hydroflourocarbon] and PFC [perfluorocompound] projects; (2) the Government of China takes 30 per cent CER transfer benefit from N_2O project; (3) the Government of China takes 2 per cent CER transfer benefit from CDM projects in priority areas and forestation projects".

97 Hereinafter *Measures*.

as a basic regulation guiding the implementation of CDM projects in the country. The Measures were revised in 2011, when a chapter entitled "Liability" was added to safeguard the smooth implementation of CDM projects.

Fourthly, information disclosure is another concern. Initially, when the CDM was being implemented in China, participants claimed that some of the information on the carbon market was not available. This caused them to lose the opportunity to find buyers, and undermined their confidence in implementing CDM projects.

Fifthly, another concern is the unsatisfactory performance of designated operational entities (DOEs). The emissions reduction needs to be certified by the DOE, which plays an important role in developing CDM projects as it decides directly on the successful registration of such projects, on the successful issuance of emissions reduction, and on the quantity of certified emission reductions (CERs) that can be issued. However, the current problems of the DOEs per se cause barriers to CDM projects in China. The DOE's current staffing is too small to handle the rapid processing of an increasing number of CDM projects. The problem of insufficient staff is compounded by asymmetrical information. As a result, the CDM system relies on verifiers to validate the project developers' claim. Many proposed CDM projects in China are delayed because of the wait for DOE validation. Moreover, the DOE's performance is highly volatile, and there are questions about the qualification of its staff.

Finally, the carbon-trading-related service industry needs to be regulated. As mentioned previously, the CDM operational rules are extremely detailed and technical, and the CDM project owners do not usually have the necessary expertise, technical capacity or practical experience to successfully implement CDM projects in China. Consequently, they tend to resort to the CDM-related consultancy service agencies – and indeed, this service industry is deemed an indispensable part of the implementation of CDM projects in China. However, the CDM-related industry has no professional standardisation, so the quality of its services and the qualification of its staff cannot be guaranteed. This situation results in many problems within CDM projects, such as a low CER issuance rate, and great inconsistency between monitoring plans and operations in practice.

To address this situation, the *Important Declaration of Standardization of Consulting Service and Appraisal Work for CDM Projects in China*[98] was

98 Hereinafter *Declaration*.

issued by the Office of the Committee in February 2006.[99] The Declaration is mainly aimed at regulating the behaviour of CDM-related service agencies. It addresses issues such as concluding contracts with project developers for direct sharing of CERs, concluding contracts with project developers for direct sharing of CERs or the proceeds of transferred CERs upon project implementation, and other behaviours that violate the Measures.

As it is an inevitable and long-term trend to reduce carbon emissions through carbon trading, and as the CDM is developing rapidly in China, it is necessary to enact a series of comprehensive and compulsory professional standards for the CDM-related service industry. The Declaration has a limited binding effect in China and can no longer meet the demand caused by the development of CDM projects in the country. It is, therefore, urgent and necessary to set up legitimate and legally binding standards for the CDM-related service industry, with a view to regulating and ensuring quality of service and highly qualified staff.

IV. Case Studies on Carbon Dioxide ETSs

Voluntary carbon dioxide ETSs have already been trialled. These trials have provided valuable experience. China launched a carbon dioxide ETS, led by the China Beijing Environmental Exchange, the Shanghai Environment Energy Exchange, and the Tianjin Climate Exchange. All three exchanges were set up in 2009.[100] The Tianjin Climate Exchange established China's first comprehensive platform for enabling the transfer of credits for energy intensity, and aims to promote environmental protection and emissions reduction by means of market and financial measures. While the traded unit was a carbon emission credit, it was created on the back of a local energy efficiency scheme. The China Beijing Environmental Exchange created China's first voluntary emissions reduction standard, dubbed the *Panda Standard*, which will certify domestic environmental projects across a variety of industries, including forestry and agriculture. This is likely to lead to the creation of a number of offsetting projects and new projects which could lead to new investment opportunities.

99 PRC (2006b).
100 See Oster (2008:A11).

These exchanges build domestic platforms for carbon credit trading. International companies can come to China to buy carbon credit on the exchange. In the meantime, the public trading of carbon credits on the exchange could help China gain its pricing rights in the global carbon emissions market. On the other hand, China is a big user of carbon resources, but it is currently at the lower end of the carbon trading market, and its carbon finance market is relatively backward. Until now, China has been a seller of carbon credits, allowing Western companies and nations to offset their emissions by buying up the credits generated by environmental schemes in China. Now the world's largest emitter of GHGs is likely to emerge as a big buyer of the credits. According to the credit rating agency Standard & Poor's, the potential value for a domestic trading market in China is about £125 billion a year, nearly twice that of the entire global carbon trading market. This is because China's rapid economic expansion implies it will continue to produce large amounts of emissions. China is currently in keeping with predictions that it will account for a third of global emissions by 2030.

So far, however, these exchanges have only served as platforms for individual, small-scale deals.[101] China's first voluntary carbon trade was agreed in 2009, when the Shanghai-based Tianping Auto Insurance Co. Ltd purchased credits generated in Beijing during the 2008 Beijing Olympics through the deployment of a green commuting campaign, where motorists could only drive on certain days. It is expected that the unsatisfactory situation will change, following the issuance in 2012 of the *Measures for Implementing a Voluntary Emissions Scheme in China*.

E. Key Issues of Carbon Dioxide ETSs

Based on the above analyses, as well as on domestic and international circumstances, it can be concluded that it is both necessary and feasible to implement a carbon dioxide ETS in China. Although a pilot programme is being carried out in different regions, the future of China's ETS is still uncertain. There are some key issues that need to be addressed before the establishment of a nationwide carbon market in China can be considered. These are discussed in the following subsections.

101 China Tells (2009).

I. Purposes and Principles

China is under considerable pressure to reduce carbon emissions without undermining its economy. According to the experience and practice of other countries, carbon dioxide ETSs have proved to be a cost-effective tool to reduce emissions. Therefore, China is attempting to establish a nationwide scheme for carbon dioxide emissions trading to promote the reduction of carbon dioxide emissions in a cost-effective and economically efficient manner. The objective of China's carbon dioxide ETS is to put in place the necessary infrastructure to develop a dynamic domestic carbon market. In order to realise this objective, the current plan is to establish regional carbon dioxide ETSs targeted for certain industries by 2013, after which regional carbon markets targeted for key industries will be established by 2015, and finally a national carbon market will be set up, commencing in 2015.

The establishment of China's emissions trading market will be based on the principles of –

- cost-effectiveness
- openness, impartiality and fairness
- state guidance and adapting measures to local conditions
- promoting outstanding features
- steady progress and gradual development, and
- combining government guidance with public supervision.

II. Mode of Emissions Trading: Cap-and-trade or Baseline-and-credit?

There are two modes of emissions trading: cap-and-trade, and baseline-and-credit. Under the former system, a government authority first sets a cap by deciding on the total emissions allowed. Next, companies are allocated credits – essentially permits to emit – based on their size, what industries they operate within, etc. If a company emits below its cap, it is granted credits which it may then trade with other companies. For companies which emit below their caps, a cap-and-trade system works well because they can sell their extra credits. Therefore, they make a profit while reducing their emissions. For companies which cannot get their emissions under control, this system penalises them for their excess emissions, yet it still brings their overall emission rates down. In a sense, the need to purchase credits acts as a fine, encouraging companies to reduce their emissions.

In a baseline-and-credit system there is no explicit cap on aggregate emissions. Instead, each company has the right to emit a certain baseline level of emissions which may be derived from historical emissions or from a performance standard that specifies the permitted ratio of emissions to output. Companies create emissions reduction credits by emitting fewer than their baseline emissions. These credits may be banked or sold to companies who exceed their baselines. The effect is to limit aggregate emissions to an implicit cap equal to the sum of the individual baselines. Typical baseline-and-credit plans also differ from classic cap-and-trade plans in a number of ways, e.g. credits are often computed on a project-by-project basis rather than on the basis of enterprise-wide emissions. They are also required to be certified and registered before they can be traded, and there are generally restrictions, e.g. credits cannot be registered until the emissions reduction has actually occurred. In operation, therefore, the baseline-and-credit system is more complex than the cap-and-trade system.

Based on China's national circumstances, and in accordance with the principles discussed above, it is appropriate for China to adopt a hybrid plan which combines the two systems, i.e. companies targeted for an ETS are divided into existing and new enterprises in a specific year. A cap-and-trade mode is adopted for existing companies, and a baseline-and-credit mode for new companies. The baseline-and-credit mode is to set a higher baseline level of emissions than that in a business-as-usual scenario. The new companies create emission reduction credits by emitting less than their baseline emission, and these credits may be banked or traded in the carbon market.

III. Targeted Industries

Three factors need to be considered when deciding which industries would be covered by China's ETS in its current phase:

- China's level of economic development
- The country's regional economic disparities, and
- The regional differences between the various industries, and their different emissions levels.

Based on the above-mentioned factors, China's ETS should cover carbon dioxide emissions from installations such as power stations, combustion plants, oil refineries and iron and steel works, as well as factories making cement, glass, lime, bricks, ceramics, pulp, paper and board. Nitrous oxide

emissions from certain processes would also be covered. Thus, the target industries may include the power industry, the chemical industry, the non-metal mineral processing industry, the metallurgy industry, transportation equipment manufacture, etc.

IV. Allocation of Emission Credits

The existing methods of apportioning carbon credits in the international carbon market include free allocation, auction, and mixed allocation. Each method has its own advantages and disadvantages. The free allocation method, for example, allows the large carbon emitters to obtain emission rights free of charge, reducing economic efficiency and undermining market competition. The auction method best ensures the efficiency, transparency and simplicity of the system, and creates the greatest incentive for investments in a low-carbon economy. It also complies best with 'The Polluter Pays' Principle, and avoids giving windfall profits to certain sectors that have passed on the notional cost of allowances to their customers despite receiving them for free. However, the auction method also has shortcomings in that it increases production costs, so companies often resist it. The mixed allocation combines free allocation with auction. Parts of the allowances are allocated for free, and other parts are allocated via auction.

As the originator of the ETS, the EU member states allocated at least 95% of the allowances free of charge for the three-year period beginning 1 January 2005, and at least 90% of such allowances free of charge for the five-year period beginning 1 January 2008. From 2013 onwards, the EU member states will gradually transfer the method of free allocation to one of auctioning all allowances which are not allocated free of charge.

China's ETS would follow the EU's example. Various regions would allocate all allowances free of change by 2015. Once a national ETS is set up, China would allocate one part of the allowances free of charge, and the ratio of allowances allocated free of charge would gradually be reduced until all allowances are auctioned. The auctioning of allowances will become the basic principle according to which allocations would operate.

V. Other Key Issues

There are other key issues which need to be considered when designing domestic carbon markets. The competent authorities, as well as their responsibilities, should be clearly defined. Registry systems need to be set up to track changes in allowances. Offset mechanisms and linkage programmes should also be considered to promote the development of China's ETS. Incentives and penalty mechanisms also play an essential role in encouraging companies' enthusiastic participation.

F. Conclusion

As global warming emerges as one of the greatest challenges for humankind, carbon dioxide ETSs will become an increasingly universal instrument to reduce emissions. The Chinese Government has a strong political will to promote the establishment and development of a national carbon dioxide ETS. Indeed, China has adopted a pilot ETS programme and plans to establish a nationwide ETS in the near future. Having reviewed the international experience of carbon dioxide ETSs, as well as lessons learnt from pilot ETSs in China, it is considered both necessary and possible for China to establish a national carbon market, in spite of the practical difficulties and challenges it faces.

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