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The Clean Development Mechanism in China

- A Win-Win Synergy?

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“The Clean Development Mechanism is a significant market-based mechanism for both sustainable benefits to the host countries and more cost-effective commitment fulfillment among developed countries. It could significantly lower the overall economic costs of climate change mitigation and help bridge the different position between developed countries and developing countries, and hence making a global climate regime possible.”

- **Xianli Zhu**

May 6th, 2008

United Nations Environmental Program Risø Center

Dedicated with greatest affection to

Malinee, Surahong, Neeruch, Preecha & Sabine

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Also, this bachelor thesis would not have been completed without invaluable experiences from my interviewed ladies and gentlemen.
I wish to thank them for sharing their thoughts and opinions.

Abstract

Outstanding economic growth in China has its price to pay. By prioritizing economic growth as number-one issue, complementing cheap energy consumption has undeniably been side-by-side. Although the energy base on fossil-fuel energy consumption, together with inefficient technology has pushed forward China to lifting millions of the population out of poverty, it has also mounted emissions in China, causing disastrous incident nation-wide and help China ranking the largest emitter today. On the other side of the coin, these negative stands can open doors of opportunity to China, as it has potential in offering low-cost abatement options and rooms for alleviating climate change effects. Therefore, it is widely expected as the world's largest host country for clean development mechanism (CDM) projects. Nonetheless making this potential a reality presents a number of challenges. Blockades towards cost effectiveness provision have been a general lack of awareness and experience by the government and business communities, market demand uncertainty, high procedural transaction costs, low transparency, information constraints, and foreign equity investment restriction. Impediments towards sustainable development provision are narrow project target, low sustainable development sentiment, and small scale of CDM market.

This paper aims to address if the CDM projects will be efficiently contribute to the dual goal equally. This is performed by examining the major setting of regulations and procedure of CDM in China namely, the capacity building projects with bilateral and multilateral donors, the establishment of streamlined CDM procedures, the increase in transparency of CDM procedures and sound governance, the certified emission reductions (CERs) taxes scheme and the national eligibility. These initiatives taken by the Chinese government is likely to facilitate China to fully exploit the win-win opportunities. As evidence, the preliminary prediction of the cost effectiveness benefits and sustainable development benefits shows promising figures. However, the controversial standpoint is apparent in CERs taxes scheme and national eligibility regulations. It is where China trade-off its cost effectiveness benefits to investors with own sustainable development benefits. Instead of achieving win-win synergy, China undertakes a pro-sustainable development strategy. The decision is deemed reasonable with China's promising market future, legal facilitation and specific demand for quality in the market. I believe that there is room for improvement in China's CDM exploitation that is noteworthy but should also be approached with caution. These are clearly defined sustainable development objectives, which are: wider and deeper project focus onto those projects beyond renewable projects, incorporating the locals and project developers to engage in CDM planning process and balancing the dual goal attainment, not to incline too much on developmental benefits as of today.

Keywords: The Clean Development Mechanism, climate change, China, Win-win synergy, cost effectiveness, and sustainable development

Glossary

Asian-Pacific Partnership on Clean Development and Climate (APP)

Assigned Amount Units (AAUs)

Carbon Dioxide (CO_2)

Clean Development Mechanism (CDM)

CDM Executive Board (CDM EB)

Certified Emission Reductions (CERs)

Designated National Authority (DNA)

Emission Reduction Units (ERUs)

European Trading System (ETS)

European Community (EC)

European Union (EU)

Foreign Direct Investment (FDI)

Greenhouse Gases (GHGs)

Gross Domestic Product (GDP)

Hydrofluorocarbons (HFC)

Marginal Abatement Cost (MAC)

Ministry of Foreign Affairs (MFA)

Ministry of Science and Technology (MOST)

National Development and Reform Commission (NDRC)

Nitrous Oxide (N_2O)

Project Design Document (PDD)

Renminbi (RMB) Chinese Currency

Tonnes of carbon dioxide equivalent (tCO_2e)

Millions of tonnes of carbon dioxide equivalent ($MtCO_2e$)

United Nations Environmental Program (UNEP)

United Nations Framework Convention on Climate Change (UNFCCC)

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1 Introduction

One of the most urgent issues that our generation has to tackle is undeniably global warming. Worldwide efforts and strong commitments are demanded to prevent the climate changes today. Furthermore "the benefits of strong and early action far outweigh the economic costs of not acting in combating climate change" (Stern 2007:xv).

With the recent Kyoto conference in Bali, the world started to pay more attention to reducing emissions efficiently. A key achievement is the market-based instrument concept of emission trading that offers developing countries a global thinking approach to tackle the climate crisis. Via the flexible mechanism of CDM, a win-win situation is believed to occur. The CDM is built on the investment in clean technology in developing countries by industrialized countries in the exchange for CERs. The industrialized country can later use these lower price rights to meet its own Kyoto Protocol's obligation, while developing countries enjoy the sustainable development benefits from such emerging economic opportunity.

Although the host countries are allowed to define sustainable development requirements for CDM projects in their country according to their own wishes, the global emission market is more or less a buyers-market. Here lies the trade-offs. In order to attract CDM investment projects with low abatement costs, developing countries might need to lower standards for sustainable development benefits to the country.

China presently ranks as the world's largest CO_2 emitter and largest coal producer and consumer. Given its huge emissions of Greenhouse Gases (GHGs) and large potential for low-cost emission reduction, it is no surprise that China is the largest supplier of the world's CERs. Despite the growing numbers of CDM investments in China, a win-win synergy will not necessarily occur. This paper aims to examine whether the CDM implementation in China provides a win-win synergy, achieving the twin objectives of the CDM.

1.1 The Win-win Concept

The CDM is the one doorway in the Kyoto Protocol to accommodate the interest of both investors and host countries. Investors have high hopes for the mechanism to bring access to lowest cost of emission reduction through investment for emission reduction projects and receive CERs in return. At the same time, host countries anticipate new opportunities to improve efficiency, sustain economic development and contribute to a cleaner environment for their residents.

The Kyoto Protocol frames the dual objective of the CDM, Article 12 reads:
(a) To assist Parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the Convention, and;
(b) To achieve Parties included in Annex I in achieving compliance with their quantified

emission limitation and reduction commitments under Article 3" (Please see list of Annexes in Appendix 2).

To fully exploit the CDM potential benefits, it requires a careful integration of two objectives. They cover the private sector's goals guided by profit maximization, and host countries' goals guided by their development priorities. With different goals combined in one market-based tool, at times, conflicts occur. Therefore, a number of doubts have often been cast on the crop of the CDM, whether it is able to contribute to win-win outcome as much as had been hoped for.

1.2 Problem background

1.2.1 Climate change

Life on earth is made possible by energy in form of visible light from the sun. The balance of radiant energy mechanism, so-called the greenhouse effect, as depicted in Figure 1. It determines the Earth's average temperature. Approximately 30 percent of sunlight is scattered back into space, the remaining is absorbed by the surface, through circulations of the atmosphere and the oceans. GHGs such as water vapor, ozone, methane and carbon dioxide, delay the escape into space of the 30 percent, which is reflected. The GHGs act as a blanket. They trap heat and warm the planet some 30 degrees Celsius warmer than it would be otherwise. As a result of excessive human activities, the unprecedented raise of GHGs- 60 percent of those GHG stems from continuous increase in carbon dioxide- beyond natural absorbing ability is making the blanket thicker. This has led to enhanced greenhouse effect and subsequently to unnatural global warming. The average temperature rises, speeding up the natural climate change to pressing level (Tietenberg 2007: 258; UNFCCC 2008a).

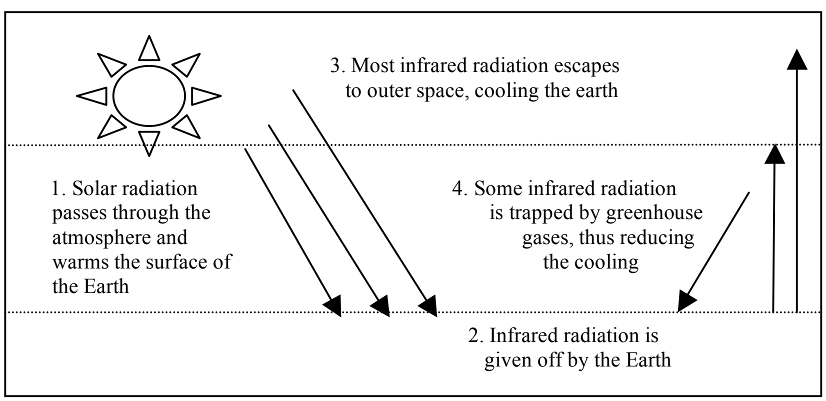

Figure 1: The Greenhouse Effect Mechanism

Source: Department for Environment, Food, and Rural Affair, DEFRA (2005)

Possible consequential future physical, biological and ecological impacts are immense. Climate change impacts are already happening and will be worse in the future. Shortages of water and food, increases strength of tropical storms, coastal inundation and rampant spread of disease will put health and life for billions of people at risk. The flee of climate victims into areas already inhabited by people with different cultures, religions, and traditions increased not only the environmental pressure on hosting areas, but also the possible political conflict and chaos. Furthermore, in terms of damage valuation, overall costs and risks of climate change are equivalent to losing at least 5 percent of Gross Domestic Product (GDP) each year. Such cost could rise substantially up to 20 percent (Stern 2007:4).

1.2.2 The Kyoto Protocol

The adoption of United Nations Framework Convention on Climate Change (UNFCCC) in 1992 was a major step forward in dealing with global climate change. However, GHGs emission level continued to rise around the world, particularly in enormous populous developing countries such as China and India. Historic and future emission scenario reveals that developing countries are rapidly expanding their industrial output, contributing largely to increasing CO_2 emission and is expected to supercede those of Annex I in the next decade. The industrialized countries are on the one hand responsible for most of the problem historically. On the other hand, their efforts can be efficient if and only if developing countries' emission do not grow indefinitely.

Nearly seven years after protracted negotiations, on February 16, 2005, the Kyoto Protocol entered into force. The Protocol sets in place for legally binding reduction of GHGs by leading industrialized countries during the reduction target period of 2008 to 2012. The detailed rules for its implementation were elaborated in Marrakech in 2001 (UNFCCC 2008b).

A key achievement of the Protocol is the establishment of the three market-mechanism designed to facilitate industrialized countries to achieve their commitments at the lowest cost. The principle behind them is that whereas the cost of limiting emissions varies considerably from region to region, the benefit for the atmosphere is the same, wherever the action is taken place. One of those mechanisms is the CDM. It allows developing countries that were not subject to binding emission reductions as part of the Protocol, to directly involve in this agreement, as they are believed to provide lower-cost reduction. Through emission trading, carbon permits from CDM can be traded at global level. The CDM market consists of three types of markets accommodating features of the CERs accordingly; the primary market involves first buying and selling from CDM projects. Countries earning the credits have option to apply them to meet their own reduction targets. The secondary market involves CERs that have already been traded through primary transactions, trade the credits in carbon market, or options market to "bank" them for later use (UNFCCC 2008c). The new economic opportunity of carbon-trading market never existed before therefore prospered in developing countries.

1.2.3 Current State and Prospects for the CDM Market

In preparing to meet national targets for the first commitment period, the demand as well as the supply of credits generated for CERs is growing rapidly. The CDM market increased 68 percent in volume and 199 percent in value terms from 2006. The prices are 16 € in secondary market and 10 € in primary market. Nonetheless, a significant bottleneck in the market is anticipated. This is due to the CDM approval process that is generally lengthy and complex (Point Carbon 2008c: 17).

The demand is predicted to outstrip supply, due to the recent estimates shortfall of carbon credits in Annex I countries. The United Kingdom remains the leading buyer of the CERs. On the supply side, as of writing, the CDM has registered 1,000 projects in 49 countries. The CDM projects have so far generated more than 135 million CERs. As supply grew healthily over the year, two notable features were the decline in project size and increase in small-scale renewable energy projects. China remains the largest supplier of the CERs. Next are Brazil and India respectively (UNFCCC 2008d; Point Carbon 2008c: 18).

The carbon market prospects beyond 2012 are promising, yet it is still unclear whether a new international climate agreement will be reached after the first Kyoto period ends. However, what seems evident is that the momentum in regional carbon markets. There is strong signal that they will continue to operate independently of a new international agreement, for example, the European Union Emission Trading System (EU ETS) Phase 3 (2013-2020). Particular attention is also paid to the encouraging development towards carbon market in the United States. Recent federal emission trading bills will facilitate what may be the world's largest carbon-trading scheme, The United States-EU carbon market link in the near future. Canada announced a system for 2010. New Zealand is working on the design of a system. Proposals for a national emissions trading system are under consideration in Australia. Moreover, China's participation in the Asia-Pacific Partnership on Clean Development and Climate (APP) has expanded China's CDM market greatly. The goal of the cooperation is to expand investment and trade in cleaner energy technologies, goods and services within key market sectors (APP 2008). No wonder economists expect global carbon market to continue substantial growth in the next decade (Point Carbon 2008a; Point Carbon 2008b).

However, the key question is that to what proportion the demand will be satisfied by CERs. Domestic shortfalls can be fulfilled by CERs, emission removal units (ERUs) from Joint Implementation or assigned amount units (AAUs) from the unused portion of emissions allowances from countries namely Russia and the Ukraine. The AAUs are predicted to compete with CERs on price (Cosbey et al 2005: 7).

1.3 Question of issue

This essay aims to examine:
First, is the current configuration of the CDM in China fulfilling the investors' expectation as a cost-effective emission reduction method? The Chinese ability to offer lower price, high transaction costs and a lack of transparent institutional framework in China are cited as challenges. Second, are the current CDM implementations in China shaping up to delivering a promised sustainable development? The answer to this question is far from simple; since the host country determines sustainable developmental merit of the CDM project. There is no commonly agreed definition, nor criteria by which to judge. A number of economists have come up with similar results when attempting to do so. Indicators are environmental, technological, and economic objectives.

My exploratory thesis is directed towards the growing economic opportunities of carbon trading market. By using China- the biggest CDM recipient- as a case study, the efficiency in patronizing both cost effectiveness and sustainable development benefits is explored.

1.4 Definitions

1.4.1 The Cost Effectiveness Benefits

The investors defined in this thesis refer to direct investors in the CDM project, not including the CERs buyers. With regards to initiation of the UNFCCC, the CDM is expected to benefit the investors in terms of access to lower cost of reduction. Additionally micro perspective of the CDM proceeds as suggested by the interviewees' answers is in concurrence with the McKinsey survey (2008) result and also with Perman et al (2003). That is, not only the monetary value, investors appreciate the quality of the CDM highly as well, suiting their internal goals. The goals mostly cover lowering cost in brand protection and increasing reputation, thus driving profitability and competitive position of the long-term approach in investing.

1.4.2 The Sustainable Development Benefits

As originally proposed by the UNFCCC, the CDM prioritizes sustainable development of developing countries. The evaluation standards of CDM implementation utilized in this thesis derives from the answers from the interviews and the criterions from the United Nations Environment Program (2004) and the International Institute for Sustainable Development (2005). Accordingly, the key contributions of the CDM to developing countries consist of technological, economics, and environmental dimensions, which is detailed into:

(1) Environmentally sound technology evolution
(2) Economic growth
(3) Environmental and human health improvement

The CDM success in developing countries therefore will be analyzed accordingly to the criterions as described.

1.5 Delimitations

This thesis bases its assumptions on anthropological theory of climate change, which is defined by the UNFCCC and chiefly supported by its followers who calculate their prediction according to the UN scenarios. These cohorts are frequently referred in this paper for their forecasts namely, Stern (2007), Perman et al (2003), Tietenberg (2007) and Gore (2007).

However, recently, a number of researchers claim that the UN publications are inaccurate and have been influenced by political pressure. The skepticism has been cast substantially on the UN 2001 report's credibility, due to its calculations and information presentation. This contributes to overestimation of climate change effect, as predicted by the UN apparatus and its followers (e.g. Chen et al 2002; Cess &Udelhofen 2003; Hansen et al 2006). Furthermore the importance of human activities as the main source of climate change is debatable. Alternative theories of climate change are basis of solar, volcanic, ozone, aerosol and meteors (e.g. Shaidurov 2006; Stott et al 2001).

According to the interview with the UNFCCC secretariat, I believe that if this proposal is correct, then the Kyoto protocol mechanism that control the emission from human economic activities will be neither cost-effective, nor will have discernible impact on the climate whatsoever. This thesis value of contribution to the field of interests may be at risk. Furthermore, the benefits of the Win-win concept data reveal difficulties in assessment. This is due to the fact that it is hard to calculate into numerical terms. The data may suggest different outcomes, depending on assumptions the researcher made. Also, the data is confidential to the firm and the Chinese CDM market is relatively new, henceforth most of data available is predictions and estimation. This limits ability to assess actual ongoing implementation of Chinese CDM.

1.6 Disposition

After the introduction the paper continues with information about the climate change and the urge to mitigate the problem. Chapter 3 provides the economic concepts concerning environment and global cooperation. To name a few, this accounts sustainable growth theory, public goods, and transaction cost, policy options, valuing life concepts and game theory. Chapter 4 gives an overview of global cooperation of the Kyoto Protocol. It reveals appealing condition for developing countries to participate namely the CDM. Chapter 5 consists of empirical data on China as a developing country. The chapter discusses how Chinese economic growth and environment dimensions lead to institutional development and commitment to CDM. The following chapter then provides data on current CDM implementation in China, in terms of cost effectiveness and sustainable development fulfillment. Chapter 7 then analyzes from empirical data the efficiency of the CDM implementation and whether it achieves the promising win-win synergy to both investors and the host country, ending the chapter with conclusion. Lastly, the bibliography as well as attached documents is exhibited in the appendices. This setup is designed according to a general setup of qualitative case study with an inductive approach.

2 Methodology

In this section, the following steps are presented: process of searching for literature, the research method, the research approach, the data collection method, the data analysis, the validity of data and the methodology critique.

2.1 Search for Literature

There are growing literatures on emission trading in developing countries and particularly in China, however, not much has been said about the in-depth analysis of the success by using solid criteria indicating the efficiency of the implementation. Therefore, a literature search began. The literature was collected from Lund University and Stockholm University libraries. Databases such as ELIN@Lund, Emerald, EconLit and SourceOECD made it possible to retrieve articles and scientific journals. Financial Times, Reuters, BBC and China Daily are frequently used for their up-to date news. The UNFCCC, World Development Indicator and the China Environmental Statistics Yearbook 2006 are referred to for their statistics. Furthermore, the use of Internet search engine, namely Google scholar, was used to find online materials. Interviews were also conducted for analytical objective. Therefore the literature consisted of books, articles, scientific journals and online materials.

2.2 Research Method

The method selected is a qualitative approach. In conducting this research, more open-ended and exploratory reasoning is deployed. Therefore, like most qualitative studies, the findings will be presented in an inductive incentive to provide increased knowledge into the field of study.

2.3 Collection of Empirical Data

Data collection for this thesis arrives from two sources. To answer the research questions, I collected both primary and secondary data about the area of investigation.

2.3.1 Interviews

My primary data comes from interviews. Interviews have their strength as an insightful and targeted source of evidence. The interviews were performed during May 2008.

Selecting Representatives

The interviewed individuals are chosen on the basis of two criterions; first refers to an assessment whether the interviewees possess the information necessary to answer my questions of issue. To answer my question of issue, opinions from the investor side, the Chinese environmental institution side, and the neutral institutions are crucial. The second relates to the possibility for an interview. This condition limits my options on the Chinese institution. This is due to the difficulties in contacting an officer. Therefore, numbers of Chinese ministries interviews are not available, only NCCCC and Tsinghua University appears to be possible. On the contrary to private organizations and global organizations, teams of contact persons for information and interviews are provided and easily reachable.

For the investor side, the selection consists of PricewaterhouseCoopers, Miljøsystemanalyse, Arreon Carbon UK Limited, Toyota Tsusho Corporation, Environmental Investments, and First Climate Group. The companies are selected to answer the benefits to investors' point of view. Therefore the collection of interviewees includes those who are leading players in the Chinese CDM market. With their first-hand information on the CDM costs and benefits to investors and practical knowledge from long experiences with Chinese CDM process and institution, their perspectives are valuable.

With regards to the Chinese institution dimension, the National Coordination Committee on Climate Change (NCCCC) and the Tsinghua University are chosen to be representatives. The NCCCC is an essential apparatus in the CDM institution in China, in terms of policy making and coordinating CDM-related issues. The Tsinghua University conducts extensive research on CDM projects, providing analysis and recommendation to the government. The insightful perception of CDM implementation in China would be useful in analyzing the sustainable development provision of CDM in China.

Global organizations consist of UNFCCC, The Carbon Finance Unit at World Bank, and United Nations Environmental Program (UNEP) Risø Center. The UNFCCC opinion is crucial to this thesis, since the CDM projects root from the UNFCCC initiations. The World Bank Carbon Finance Unit finances the project-based GHGs reduction in developing countries, including China. The UNEP works closely with wide ranges of issues for environmental development program worldwide. A neutral overview of China's CDM project can be revealed from the interviews.

As an observer, Point Carbon is selected, as it is the leading provider of independent news, analysis and consulting service for carbon market. The big picture of the market momentum, and development can provide firm foundation to my analysis.

Interview Procedure

I first sent the questions along with request for telephone conversation. Then after obtaining the reply, the interviewees were then separated into two groups. For those who wish to answer through electronic mail, the discussion and clarification of their answers were carried on through additional interactions. In this sense, I can avoid misunderstanding and misinterpretation of data, even if face-to-face interaction is lacking. Those who wished to answer through telephone conference were completed by a telephone conversation. The disadvantage of this method is the lack of a hard copy, thus lowering credibility and validity of the data. To correct the flaw, I used the recording program over every telephone conversation. The interviews were focused, but still open- ended. This allows the interviewee to give his or her own answer to the question. Some of the interviewees have been interviewed several times. These interviews were in the form of telephone conferences and electronic mails. All the interviews were conducted in English, as the international jargon and language used in this thesis is in English. In essence, this can avoid the error in translation and presentation of data.

2.3.2 Written Materials

Examination of written materials in this thesis covers previous researches, books, articles, reports and statistics. I used the secondary data to complement my primary data ones. The major advantage is its availability. The data is already created. Yet, most of them are in forms of news article. The data presented thus is in popular style, not academic research style. Therefore in assessing the data, I proceeded with high level of caution and neutrality in the back of my mind.

2.4 Validity and Reliability

Validity and reliability are the keystones in evaluating the merit of a qualitative study. If a research fails to live up to a certain level on these criteria, the research thus contributes no additional scientific value to the field (Trochim 2008). To ensure the high level of scientific value of the research, I limited the use of prediction, calculation or statistical data that is debatable namely, the forecast by Gore (2007) or the statistics from the Chinese authority with discrepancy. I compared the information collected from the interviews with the data from documentation. When inconsistence occurred, I accessed the validity of the data collection method and concluded that the data obtained from the interviews was more insightful and trustworthy, as I had more controlled over this type of collection.

2.5 Methodology Critiques

During the process of gathering empirical data for this thesis, a few difficulties were encountered. This thesis relies mainly on secondary data, along with complementary additional findings from primary data as interviews.

The interview data collection proves to difficult, due to the method of communication available. The personal interview would be the best option. However, the topic requires interviewees from different parts of the world. The most suitable way of communication chosen is via telephone and electronic mail. Complications again occur, when dealing with the Chinese institution or authority. The impediments encountered can be described as follows; the first refers to the opportunity for an interview. Important organs' complicated communication methods and underprovided supporting team for information pose as constraints. For example, the backbone of Chinese CDM apparatus, SEPA, requires an application for an interview. It is available only in Chinese version as a downloadable document and ought to be fulfilled in Chinese characters. The applicants are granted interviews, upon the ministry's decision. The second relates to the chance to reach those officers who are well experienced, possessing the information aspired. They often are accompanied with a high rank. The interview options with those are therefore farfetched without any recommendation or linking connection. Third is the intention to provide the complete information. The Chinese officers do typically not reveal opinions to certain questions involving the negative sides of the Chinese CDM process or institution. The underlying strict information control in China can plausibly explain the action. Forth regards to the ability to accurately transmit the information. Language barriers appear to be in a great concern. The interviewees are able to understand the questions, though at times it is difficult to deliver in English jargon. Above all, the last barrier is the fact that interviews are dependent on luck, since the choice of scheduled interviews is not available. To elaborate, interview attempts with the NCCCC are performed several times, through direct phone calls to the institution. Without fixed time and respondent, different times give different results. Some are unsuccessful, due to the language barrier of the reception at the initial stage. Others are successful, with the helpful assistance of the reception to put through to the responding officer.

In collecting documentation, the most frequently counteracted problem is firstly, the accessibility of the recent news and market analysis in the area, since it is valid only through membership of particular private organization. Secondly, availability is also problematic. A number of useful documents concerning newly implemented laws and regulations, which are possibly valuable to the analysis is not available in English version, namely the laws concerning new emission index punishment/bonus mechanism on big enterprises. Thirdly, the hurdle refers to discrepancy of Chinese official statistics. As an example, some statistical figures on the Ministry of Environmental Protection in English version contain discrepancies, when compared to those same documents in Chinese version. The Ministry web page clearly acknowledged the fact and further recommend to the researchers to rely on the Chinese version. Yet, this has not only creates more hurdles to non-Chinese speaking researchers, but also cast doubts on the information's credibility. When drawing conclusions, careful attention is therefore necessary. Lastly, unlike other topics, this topic is subject to fast pace changing in terms of market development. Therefore, frequent revision of the paper to match the recent achievements in the area is crucial.

3 Theoretical Framework

In analyzing environmental problems and implementation of CDM projects in China, six economic concepts are found highly appropriate. These concepts are sustainable growth theory, public goods, transaction costs, policy options, valuing life concept and game theory.

3.1 Sustainable Growth Theory

According to Tietenberg (2007), there are five principles to pursue sustainable growth. There are the full-cost principle, the cost-effective principle, the property right principle, the sustainability principle, and the information principle.

The full-cost principle is based on the concept that all humans have equal right to a healthy and safe environment. The invasion of that right has to be made up for. Therefore it obliges all those who made some damage to compensate to those who suffer from such action.

The cost-effective principle states that cost effectiveness nature must be embedded in all environmental apparatus. This criterion is set in the hope to raise incentives to implement those tools. The major impediment lies within the perception that environmental policies are too costly to be worthwhile. This ideology is still apparent, particularly in developing countries (Vennemo et al 2006: 215).

The property rights principle relates to the environmental damage presence. With an absence of private property rights, the global atmosphere has always been a free resource throughout history. Rational man sees the cost of emitting pollution into the commons as less than cost of purifying his wastes before emitting them (Hardin 1968: 1243-1245).

The sustainability principle concerns the preservation of resources for the coming generations and the miscalculation of national income. Putting a value on the resource for future extraction is difficult. One cannot determine if an extinction of any species today can either be worthless or a substantial loss to the future generations. Therefore it is essential to preserve all species as our duty and let the future generation decide the answer to that.

The information principle is based on the spread of information to the population. The prospects for sustainable development will be enhanced if more public attention is given to the regulation, management and disposal of waste. The freedom of press and media is crucial. One school of thought argues that businesses increase profitability by behaving in environmentally friendly ways and consumers give preference to sellers with good environmental credentials (Perman et al 2003: 100).

3.2 Public Goods

Traditionally, public goods distinct qualities are that they are non-excludable and non-rival in consumption. Non-excludability criterion refers to a condition that goods cannot be withheld from one individual consumer without withholding them from all. Non-rivalry criterion occurs, as marginal cost of additional person consumption, once they have been produced, is zero. Inability to exclude people who refuse to pay from consuming and benefiting from public goods leads to a problem of "free riders." Henceforth, there are risks of public goods being under-provided. Alternatively public bads can pose negative impact on all individuals, due to their non-excludable and non-rival criterions. They are thus at risk of being over-provided. With regards to its effect in deviating socially optimal level of production, public goods and bads are likely to cause market failure (Johnson 2005).

Interestingly, there has been growing concept of traditional public goods and bads to capture the global character of environmental problem. Certain public goods can benefit across borders, generations and population groups. Such shared and trans-boundary public goods are so called global public goods. Conversely, global public bads possess negative impacts across boundaries. In application to accelerating environmental issues, climate protection is considered a global public good. Emissions are deemed as global public bads (Towards Earth Summit 2002: 1).

3.3 Transaction Costs

Transaction costs is a generic term for a variety of costs that consists of:

- Information search cost: acquiring relevant information
- Contract cost: creating, monitoring and enforcing contracts
- Implementing cost: establishing, implementing and revising the instruments it employs
- Control cost: controlling performance and ensuring compliance

Principally these costs arise due to uncertainty. Uncertainty from lacking information about abatement costs may result in efficiency loss. Overestimation and underestimation of abatement costs will lead to an inefficient level of emission decision, therefore efficiency loss. Although these costs, in practice, often constitute a large proportion of total costs of pollution control, the magnitudes of the costs depend on prevailing circumstances, and have to be examined on a case-by-case basis. An efficient choice of abatement can be made, if and only if all transaction costs have been taken into an account. With different transaction costs encountered among firms, total cost functions differ, due to diverse marginal cost of abatement (MAC). Given the same gross marginal benefits of abatement, different firms tend to make different efficient abatement decision (Perman et al 2003: 252,263).

3.4 Policy options

One of the insights derived from the empirical literature reveals that, in many cases, the traditional command and control regulatory measures are insufficient in protecting the value of the resources. On the other hand, economic incentive instruments provide firms with greater flexibility and incentives to grasp more efficient ways to achieve sustained environmental process. Due to the price mechanism, it is believed to be more cost-effective in achieving the same level of environmental benefits or that better environmental quality could be achieved at the same cost. One of the environmental economics theorems demonstrates that appropriately defined environmental taxes and subsidies, and tradable permits system can maximize the value gained from the resource (Hahn &Stavin 1992: 464; Tietenberg 2002: 17).

3.4.1 Environmental Taxes and Subsidies

A Pigouvian tax can restore efficiency in resource allocation. By setting taxes equal to the marginal damage level where the output dispensed, firm's private marginal cost raises. Then the firm is to adjust their production level, to regain new optimal production level. The cost-effective production is regained. The alternatives to taxes are subsidies. A unit subsidy for emissions abated, also equal to marginal pollution damage, has same desirable property. However, in long run subsidies induce production level away from optimal. It drives firms to smaller scale of production, since subsidies are then accounted as opportunity cost in production. It also attracts new firms to enter the industry; therefore the production level in the industry is higher level when the abatement is subsidized.

Both taxes and subsidies are cost-effective policy instrument. However, the major difference lies within the distribution of gains and losses. Taxes involve net transfers of income from producer to government, whereas subsidies lead to net transfer from government to producer (Kohn 1992: 79; Perman et al 2003: 218).

3.4.2 Tradable Permits

Permits assign property rights on otherwise un-priced natural resources. In other words, emission permits set monetary value to the rights to pollute. The total allowable quantity of permits is initially allocated. Both parties holding permits in sufficient number to cover their desired emission levels and those who are not- will evaluate the marginal worth of permits. The one with desired emission, which exceeds the regulated amount, will have high MAC. Whereas the one with desired amount lower than the regulated amount will have zero MAC. With the difference, the highest abatement cost party will purchase emission permits sold by the lowest abatement cost, resulting in mutual benefits.

The cost-effective logic of the system is simple. Those that would receive lower value (lower MAC) from using the permits have incentive to trade them to someone who would value them more (higher MAC). A simple numerical illustration can elaborate the concept, as depicted in Figure 2. There are only two firms emitting, therefore only those two are able to abate. Given the total permit allocation of 50 units is equally allocated to both firms. Assume that firm A would emit 40 units and B 50 units, with the absence of control system. With the permit allocations, firm A must reduce emissions by 15 units and B by 25 units. As shown by MAC functions, firm A has a MAC of 45 and B a MAC of 125. Since firm A has lower MAC, it implies that the total abatement of 40 units is not achieving the cost effectiveness. On top of that firm B values an incremental unit to pollute much higher than A, therefore both firms would be mutually beneficial to trade with one another in permits. Under competitive market, firm B with higher MAC would buy permits from firm A with lower MAC, upon reaching the equilibrium. Trading finishes where MAC is equalized across polluters, the total cost of abating 40 units thus is minimized (Perman et al 2003: 224). This situation implies the benefits to both parties. Firm A can enjoy sales from the emission traded, whereas firm B can enjoy lower cost of abatement.

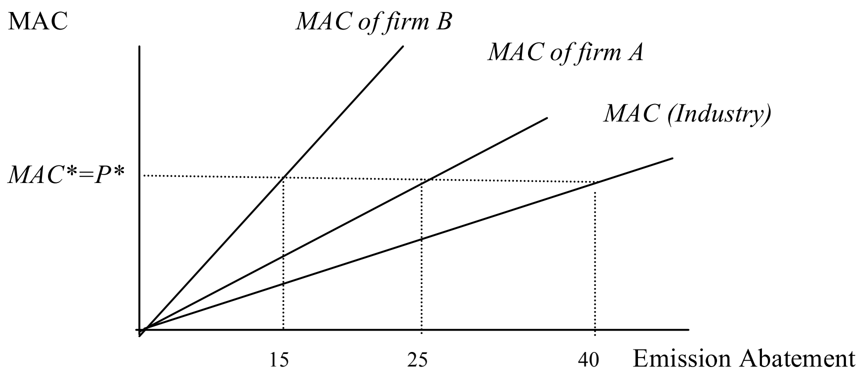

Figure 2: Cost-effective Abatement with Two Firms and Marketable Permits

Source: Perman et al (2003)

3.5 Valuing Life Concept

Economists value life not by price of life itself, but instead by risk avoidance. The method is to divide the total willingness-to-pay amount by the reduced probability. Whereby, the change in the probability of dying results from the change or reduction in environmental damage and the total willingness-to-pay is an outcome of the amount that each individual is prepared to pay in order to avoid risk in a certain population multiplied by the total population. To estimate such willingness-to-pay, there are four methods. First, the most common one is performed through survey-like methods with designed questions namely; to what price individuals are willing to pay in form of taxes and other expenses to reduce mortality risk. Second is to judge the difference between well-paid, but risky jobs and less well-paid but less risky jobs. Third is to assess purchases of risk-reducing equipment. Lastly is to compare other areas given a benchmark for the level of sacrifice to put into the environmental area (Tietenberg 2007: 42; Vennemo et al 2006: 222).

3.6 Game Theory

Game Theory predicts the strategic interactions among rational players produce outcomes with respect to the preferences or utilities of those players. All of the Prisoner's Dilemma Games have single Nash equilibrium, which exhibits dominant strategy for each player. The game is derived from the following situation. Supposed that the police have arrested two people whom they know have committed a robbery together. The police lack enough admissible evidence to get a jury to convict. However, they have enough evidence to send each prisoner away for two years for theft. The investigator thus makes the offer to each prisoner: If Prisoner I confess, implicating Prisoner II, and Prisoner II does not confess, then Prisoner I will go free and Prisoner II will get 10 years. If both confess, Prisoners will get 5 years each. If neither confesses, then Prisoners will each get two years. The situation can be modeled in terms of utility functions, and present the entire situation on a matrix. The numbers express both Prisoners' payoffs in the various possible outcomes. From the payoffs, Prisoner I will be better off confessing, regardless of what Prisoner II does. This case, Prisoner I's action strictly dominates the second one. Therefore confessing strictly dominates the path. Thus under the premise that both players are economically rational- prefer higher payoffs to lower ones- there is very strong grounds for viewing joint confession as the solution to the game.

However, Olson (1965) argues the structure of incentives can change the outcome of a game. Individuals are rational and self-interested. Unless being coerced, or induced to do so with benefits that were not available to those who did not participate, they will choose to free ride when it comes to secure a common interest. Game theory refers to powerful behavior analysis tool for global public goods, where actions of individuals or firms are interdependent. International environmental problems are thus widely analyzed using the Prisoner's Dilemma. This is because pollution spills over national boundaries- the cost of pollution abatement borne by any country will benefit all others as well (Perman et al 2003: 300).

4 The Kyoto Protocol

The global public goods and bads characteristics of climate protection and emissions pose needs for global commitment in combating climate change. However, at the same time, the features provide incentive to deviate from it as well. Fortunately, the Game theory suggests that the cooperative behavior can be induced, by setting incentives to do so. The conditions for global cooperation are apparently embedded in the Kyoto protocol. One of the conditions noteworthy to mention is the CDM.

4.1 Global climate change

In the language of public goods, GHGs emissions have all the characteristics of a pure global public bad. Emissions, no matter where they occur, spill over crossing national borders. They contribute to a global climate problem.

A climate protection, conversely, is a global public good. Irrespective to who bears the cost or where in the world the protection has been implemented, the proceeds are spatially indivisible and freely available to all. The establishment's gain by one individual country do not dwindle their availability to others. Nonetheless individual costs decrease with efficient protection actions undertaken by others. However the climate protection, like other global public goods, raises incentive to free ride. This leads to a situation where mitigation costs are borne by some individual countries, while others succeed in evading the responsibility but still able to enjoy the benefits. In that case, the climate protection will be underprovided. To efficiently tackle global climate change problem, it thus requires strong global commitment towards climate protection.

4.2 Global cooperation

Given two choices of action between to cooperate (climate protection) or not to cooperate (free-riding), both players will choose the highest pay-off strategy, based on their cost and benefit structure of climate protection. Without negotiation or incentive to cooperate, as a classic Prisoner's Dilemma, dominant strategy of not to cooperate is likely to occur. Even if they cooperate, the existence of strong incentives of not cooperating can lead them to cheat. Here lies the major problem in achieving efficient climate change mitigation through global cooperation. The theory, however, suggests that the outcome of the game can be altered. Cooperative behavior can be induced by increasing incentives to do so. Conducive conditions for global cooperation are apparently embedded in carbon trading under Kyoto protocol. These are international architecture, leadership by a dominant player, and the CDM.

The existence of the Protocol as an international institution with authority and power to administer and enforce a collective agreement is conducive to global cooperation (Stern 2007: 515). The Kyoto Protocol deposits an instrument to ratification, acceptance, approval or accession by Parties to the Convention. The Protocol assigned a legally binding quantified GHGs emission limitation and specific commitment to developed countries, while unquantifiable commitment to developing countries for the period 2008-2012.

The European Community (EC) leadership reveals another conducive condition. As of 28 April 2008, there are 180 countries and 1 regional economic integration organization (UNFCCC 2008e). The EC has been historical and current leader in the climate change regime (Gupta &Grupp 2000: 5). It has consistently been stressing the urgency of climate change issue and pressing for stronger policy responses. The commitment of the EC induces other nations to follow the path for closer cooperation. As evidence, please see goals on climate change and clean energy adopted by 10 largest economies in Appendix 3.

4.2.1 The CDM flexible mechanism

The existence of linked benefits both to developing and developed nations through CDM project have led to international commitment in combating environmental problem globally.

The foundation of CDM investment lies within an exchange of CERs with the clean development investment. The Protocol assigned property rights via monetary value to the earth's shared atmosphere; the environmental damage would be eliminated. The conducive condition towards global cooperation of the CDM is found in its win-win synergy nature. The dual goal of the CDM increases the benefits to both parties, only if they cooperate.

The host country benefits from CDM are the provision of technology transfer, economic growth, and environmental condition. As of today, first is the environmentally sound technology transfer. The contribution is accomplished by financing emission reduction projects and using technologies that are currently not available in the host countries. The rate of technology transfer is substantially higher than average for projects in Ecuador, Honduras, Mexico, Sri Lanka, Thailand and Vietnam. The transfer is higher in share of Agriculture, N_2O and HFC projects, whereas less of the Cement, Hydro and Reforestation projects. Approximately 39 percent of total registered projects reported some technological transfers and over 56 percent of them transfer both equipment and knowledge (Seres 2007: 20-22; UNFCCC 2007: 114). Through national criterions of CDM project requirements, the host countries can fully exploit benefits of technology transfer. In essence, the host countries receive the technology according to their needs, instead of according to profit-driven by the investors. The second is economic growth is simulated through increased foreign direct investment. The CDM is expected to generate flows of investment to developing countries; the on-going stream of 55.8 billion USD has been invested. Of that amount, China accounts for half of the total investment project, valued 28.3 billion USD and India accounts for almost another quarter, which amounts to 11.3 billion USD. Third, reduction of emission can improve environment and has consideration impact on health and life expectancy in the population. As WHO (1999) suggested, 1 percent additional daily death for every 10 $\mu g/m^3$ increase in daily ambient concentration of particles smaller than 10 μg, PM_{10}. In reverse, reduction of emission can therefore save lives. The growing amount of CERs from registered CDM projects of 212,952,202 annually, accounting over 135 million $MtCO_2e$ from entering Earth's atmosphere. This represents not only a promising the cleaner environment, but also the health improvement and life saving opportunity in developing countries. This lucrative alleviation is more apparent in China, India and Brazil where are the leading countries in terms of expected average annual CERs (NCCCC 2008a).

Developing countries have lower technological level than the industrialized ones and their production structures tend to rely heavily on carbon dioxide intensive input. Together with the intense energy demand to accommodate the aspired economic growth, the high level of dependence on cheap and an inefficient fossil fuel consumption pattern is apparent. Consequently, the substitution of less emission intensive fuel sources technology would be expected to incur at a relatively low marginal abatement cost and experience the lower economic costs, other things being equal. Furthermore, with lower MAC implies higher returns on investments of a CDM project in developing countries- more CERs by the same amount of money, rather than the developed ones (Klepper& Peterson 2004: 3; Fisher& Brown 1997: 8).

However this win-win concept, as a conducive condition, can be limited by the nature of the international CDM regime and developing countries' characteristics. To elaborate, the CDM process entails complex and time consuming procedural requirements. Also, the streamlining of procedure involves numerous institutions' participation, as depicted in Figure 3. Main steps consist of: (a) preparation of a project design document, a baseline study and monitoring plan; (b) validation; (c) negotiation; (d) registration; (e) monitoring, verification and certification; and (f) issuance of CERs. The procedure involves different participants at different levels. The first level includes private companies, national government. At the second level, institutions include the operational entities contracted by project developers for validation and certification purpose, supporting institutions of the Executive Board, technology suppliers, brokers and traders. Consequently, the project approval process can take up to three and a half years (World Bank 2004: 8).

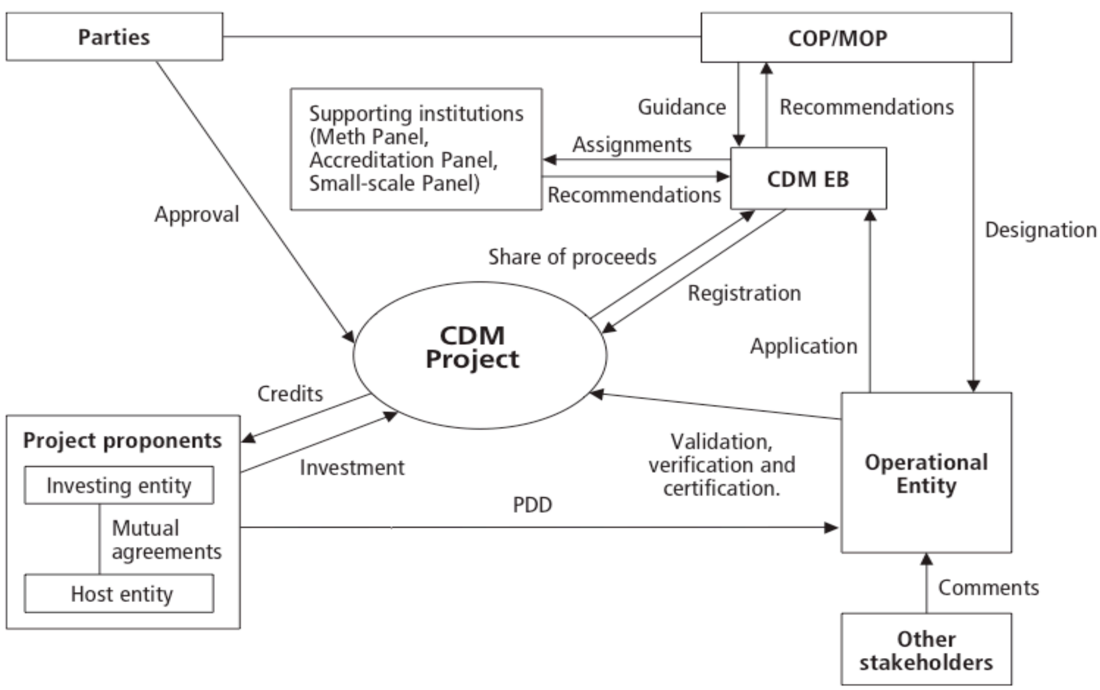

Figure 3: CDM implementation process

Source: World Bank (2004)

With regards to the nature embedded in international CDM structure, the blockades to achieving the co-benefits of the CDM projects are:

- High procedural transaction cost. The implementation process involves a number of parties. The cost of sending in a project through the CDM approval cycle is costly.

- Uncertainty of proceeds. The procedure entails long time frame upon completion. Therefore the revenue streams generated from the CDM to investors are opaque in short-run. This henceforth clouded CDM proceeds to investors with high uncertainty.

Alternatively, certain characteristics of developing countries could become constraints in achieving the win-win synergy from CDM projects (Please see Eskeland &Jimenez 1992; Blackman &Harrington 2000: 6; Krupnick 1997 for more discussion). These restraints include:

- Information constraint. Many developing countries freedom of press is limited to certain level. Additionally, private sector environmental advocacy is less prevalent, less well organized and less active in developing countries than in industrialized countries.
- Lack of experience and knowledge. The common knowledge about environment is restricted to low level. Short supply in fiscal and technical resources for environmental protection.
- Low sustainability initiative. The dilemma between economic growth and environment is prevalent. Public sentiment generally favors economic development over environmental impact.
- Low transparency lead to high transaction costs. Institutions dealing with environmental regulatory, along with judicial, legislative, data-collection is weaker than in industrialized countries. The low transparent and high corruption in the governmental institution.

Along with the international architecture, the leadership by dominant player, the CDM represents vital conducive condition towards global cooperation. It could substantially lower the overall economic costs of climate change mitigation and helps bridge the different position between developed countries and developing countries, hence making a global climate regime possible, according to Game theory. Nevertheless this potential contribution of CDM towards benefits for both parties, in practice, can be inflicted by impediments, as the nature of CDM procedure itself and developing countries' characteristic.

5 Overview of China's Current Situation

There are several reasons for China's emission reduction commitments. This section provides an overview of China's economic development, energy consumption, environment and health, and environmental institution situation. It discusses both push and pull forces that are currently influencing CDM implementation in China. Hereby the characteristics of developing countries, as analyzed in the previous section, are revisited.

5.1 Economic Development Situation

China's rapid economic growth since 1979 has transformed it into the one of the world's major economic power. After embarking on free market reforms, China has been one of the world's fastest growing economies and has lifted millions of people out of poverty. The UNSD reports that in 2006 gross GDP at current market price was 2,668,071 million USD and economic growth was 10.7 percent (UNSD 2008). Despite the astonishing features, China is still a developing country. Due to the weak economic foundation, China possesses great imbalance among the different regions and between urban and rural areas. The World Bank (2006) estimates that more than 135 million people have consumption levels below one USD a day. Income disparity is rising between urban and rural areas. Rural populations amount over 60 percent of total population, yet they have lower than 78 USD per capita incomes. They are lacking infrastructure and access to power. Public sentiments are undoubtedly value economic growth. Even though it comes at the cost of environmental impacts, Chinese authorities remain an urgent priority to narrow the gap between the rich and the poor.

5.2 Energy Consumption Situation

As illustrated in the Figure 4, during the 1990s when economic performance was strong, China's emissions increased by nearly 40 percent. Furthermore, one can generalize that cheap energy has stipulate rapid economic growth, reduced poverty and raised standard of living. Alternatively, during 1980-2000, when China's energy consumption almost doubled, its GDP quadrupled. Moreover, in 2001 China plans to once more quadruple its GDP by 2020, with the help by doubling its energy consumption (Heggelund 2007: 161).

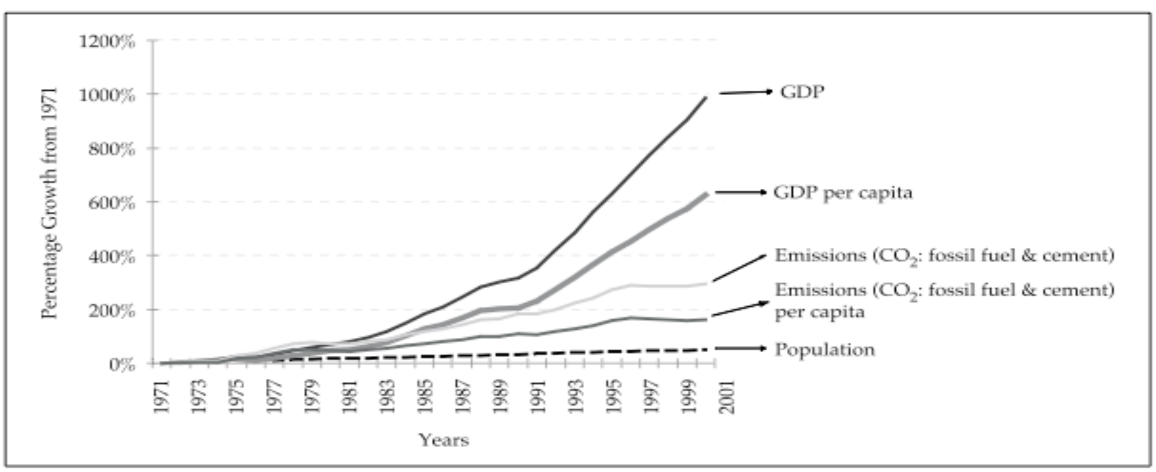

Figure 4: Economic development, Population Growth, and CO_2 Emissions in China, 1971-2000
Source: World Resource Institute, CAIT (2005)

It is expected that China's emission will represent more than one quarter of the increase in world emissions by 2030. As of 2006, China's recorded GHGs emissions were beyond those from the US already (The Guardian 2007). Interestingly, if one considers in terms of emission per capita, one might find different result. In that sense, one United States citizen pollutes three times higher than a Chinese as of today (BBC 2007). This is due to the enormous number of Chinese population, thus lower emission per capita. The energy consumption by rural populations is substantially lower than urban, yet it is bound to grow. In 2004, China experienced power shortages, although China attempted to shift to cleaner energy: less in coal consumption from 75 percent in 1996 to 67.7 percent in 2004. Nevertheless fossil fuels maintain their position as dominant energy source now and expected to do so in the future, constituting 53 percent of total consumption in 2030. Additionally, oil is becoming second important energy source, as well as pollution source. Due to the continuous rise in energy demand, energy shortages, and consequential pollution, Chinese leaders tried to solve by reorienting the basic structure of energy and introducing vital energy policy changes. Consequently, China's top priorities now include energy conservation and renewable energy (MFA 2005).

This resulted in introduction of numerous policy measures. The China Medium and Long-term Energy Development Program (2004-2020), approved in June 2004, focus on the government support for energy conservation (NDRC 2008). Moreover, in 2006, energy efficiency was considered as a key measure of economic growth, a reduction of 4 percent in 2006 energy intensity was proposed. Furthermore the initiatives towards energy conservation and environmental protection have been, for the first time, incorporated into China's Five-year economic plans. The current 11th plan (2006-2010) mandates energy per unit of China's gross domestic product (GDP) to be cut by 20 percent and under the Renewable Energy Law approved in 2005, the target is set to increase consumption of alternative energy sources, which accounts for 7 percent at the present time, up to 16 percent of the total energy consumption by the year 2020.

To summarize, vital drive behind economic development in China is energy consumption. Poverty alleviation and economic development are priorities agenda. Main energy source in the present and near future is CO_2 intensive energy. With backward technology in consumption, this results in considerable amount of pollution and GHGs emissions. Recognizing this pressing problem, the Chinese leader has put energy policy into the priorities. With being under pressure for clean and efficient technology, the technological transfer from abroad is aspiring offer to China. Also China's status of the leading emitter is being viewed by investors, as mean to provide necessary technological innovation at lower cost. The economic opportunities for CDM have risen prosperously (UNDP 2007; UNDP 2008).

5.3 Environment and Health Situation

High level of emissions in China has contributed to negative impacts on environment tremendously. Extreme weather conditions are becoming more prevalent, claimed by the China Meteorological Administration's Department of Forecasting Disaster. These extremes include typhoons, sandstorm, floods, and worst drought in more than a century last summer. Flood water pours into the Yangtze River at 51,000 cubic meters per second caused massive summer floods have killed more than 700 people across 24 provinces, especially in Hubei province and deprived over 5 million residents of their homes in 2007. Notwithstanding severe drought has left more than 8 million short of water and damaged over 11 million hectares of crops (Reuters 2007a). Particularly in Hunan province alone, more than 1.2 million people received 25 percent less rain than normal as the province was encountering over 40 degree Celsius. This also affected the country's breadbasket province of Henan, where 70 percent less than average rainfall received for the past two years (Reuters 2007b). For death and economic loss caused by natural disaster 2005 is illustrated in Appendix 4. These kinds of extremes will become more frequent, and more obvious. Noteworthy the study further expects the predicted increase in sea level would threaten large swathes of China's coastline. The areas are home to more than 50 percent of the population, over 70 percent of her large cities' location, including Shianghai, and accounts for 60 percent of China's economic output (World watch 2007). If this were the case all these millions would flee in the already heavily populated area and place greater pressure on the economy, its population's health and its environment substantially.

Apart from natural disaster as a result of increasing GHGs emission, environmental degradation in air also are problematic in China. The satellite data from the European Space Agency reveals alarming rate of pollutant increase in the sky over China. With a rise of 50 percent over the past 10 years, China has become the home to 16 of 20 the world's most air polluted cities. The northeastern provinces of China, including Beijing ranks the highest level of nitrogen dioxide concentration. Similarly, the areas of Shanghai and Guangdong province, where located major industrial cities and neighboring business center of Hong Kong, share pressing level of pollution. Today, diseases linked to air pollution are among the largest threats to public health in China (WHO 2008). This air pollution level is blamed for 411,000 premature deaths in 2003, mostly from lung and heart-related diseases, which can also be an indirect effect from constant exposure to pollution. The Environmental protection Agency expects the pollution level to quadruple within 15 years (The Guardian 2005).

Along with the dire environmental situations of increase in GHGs causing drastic natural disasters, water crisis, and perilous air condition, concerns over human health are distressing. An efficient pollution management system is therefore in demand. A local and global elevating environmental problem has begun to widely realize by the public, despite the information control initiation of the government that has long been mandated. Recently implemented, the September 25th, 2005 Regulations tightens control over online news services further; blocking of web pages of popular news agency namely BBC, Epoch Times, Voice of America Service, and the public encyclopedia, Wikipedia etc (Lau 2005: 3).

Here lies the win-win concept, China needs the development of renewable energy and improvement of energy efficiency to cope with its increasing energy demand gap and mitigate the disastrous environmental effect. Simultaneously, it has generally low cost of abatement, as a lucrative cost-effective option to satisfy the investors. These general situations favor CDM implementation in China. The following section describes the consequential environmental institutional development in China.

5.4 Environmental Institution Situation

5.4.1 The Measures

The interim CDM measures were issued in June 2004. The regulations however were revised in light of experience from project implementation. The new measures came into force as of

October 12, 2005. They include clear features such as requirements for participation, allocation ratio of CERs with the Chinese government, and proposal of price of CERs. The noteworthy provisions are:

- Priority areas cover energy efficiency improvement, development of alternative energy, renewable energy and methane recovery and utilization
- Revenue from CDM projects of HFC-23, N_2O and priority areas is levied by government by 65, 30 and 2 percent respectively (revised)
- Project owner shall be wholly Chinese enterprise or Chinese holding enterprise with foreign investment stake no more than 49 percent qualify as project owner (revised)
- Require third independent party as for expert review on approved after NDRC's approval
- All documentation needs to be submitted in Chinese (Vrolijk &Jinze 2005: 47; Xuedu 2006: 12; NCCCC 2008c).

5.4.2 The CDM Operation

The national CDM institutions in China are based on the Measures of Operation and Management of Clean Development Mechanism Projects. For the approval of CDM projects, the Chinese government has set up a National CDM Board. This Board consists of the NDRC and Ministry of Science and Technology (MOST) as co-chair. The remaining bodies include the Environmental Protection Administration, the China Meteorological Administration and other ministries. The board is responsible for reviewing and approving CDM projects. Each of them has specific responsibility within the process. The National Development and Reform Commission (NDRC) has been appointed as the Designated National Authority (DNA). The DNA follows the approved CDM projects by the national CDM Board. As depicted in Figure 5, the process is that applications are directed to the NDRC, which forwards them to an expert review. The Chinese DNA usually takes up to three months to issue letter of approval. The project proposal is then forwarded to the CDM Board, which assesses the proposal and makes a joint decision (Yang interview). Should the project be denied, it will have to be revised and then resubmitted. After the approval by the CDM Board, the NDRC (the DNA) provides a letter of authorization. Then the endorsement from the MFA and MOST follows (NCCCC 2008b).

The Chinese CDM investment is characterized as a long-term investment, due to its lengthy process as in CDM nature. The bottleneck of the process in China lies not within the government actors, but more on the EB and the Designated Operational Entities (DOEs). The NDRC has been regarded as facilitating stage of the process. This is due to the enthusiastic in promoting CDM projects investment in China, particularly projects within priority areas. The Chinese DNA's approval requirement is becoming less complex, and more reasonable (Yang interview). The DOE validates and then requests registration of a proposed CDM project, verifies emission reduction of a registered project and certifies as appropriate and requests issuance of CERs by the EB. This is apparent by the numbers of approval by the DNA of more than 100 projects per month, while many of those are waiting for validation from the EB and DOEs. The length varies by case-to-case basis, normally ranging between one to three years (Xu interview).

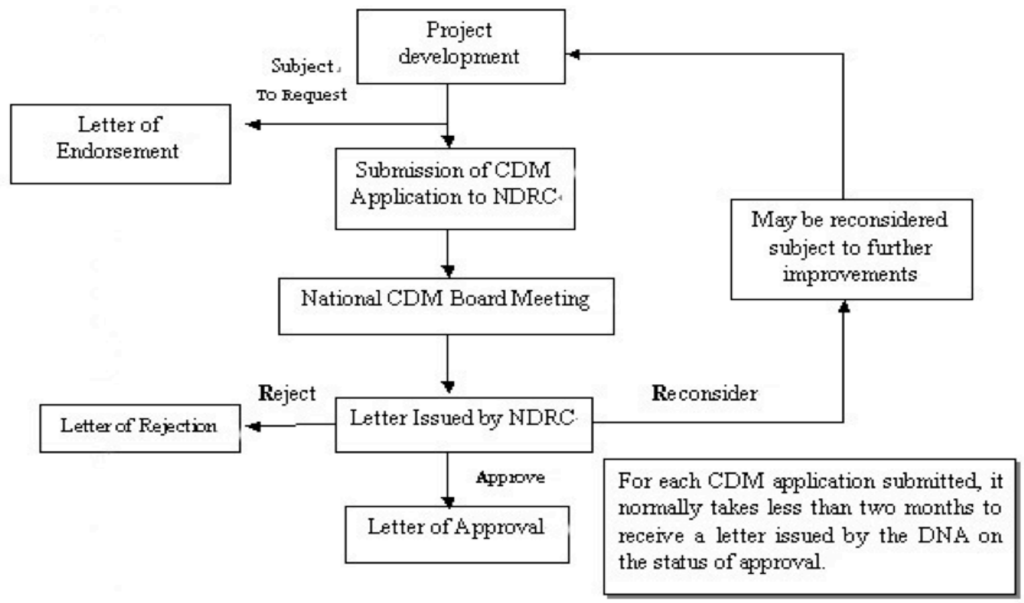

Figure 5: Chinese CDM Approval Process

Source: Zeng (2006)

Other actors besides governmental ones are also involved in the CDM implementation. To ensure the transparency of the operation, the National CDM management center- a semi-governmental organization- operates at the project level and make sure that the government CDM policies are followed. Under the guidance of NDRC it will operate at the project level and assist the office with receipt of material for CDM project application, organize experts and keep a database of the project. CDM centers are being prepared throughout the country, especially the less developed areas.

Capacity building is promoted both centrally and locally to ensure that China is well positioned to take advantage of CDM opportunities. The MFA, NDRC, and MOST are among the highest level of expertise of the commission and ministries regarding the international and domestic CDM policy-making issues. Researches on CDM in international stance have been mounting, mostly from the perspective of economics, business and engineering. Within the academic area, Tsinghua University and the Energy Research Institute have the greatest capacity in terms of technical aspects of CDM, as they provide technical expertise and supporting analysis to the governmental institutes. Training centers are established throughout the country. This is to facilitate capacity building. Furthermore the capacity building assistance by international organizations, bilateral and multilateral donors has helped China to create an efficient projects approval systems, lowering transaction costs and enhance awareness of CDM among local stakeholders, who are lacking of experience. The donors of such projects are namely, the UNDP, World Bank, Japan Bank for International Cooperation and Asian Development Bank etc. (Wei et al 2004: 9; Heggelund 2007: 182).

6 Outcome of China's CDM Implementation

China's economic growth, energy consumption pattern, environment and health and relevant institutional situations have laid a firm ground for CDM implementation. Consequently, China becomes the leading recipient of CDM projects. Since May 2008, China has altogether 208 registered projects, compared to 37 projects were registered at the CDM EB since December 31st, 2006. This accounts a share of 19.87 percent of the total registered CDM projects. These registered projects account for 51.59 percent of expected average annual CERs, ranking China the biggest CERs supplier.

Considering the timeframe of three years taken for the first project in China from submitting to eventual registering, the current numbers of approved projects have revealed the improvement in Chinese DNA process. It has so far in 2008 approved 1150 projects, quadrupling the number in December 2006 of 255 projects within. The time consuming process appears to be more dynamic. With more than 100 projects are submitted and being approved each month, the DNA process has been smoothly operated (NCCCC 2008c; UNFCCC 2008f; IGES 2008; Vrolijik &Jinze 2005: 46; Xu interview; Yang interview). With the promising CDM implementation, encouraging achievement in fulfilling the win-win concept is predicted. The details are discussed as following.

6.1 Cost Effectiveness Provision

6.1.1 Cost Effectiveness Benefits to Investors

Investors are not appealed to China only due to its price issue, but also due to broad project options, future investment opportunity, and quality as well.

Low Cost of Abatement

The Policy of Global Change and the Global Trade and Environment model, the Emission Prediction and Policy model both demonstrate that China has a relatively flat MAC curve, compared with other countries as illustrated in Figure 6 (World Bank 2004: 92). Therefore the amount of emission reduction target, countries with higher MAC can benefit from lower costs of abatement by attaining permits from countries with lower MAC as China. According to Energy research centre of the Netherlands publication, the forecasted total abatement potential in China in the year 2010 is roughly 615 MtCO_2eq. Around 38 percent of this potential can be achieved at net negative costs, making China a truly ravishing alternative for CDM project investment (Wetzelaer et al 2007: 26). Please see Appendix 5 for GHGs emissions reduction options for China in 2010, in terms of potential amount and cost. This owes to its large emission base as well as inefficient energy consumption.

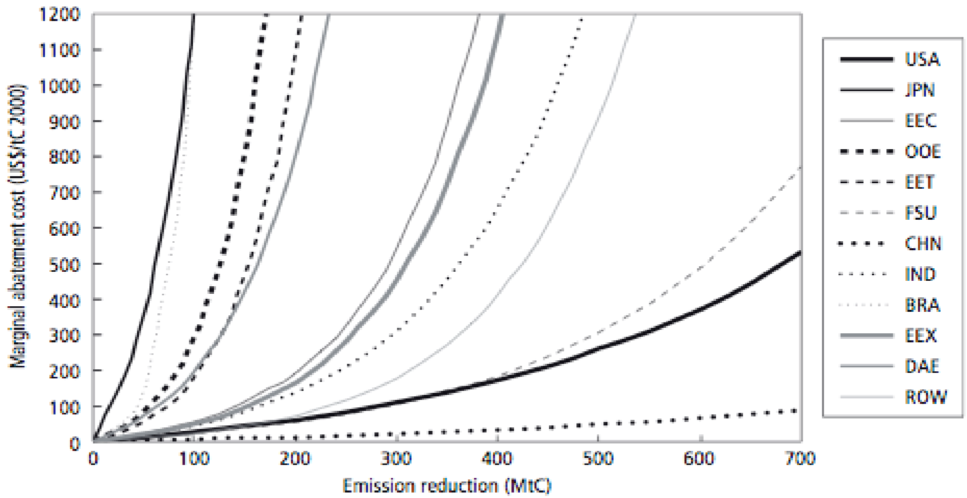

Figure 6: MACs for All GHGs in 2010

Source: GTEM, from World Bank (2004)
Note: USA, JPN, EEC, OOE, EET and FSU stand for the United States, Japan, European Union (EC 15), Other OECD Countries, Eastern Europe and Former Soviet Union. This groups Annex B countries and regions together. EEX, CHN, IND, DAE, BRA and ROW represent Energy Exporting Countries, China, India, Dynamic Asian Economies, Brazil and the Rest of the World. This latter group belongs to non-Annex B countries and regions.

Broad Project Options

Furthermore due to its wide base of GHGs emission, wide ranges of project types in China are viable. Investor thus being offered broader option in investment, in terms of sizes and types of technology (Xu interview; Baláč interview). They can choose to invest in the project with criteria that best suit their goals. It can be in terms of cost and benefit structure, innovation available or internal objectives. The wider offer thus maximizes profit for current investment decision

Long Term Investment

Also, the position of the world's largest emitter and increasing energy demand has led to the prediction that China will continue to have potential of emission reduction investment opportunity in the coming years. This therefore rising attractiveness to invest in China (Xu interview). The investors can expect to lower transaction costs in long terms as gaining more experience and information of the market and regulations, familiarizing with the actors and developing relationships and networks as time passes. At the same time, they can avoid additional transaction costs when penetrating into new market otherwise

High Quality Project

Many investors invest in the CDM with anticipation to improve reputation and lower brand protection costs. By projecting themselves with true concerns over the side benefits of the CDM namely public health and environmental improvement, they expect to gain competitive position and rising profitability. Therefore the needs suits the high "quality" offers of China. China policy in Project Design Documents (PDD) is known to demand a number of side benefits, when compared to other potential competing countries (Xu interview). It nurtures the quality of the CDM project, henceforth enhancing attractiveness of the CDM investment to those investors that are avoiding buying "hot air" (Cosbey et al 2005: 8).

6.1.2 Obstacles Against Cost Effectiveness Provision

Nevertheless, China's CDM investment has encountered impediments in cherishing its cost-effective offers. To name a few, the CDM nature itself such as future market uncertainty, high procedural transaction costs, or the Chinese market nature such as, transparency, information constraint and low sustainability sentiment can be problematic.

Market Demand Uncertainty

The market prospect beyond 2012 is though promising, still is unclear whether a new international climate agreement will be reached after the first Kyoto period ends. There is strong signal that they will continue to operate independently of a new international agreement namely, the EU ETS Phase 3 (2013-2020). Particular attention is also paid to the promising carbon market development in the United States. Yet again, there has been no confirmation of the commitment to emission reduction target announced (Point Carbon 2008a; Point Carbon 2008b). Alternatively, even if the market for carbon were to grow, the key question lies within to what proportion that the demand will be satisfied by CERs. Domestic shortfalls can be fulfilled by CERs, emission removal units from Joint Implementation or AAUs from the unused portion of emissions allowances from countries namely Russia and Ukraine. Moreover the AAUs are predicted to outcompete CERs on price (Cosbey et al 2005: 7). Though with the CDM market being transformed more towards sellers market, and China has gained more market power through its position of leading supplier, the uncertainty for the future demand is uncontrollable and is going to affect the CDM market as a whole, China is no exception.

High Procedural Costs

Complex process of the CDM approval process give rise to high transaction costs, particularly in terms of information costs and implementing costs. First, Chinese CDM requires consultation services from the third party. These organizations are namely, Det Norske Veritas Certification, Korea Foundation for Quality, Japan Quality Assurance Organization, SGS United Kingdom (NCCCC 2008d). Noteworthy, none of them are applicants from China. This implies expensive services paid to foreign DOEs, as part of implementing costs. Second, the methodology is complicated and strictly used in a project-by-project basis, therefore raising information-gathering costs. Third, the EB and methodology panel frequently adjust, modify or sometimes abolish the existing methodology. Often, the on-going PDD is rejected, due to the invalidation of certain methodology by the EB (Yang interview). Henceforth the costs redesigning and revising, during implementation are considerable. Furthermore, the large-scale projects incur double the money and time cost, since the government must approve them as do with other FDI. On the other hand, such high transaction costs are prohibitive to small-scaled projects- a volume of less than 10,000 tCO_2 per year- from being implemented. The estimated cost is at least 250,000 USD per project (World Bank 2004: 71;Vennemo et al 2006: 255).

Also time delays in the process contribute additional costs. As investors take risks in putting up the money long in advance of the generation of the credits, the investors can lose all of the money invested. The timing though varies case-by-case; it is ranging between 1-3 years (Xu interview; Chandler &Gwin 2008: 15). High information and implementation costs, along with uncertainty from time delay add up to high transaction costs. The substantial procedural costs henceforth questions the cost effectiveness provision of Chinese CDM.

Low Transparency

Perception of Chinese administrations to investors has long been clouded by high corruption. By June 2007, a total of 24,879 cases had been investigated, with bribes totaling more than 6.156 billion RMB (0.8809 billion USD) (China Daily 2008). The corruption perception index by the Transparency International (2007) shows confidence rate of 3.5 (the highest is 9.4) and ranks China 72 out 180 countries. Corruption still exists in China, according to Premier Wen. It vandalizes the interests of the Chinese people, impairs the governance base, undermines capability of the government, subsides the social stability and disturbs the developmental reforms (China Daily 2005). Undeniably, "Guanxi"- an essential substitute for state's formal institutional support- is deeply rooted in China's economy. It provides the basis for trust and identity in a close-knit group, enabling actors to realize their preferences and interests in collective action (Nee 2000: 86; Granovetter 1985: 505). With exposed information of other allegedly corrupt individuals from China's largest corruption scandal of a senior official in Heilongjiang Province in 2005, more than 260 government officials were revealed; more than half are the local officials. Suspicious links were drawn to the former director of the Environmental Protection Bureau of Heilongjiang, who allegedly took bribes amounting to 242,000 USD while serving as a mayor of Suihua (China Daily 2005). The CDM implementation, which highly involves administration at a local level, is consequently being questioned to its transparency, thus lowering efficiency in contributing cost-effective benefits.

Information Constraint

The lack of market understanding and awareness among stakeholders stem from the historical structure of Chinese economy and political priorities, in combined with the government strict information control. Only a few decades ago, China has entered market-economy world. Furthermore, the environmental policies have never been prioritized, up until the past few years. The CDM employs market-based economic tools, with additional provision of sustainable development. With tradable permits principle, it is prone to be a cost effective method for emission reductions. The stakeholders therefore are not familiar with the instrument or the idea of paying attentive care towards environment issue. Particularly among the local institutions, which need to approve the projects locally, still lack experience (Vrolijk &Jinze 2005: 46). Furthermore, as it has been long before, information in China is still under governmental control. Availability and free flows of news and information lacking in China has raises costs in data collection in CDM process, while undermining data in need for designing international competitive structure to generate cost effectiveness benefits to investor.

Foreign Equity Investment Restriction

The CDM projects as stated in the Chinese interim measures constrain the investors from making a direct investment in the project. Instead, they are required to create a corporate joint venture into which they can invest. Without over 50 percent of the share, it implies the control over the company. This covers all decision making that directly impact costs and benefits of the company. However, there exist ways to get around the law. Yet they come with high transaction costs (Buen interview; Heggelund 2007: 185). Furthermore, the investor cannot easily make a "preferred stock" investment, therefore cannot get a priority return on investment. Therefore uncertainty of getting back the returns increase transaction costs of investment further (Chandler &Gwin 2008: 12).

6.2 Sustainable Development Provision

6.2.1 Sustainable Development Benefits to China

The benefits to China in terms of sustainable development reveal positive indication. The improvement are measured in terms of technological transfer, economic growth, and environmental and health dimensions.

Technological Transfer

As of February 2008, over 70 percent of projects approved by DNA are renewable energies projects. The number of hydropower projects has substantially increased up to 605 projects, accounting more than a half of total approved projects in China. Over 400 were added in 2007. The wind projects and the waste heat or gas utilization ranks the second and the third respectively. The HFC-23 project still covers the majority of CERs created. However the share of average annual emission reductions from HFC-23 and N_20 decomposition projects have decreased from 56.6 percent to 32 percent, whereas hydropower and waste heat or gas utilization projects are gradually increasing. The historical trend of CDM types approved by the DNA up to February 29th, 2008 is displayed in Figure 7 (IGES 2008: 7). Furthermore government introduced lower-than-average custom duties for all renewable energy equipment imports, imported wind turbines have no customs duty while local one is subjected to 3 percent. Ironically, this induces more imports and unnecessarily higher wind energy equipment cost, while suppressing localization and local manufacturer's profits.

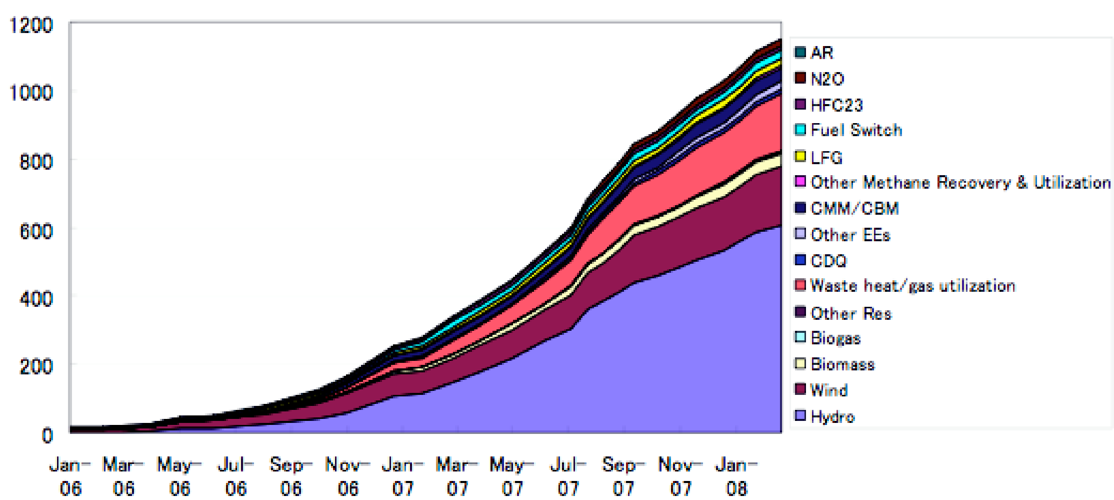

Figure 7: Types of DNA Approved Projects as of February 29th, 2008
Source: Institute for Global Environmental Strategies, IGES (2008)

One mechanism to promote technology transfer benefits in China is taxation. As stated in the measures, the differentiated taxes system assigns heavy taxes burden on HFC-23, N_2O projects. The objective is to discourage these two types of projects, and encourage priorities types instead. The fees collected will be spent on other CDM activities such as, CDM training, subsidizing other types of projects (Yang interview). The fee-collection mechanism is well organized, thanks to the help from the Asian Development Bank and the World Bank with the operation of this fund. This brings three clean energy technologies (hydropower, wind energy and natural gas combined cycle) to become economically viable with internal rate of return closed to 10 percent and the environmental costs avoided are increased by 37 percent (Resnier et al 2007: 4529).

Economic Growth

The estimated range of CER sales are 77 to 311 million USD per year. When considered within China's economic framework of 3.42 trillion USD as GDP value in 2007 (China Daily 2008b). It is noteworthy to mention that, given that these estimates are fulfilled, the CDM will not have a substantial impact on overall economic growth in China in the timeframe considered up to 2010-2020 (World Bank 2004: xi).

However, CDM implementation contributes to China's economic development, in long term, by extending foreign investment, localization of advanced technologies and technology efficiency improvement in China, thus lowering the cost of manufacturing capital goods. An increase in net FDI increase from CDM inflows of 475 million USD annually in 2010. Higher rates of efficiency improvement in the energy end-use and electricity generation sectors lead to greater resource productivity. The localization will introduce diffusion of the technologies transferred. To put in practice, given the 2005-2010 timeframe, every dollar invested in Chinese CDM projects boosts the Chinese economy, measured in GDP terms, through 2010 by an additional 0.20 USD. This multiplier effect is expected to rise over time, as technology localization advances. The combined results show GDP increase of 0.52 percent of annual GDP in the year 2030 (World Bank 2004: 127).

Environmental and Health Improvement

As of May 2008, China is expected to reduce 110,444,223 tCO_2e annually. Epidemiological research into air pollution has concluded that air pollution is harmful to human health. The literature reviews show that the estimated mortality rate is ranging from 0.4 to 2.4 percent, e.g. Pope et al (2002), Aunan &Pan (2004). It is predicted that if China were to realize its CDM potential, between 2700 and 38,000 lives could be saved annually, depending on method used in the research. Considerable impact of the avoided life years lost from air pollution reduction occurs in age groups less than 50 years of age. Therefore the reduction may have significant impact on national life expectancy. To convert into monetary benefits, this involves applying valuing life concept on China. However, based on the widely accepted estimated value of life in China, monetary benefits for those lives saved in avoidance of premature death therefore accounts between 34 and 161 million RMB (Please see Vennemo et al 2006 for ranges of estimated value of life in China). Furthermore, the figure is greater when non-mortality benefits are included. Lower air pollution involves fewer cases of respiratory disease, fewer asthma attacks, and fewer cases of hospital admissions, outpatient visits and sick leaves. Furthermore, it entails improvement in local environment condition, therefore higher agricultural yields, better forest growth, less corrosion, less wear and tear of buildings and cultural heritage, better visibility and less dust removal. These non-mortality impacts are calculated in monetary value with difficulties, as did so with mortality impacts. Yet, consensus range from the studies review proposes non-mortality benefits to amount annually to between 1 and 45 billion RMB.

Along side with CDM, the government has grown true interests in promoting environmental protection and reducing GHGs emissions. Evidently, the total investment in the treatment of environmental pollution doubled over the period 2000-2005, from 1014.9 to 2388 million RMB (China Environmental Statistical Yearbook 2006). Also China has implemented many policies to induce GHGs reduction namely, the new index on emission for big enterprises and its punishment-bonus mechanism: whoever surpasses the index will be punished, while those who emit lower will be provided with bonus. However the wide recognition of these recent implementations may be limited at global level, since most of these regulations are available only in Chinese version as of today (Yang interview).

6.2.2 Obstacles Against Sustainable Development Provision

Yet impediments appear in providing sustainable development benefits in China. These obstructions include narrow project focus, low sustainable development sentiments and small scale of CDM market.

Narrow Project Focus

China has promoted renewable energy as center of the focus. Yet insufficient attention has bee paid onto other sectors that would have greatly contributed to China's sustainable development benefits otherwise. Chinese government has barred lending to steel and cement companies. This is to postpone the unrestrained expansion of heavy industry. This is considered crude generalized industrial policy. Yet its efficiency in blocking clean energy finance is considerable. Bankers are not supporting energy efficiency projects as they expect too high transaction costs to work-around such investment control. Furthermore higher efficiency in industrial energy would stem from shutting down old factories that are often characterized by poor management and outmoded technology, and replacing them with new, modern and efficient ones. However, the idea is difficult to put into action. This is because of high political barrier to closing them; most of them are owned and operated by local government (Chandler &Gwin 2008: 9). The investments in coal energy source have also been impeded. Due to the restructuring of the State Power Corporation environmental goals have been set aside and foreign investors are being redirected only when local partners fail to keep up with the agreements within the power sector. Unclear definition of baseline, methodology and justification of additionally has been a major barrier as well (Zeng 2006: 83; Ojner 2007: 46). Similarly, the growing sector as transportation raises pressing emission problem. China is expecting more than 140 million cars on its roads by 2020, seven times higher than now (Vennemo et al 2006: 255). However, the sector is less financially attractive, mainly due to high monitoring costs (Buen interview). The wider coverage of strong market mechanism support to lower transaction costs, as provided for renewable sectors, may result in greater sustainable development to China.

Low Sustainable Development Sentiment

The fact that majority of CERs are currently generated from the HFC-23 projects questions the sustainable development sentiment of Chinese CDM. Despite the lucrative profitability of HFC-23 MAC is between 0.34 and 0.73 USD/tCO_2e, which is much smaller than the probable price, the projects are not considered conducive to China's sustainable development. Its HCFC-22 leakage effect contributes to global warming damages, ozone depletion impacts. Furthermore, the pressure of competitiveness from such highly profitable CDM project could be so high that other projects with higher sustainable development benefits will be infeasible. As an example, wind power, hydro power, landfills, biogas that could directly contribute to local farmers and end users, providing multiple economic, technological advancement and environmental benefits for low-income groups in rural area (Resnier et al 2007: 4532; Cosbey et al 2005: 7; Zhu interview).

Small Scale of CDM Market

China is the leading CERs recipient and there has been positive trend in sustainable development in China in all dimensions: energy infrastructure investment, sales of CERs, foreign investment flows, and GDP improvement. However, China Environmental Statistical Yearbook 2006 shows that the current emissions are still rising and so as the total amount of disasters, and death and number of patients discharged that suffered from respiratory disease. This implies that the current CDM investment is not commensurate with the development benefits needed. Therefore, more supplies of high quality CERs would be necessary to contribute to noticeable sustainable development in China.

7 Analysis and Conclusions

7.1 The Learning-by-doing Process

China's CDM implementation is virtually a learning-by-doing process. Its characteristics have brought about and in many cases amplified the hurdles embedded within the CDM nature. As a response to barriers encountered to achieving both concepts of cost effectiveness and sustainable development, the action taken is also an ongoing process. Though the outcome requires time in order to shine through, the outcome can be predicted by the Chinese support.

Increase Procedural Efficiency

With high costs for approval as a bottleneck, margins are lowered so much that the project becomes less attractive to invest. If not corrected, cost effectiveness concept would be dampened by high costs, while sustainable development may not stand a chance since there might be no investment at all.

According to the economic principle of cost effectiveness, the revision of CDM measure reflects an attempt to lower uncertainty, due to unclear rules defined by the interim measures. The new measures clearly define requirements for participation, eligibility, rights over benefits of CERs and proposal of CERs pricing. Also the institutional structure and streamlined procedures are meant to increase efficiency, thus lowering transaction costs of the CDM operation in China. The set up of National CDM Board, which consists of seven ministries and is co-chaired by the NDRC and the MOST has clearly defined responsibilities and functions in the development of regulations, procedures, and systems for application, approval and implementation. These efforts will alleviate the lengthy procedures for future CDM projects and make the investment more attractive to foreign investors.

Capacity Building

Due to the historical structure of the Chinese economy and political priorities, experiences, knowledge, public sentiment toward cost effectiveness and sustainability is low. Media control in China has undermined the urgent environmental situation in China, and at the same time impeded its competitiveness in participating in international permit market substantially. The lack in human capital therefore put risks to both goals' attainment.

In acknowledging the problem, the Chinese government has promoted capacity building. Through information principle perspective, it is seen as a crucial vehicle towards CDM implementation. Particularly in the case where the knowledge and experience is lacking, strong capacity building initiatives are likely to promote a higher level of involvement and efficiency from all stakeholders, raising public awareness and sentiments. Within the past few years, a number of research institutes have developed skills in technical aspects of the CDM projects; many consultancies have been operated with experienced staffs, which previously worked in official agencies. Although this diversified CDM is prevalent mainly in Beijing, it remains unclear in the areas outside the capital. To enhance capacity, training programs through the international capacity-building projects are held in local areas outside Beijing. This step is to ensure that the local stakeholders become more familiar and are ready to engage in the international markets. Furthermore, the media control over environmental reporting is more relaxed, as the issue is now included in the government's priorities. The mounting interests and knowledge as the result of the projects being performed is expected to bring greater momentum and development in China's CDM, according to information and sustainable principle. As a result, capacity building paved the way towards the dual goal of CDM projects.

Increase Transparency

Additional informal payment to officials and other participating parties is expected to be necessary in order to negotiate, validate, implement, monitor and control stages of the CDM process. Such costs are not only unpredictable; they tend to be substantial high, after summing everything up. They can become blockades against profitability of CDM investment in China. The ability of its CDM to provide cost-effective emission reduction methods is thus skeptical. Alternatively, from a sustainability perspective, corruption can pose major concerns if the decision maker values his own benefits more than the sustainable benefits of the country. Corruption could blind the CDM's true will towards sustainable development in China.

The mechanism to ensure transparency is embedded in the CDM approval process. Other actors besides governmental ones are also to participate in the CDM implementation. To increase the transparency of the operation, the National CDM management center- a semi-governmental organization- operates at the project level and makes sure that the government CDM policies are followed with efficiency and transparency. Furthermore, international organizations, bilateral and multilateral cooperation is promoted to provide Chinese CDM efficient measures to stop bribery and corruption activities. Serious penalties are assigned, as part of national anti-corruption work Transparent CDM procedures and sound governance would lower transaction costs of implementing the projects, therefore enriching the CDM concept of lower cost of abatement to investors.

As described, China has put attentive care and efforts in sponsoring both cost-effective and sustainable development benefits, by tackling impediments encountered during the implementation point-by-point. However, the equal patronage of the dual goal is not attainable at all cases. At times, trade-off between the provisions occurs.

7.2 The Dilemmas

The trade-offs between lowest cost options to investors and sustainable development benefits occur. In the role of a game setter, China has apparently chosen the strategic move with the highest return, to implement policies towards its developmental benefits over lowest cost ones. The path taken, according to game theory, is illustrated in following regulations implemented.

CERs Taxes

China has imposed large taxes on its CERs. The fees collected from the taxes would be use in subsidizing other climate change activities. In other words, the CER taxes revenue would sponsor projects, which are more beneficial in terms of sustainable development. By this decision, China lowers its cost effectiveness benefits. This can result in losing CDM investment to other large developing countries such as India and Brazil.

Furthermore the different levels of taxes varying by types of project shows great concern of the quality of CDM approved. China imposed higher taxes on those profitable projects- HFC-23 and N_20 projects, while substantially lower taxes on priority ones. Along with the subsidy, which is complementary to the tax, the fee collected would subsidize those projects with greater sustainable benefits. Although HFC-23 and N_20 project types yield a large quantity of CERs, in other words, provide the lowest-cost means of generating Kyoto units, but not the highest quality. They are not considered conducive to China's sustainable development. Therefore the tax/subsidy mechanism would trigger the attractiveness through project profitability towards the projects that bring the highest sustainable development benefits to China. Being restrained by the taxes and subsidies, the mechanism is to ensure that an optimal outcome is attained. The greatest number of CDM technologies would become viable by the indirect transfer of income between project owners via taxes and subsidies. If taxes were not imposed, the profitability of those projects would out-compete other projects that may contribute higher sustainable development benefits.

Taxes on CERs are likely to hurt the financial viability of CDM projects, thus decreasing investors' profit. Similarly imposing taxation on the lowest cost projects is simply raising the cost of the projects. Therefore they can no longer offer the lowest cost otherwise. This implementation, though it is beneficial to sustainable development, is putting cost-effective concept of Chinese CDM at high risk.

National Eligibility

The condition of project owner states that a minimum of 51 percent must be owned by Chinese enterprise. The revenue is considered an advanced selling of emission allowance of a host country. The allowance is viewed as public resources of a country thus should be exploited and owned by the country

This eligibility requirement might discourage involvement of foreign investment. Inability to hold a majority of shares implies the loss of control within the firms. Therefore foreign partners might be prevented from making decisions towards cost-effective goal. By not having control, uncertainty and risks in return from investment raises even further. Nonetheless there are ways to go around the law and establish fully foreign-owned investment, by contracts ensuring authority to maintain control before becoming a minority shareholder. Still the action is additional to the investors' own costs both in terms of transaction and uncertainty. Therefore the national eligibility dampens foreign investors' cost effectiveness achievement. Alternatively, this regulation represents the key feature to protect China's benefit of CDM in sustainable development. Since when compared to foreign companies operating in China's CDM market, Chinese ones are less competitive. Thus if the government allows sole ownership by foreigners, the Chinese companies would not be able to have any CDM projects. Therefore those, who need the transfer of technology for clean development, would not receive any transfer.

The national eligibility requirement creates a hostile environment towards CDM investment in China. Yet it ensures the creation of technological transfers, thus additional benefits. Therefore this rule stipulates sustainable development benefits in China at the costs of investors' cost effectiveness benefits.

Evidently, when facing an option between promoting the dual benefits equally as stated by CDM objectives, and cherishing own benefits, China has been driven by higher profitability to deviate towards the sustainable development provision and free ride the sustainable benefits from the CDM engagement. The proof lies within the revision of the Measures under article of CERs taxes and national eligibility.

7.3 The Focus on Quality

China has paid close attention to the quality of the CDM project. This is a desirable strategy since there is optimistic expectation for CDM investment, legal support to do so and demand for high quality in the market.

Promising Future

Though the post-2012 Kyoto Protocol is not guaranteed, great momentum in regional carbon markets is evident. Strong signals stem from the commitment of the world's dominant player, thus providing preliminary conducive conditions to attract the followers, predictably from the game theory. To name a few, the EU ETS Phase 3, the United States initiatives towards carbon market development, possibility of United States-European Union carbon-trading scheme, and the United States' leadership in APP serve as good examples. This follows by Canada, Australia and New Zealand's on-going process of constructing national a carbon-trading scheme and Republic of Korea, Japan, China, India and Australia's participation in APP. The future of CDM market in China is therefore noticeably enlightening. Together with the fact that as of now China's CDM market is growing rapidly and is enjoying increasing market power, because the majority of CDM supply belongs to China, it is more sensible for China to focus on quality and the long-term benefits to the country, rather than cut-throat cost-competition against other players.

Legal Facilitation

Another attractive condition for China to deviate towards sustainable developmental goals is legal loopholes in the international agreement of the Protocol. The CDM is both a market mechanism and a development mechanism. Though being a market mechanism implies the attainment of lowest mitigation options as measured by carbon value, it is the host country's own authority to define the project eligibility criteria and priority of projects according to the country's developmental need. The Protocol provides individual governments flexibility so that choices fit best into their national situations. Therefore the priority project areas and tax/subsidy programs are viable. This enables the Chinese government to encourage those CDM projects that sponsor the sustainable development goal, even if it is at the expense of the cost effectiveness goal.

Demand for Quality

There has been growing demand from investors in terms of higher "quality" CDM. This stems from political concerns in many countries. The government prefers not to be seen as buying simply "hot air," rather they prefer to buy productive investments that tackle the climate change problems visibly. As in the case of China, where the environmental effects have deprived thousands of people's live and damaged their homeland drastically, the focus on bringing side benefits of CDM to China that would mitigate such problems is proving to be the strength of China's CDM marketing strategy.

7.4 Suggestions

According to the analysis, the CDM project in China still has room for improvement. My suggestions to enhance its provision of the win-win concept are listed as follows. First, China should specifically define sustainable development criteria of CDM project. To which indicators the requirements are to meet, therefore relieving burden to investors in project design and at the same time, ensuring the sustainable development benefits level the country requires. Second, adopting market-mechanism instruments towards those not included in priority areas. Other sectors that are also troublesome are not attractive to investors, due to high transaction costs. By adopting market tools in those sectors, more cost effectiveness for investors can be obtained, while more investment in those concerned areas can increase sustainable development benefits to the country. Third, though the building capacity programs are prevalent in central and local areas, the CDM related major decisions are concentrated in Beijing. However it is the local authorities and project developers who make use of those laws and regulations, and are also the ones with more background knowledge of their local areas' needs, therefore they should be more involved in the process of developing CDM rules and procedures. Lastly, China should be more in a balanced position between the two goals, when implementing rules and regulations over CDM projects. This is due to the link between the two benefits. The favorable conditions for both parties to engage in the CDM is the co-benefits, therefore if not promoting both equally, deviating towards own benefits, the lower benefit to investor may lead to an option not to engage in an investment at the first place. In that case, the sustainable development benefits henceforth are not occurring at all. Moreover, as recommended in Section 6.3, China would need a bigger scale CDM market; in order to effectively relieve climate change effects which occurred, due to China's size. To achieve that, the investment in CDM must increase.

7.5 Conclusions

Historical and future emission scenario reveals that developing countries are rapidly expanding their industrial output, contributing largely to increasing CO_2 emission. Though the industrialized countries are responsible for most of the problem historically, their efforts can be efficient if and only if developing countries' emission do not grow indefinitely. Therefore, the linked benefits between developing and developed nations through CDM that lead to international commitment are necessary to combat global climate change.

Like other developing countries, one side effect of prioritizing economic growth as the number-one goal in China is growing energy consumption. It lately has been increased again after reduction in the late 1990s. The country has long based on inefficient fossil-fuel energy consumption. Therefore the level of emissions contributing to the earth's atmosphere is frightening. Moreover the industrialization and desire for higher standard of living mount the energy needs. This worrisome pattern of energy consumption reveals that an increase in GHGs emissions along with China's domestic pollution is inevitable. Together with an increase in nation-wide natural disasters, prominent vulnerability to global climate change has pushed greater political focus on alternative energy sources. Energy conservation and energy efficiency are now the top political priorities in China. The achievement can be pursued quickly, given facilitating technology and funding. This poses lucrative development opportunities for CDM.

Skeptical upon embarking the international mechanism of CDM, China has now become the leading player in the market. Its projects have been exceedingly growing in numbers since the establishment of the DNA. The CDM apparatus has improved in efficiency, along with capacity building throughout the country. Foreign governments and enterprises thus have a growing interest in many low cost emission reduction project opportunities available in China.

Upon examining the implementation of CDM in China, the promising outcome of the win-win synergy is there. Yet there exist barriers along with room for improvement. Barriers towards cost effectiveness provision have been a general lack of awareness and experience by the government and business communities, market demand uncertainty, high procedural transaction costs, low transparency, information constraints, and foreign equity investment restrictions. Blockades towards sustainable development provision are narrow project targets, low sustainable development sentiment, and the small scale of CDM market.

The Chinese government has been active in correcting problems, which have occurred. The implementation is characterized as a learning-by-doing process. I have examined the major setting of regulations and procedure of CDM in China namely, the capacity building projects with bilateral and multilateral donors, the establishment of streamlined CDM procedures, the increase in transparency of CDM procedures and sound governance, the tax/subsidy scheme and the national eligibility. The CDM implementation is found to be serving both objectives, yet unequally. When controversy occurs between the two goals, China appears to be in favor of sustainable development. The initiation of tax/subsidy on CERs and national eligibility set forth shows inclination towards the country's benefit. Sensibly, it is more profitable for China to do so. The supporting forces stem from a promising market future, legal facilitation and specific demand for quality in the market. Henceforth China's CDM is not likely to achieve both provisions of the win-win goals, instead China adopts a pro-sustainable development strategy, at the costs of the cost effectiveness provision.

Further suggestions can be made. Noteworthy to mention is the room for improvement in the long lasting exploitation of both the benefits are: clearly defined sustainable development objectives, wider and deeper project focus onto those which are not under renewable projects, incorporating the locals and project developers to engage in CDM planning process to balance the win-win concept attainment, and not to focus too much on developmental benefits as of today.

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8.4 Interviews

Interviews were conducted with the individuals listed below, either by telephone or by electronic mail. All the interviewees were surveyed in their personal, rather than institutional perspective, except for the World Bank Carbon Finance Unit, the UNFCCC, and the UNEP. Their contribution does not necessarily mean agreement with the details, analysis or conclusions presented in this report.

Carbon Finance Help Desk (01-05-2008)	The World Bank Carbon Finance Unit
Boyong Zhang (China) (05-05-2008)	PricewaterhouseCoopers Associate/Transaction Service
Jan Baláč (Czech Republic) (20-05-2008)	Environmental Investments Manager
Johan Pettersen PhD (Norway) (06-05-2008)	Miljøsystemanalyse - Environmental Systems Analysis Manager
Jørund Buen (Norway) (15-05-2008)	Point Carbon Director
Li Yang (China) (20-05-2008)	International Technology Transfer Center of Tsinghua University (ITTC) Project Manager
Marcello Balasini (Switzerland) (20-05-2008)	First Climate Group Regional Manager in China
Men Shaodong (China) (20-05-2008)	Arreon Carbon UK Limited Senior Manager
Sohei Fujita (Japan) (19-05-2005)	Toyota Tsusho Corporation Project Manager
UNFCCC Secretariat (06-06-2008)	United Nations Framework Convention on Climate Change (UNFCCC)
Wang Xu (China) (15-05-2008)	The Office of National Coordination Committee on Climate Change (NCCCC) Project Manager
Xianli Zhu PhD (Denmark) (09-05-2008)	United Nations Environment Program (UNEP) Risø Centre Energy Economist

9 Appendices

Appendix 1: Interview Questionnaires

Clean Development Mechanism in China: A Win-win Synergy?

Interview Protocol

1. Within your organization, is the CDM perceived to be significant tool for bringing both the provision of sustainable benefits to the host countries and the provision of your agency's broader policy objective or low-cost emission credits?

2. Of the CDM projects currently in development or being implemented in China, which do you feel will be the most efficient in providing sustainable development benefits to China? For which reasons?

3. Against what standard, in your view, should the mechanism's contribution be measured, in terms of:
   a) China's sustainable development benefits?
   b) Investors' benefit?

4. What do you see as the main challenges with using the CDM in China as a tool for providing both transacting parties' benefits, from the perspective of:
   a) China or host country?
   b) Investors?

5. There have been a number of proposals aiming to modify the CDM to better align the benefits of sustainable development to host countries with the benefits of low-cost emission reduction to the investors. These include:
i. Expanding the CDM so that the policy-related initiatives may be incorporated;
ii. Enabling donors to use Official Development Assistance to cover the additional cost to investors associated with providing sustainable development benefits through CDM projects;
iii. Using tax incentives to support CDM investments that provide sustainable development benefits.

   a) How successful do you think any or all of these options could be in better ensuring the provision of benefits to both parties? What do you see as being their key strength or limitation in China's case?
   b) What other approaches would you recommend?

6. What role, if any, could China play in ensuring the CDM benefits to both the host country and the investors?

Appendix 2: List of Annexes
Source: UNFCCC (2007)

Annex I	Annex II
Australia	Australia
Austria	Austria
Belarus*	Belgium
Belgium	Canada
Bulgaria*	Denmark
Canada	European Economic Community
Czechoslovakia*	Finland
Denmark	France
European Economic Community	Germany
Estonia*	Greece
Finland	Iceland
France	Ireland
Germany	Italy
Greece	Japan
Hungary*	Luxembourg
Iceland	Netherlands
Ireland	New Zealand
Italy	Norway
Japan	Portugal
Latvia*	Spain
Lithuania*	Sweden
Luxembourg	Switzerland
Netherlands	Turkey
New Zealand	United Kingdom of Great Britain and Northern Ireland
Norway	United States of America
Poland*	
Portugal	
Romania*	
Russian Federation*	
Spain	
Sweden	
Switzerland	
Turkey	
Ukraine*	
United Kingdom of Great Britain and Northern Ireland	
United States of America	

*Countries that are undergoing the process of transition to a market economy.

Note: Annex I Parties include the industrialized countries that were members of the OECD (Organization for Economic Co-operation and Development) in 1992, plus countries with economies in transition (the EIT Parties), including the Russian Federation, the Baltic States, and several Central and Eastern European States.

Annex II Parties consist of 24 original OECD countries and the European Union which are included in Annex I. This group has a special obligation to assist developing countries with financial and technological resources.

Non-Annex I Parties comprises mainly developing countries. Their commitments rely on the financial resources and technological transferred from the developed countries.

Appendix 3: Goals on climate change and clean energy adopted by 10 largest economies
Source: Stern (2007)

Country	Actions
Brazil	- National objective to increase the share of alternative renewable energy sources (biomass, wind and small hydro) to 10% by 2030 - Programs to protect public forests from deforestation by designating some areas that must remain unaltered and others only for sustainable use
China	- The 11th Five Year Plan contains stringent national objectives including: 20% reduction in energy intensity of GDP from 2005 to 2010 10% reduction in emission of air pollutants 15% of energy from renewable within the next 10 years
France	- Kyoto Protocol commitment to cap GHG emissions at 1990 levels by the period 2008-2012 - National objective for 25% reduction from 1990 level of GHGs by 2020 and fourfold reduction (75-80%) by 2050
Germany	- Kyoto Protocol commitment to reduce GHG emissions by 21% on 1990 levels by the period 2008-2012 - Offered to set a target of 40% reduction below 1990 levels by 2020 if EU accepts a 30% reduction target - National objective to supply 20% of electricity from renewable sources by 2020
India	- The 11th Five Year Plan contains mandatory and voluntary measures to increase efficiency in power generation and distribution, increase the use of nuclear power and renewable energy and encourage mass transit program - The Integrated Energy Policy estimates that these initiatives could reduce the GHG intensity of the economy by as much as one third
Italy	- Kyoto Protocol commitment to reduce GHG emissions by 6.5% on 1990 levels by the period 2008-2012 - National objective to increase share of electricity from renewable resources to 20% by 2010
Japan	- Kyoto Protocol commitment to reduce GHG emissions by 6% on 1990 levels by the period 2008-2012 - National objective for 30% reduction in energy intensity of GDP from 2003 to 2030
Russia	- Kyoto Protocol commitment to cap GHG emissions at 1990 levels by the period 2008-2012
United Kingdom	- Kyoto protocol commitment to reduce GHG emissions by 12.5% on 1990 levels by the period 2008-2012 - National objectives to reduce CO_2 emissions by 20% on 1990 levels by 2010 and by 60% on 2000 levels by 2050
United States of America	- Voluntary federal objective to reduce GHG intensity level by 18% on 2002 levels by 2012 - California, the largest state in the USA, has an objective to reduce CO_2 emissions by 80% on 1990 levels by 2050 - States in the North-East and mid-Atlantic have set up the Regional GHG Initiative to cut emissions to 2005 levels between 2009 and 2015, and by a further 10% between 2015 and 2018

Appendix 4: Population affected, deaths and Economic loss caused by natural disaster 2005 by regions
Source: Ministry of Civil Affairs (2008)

Region	**Population (10 000 person-times)**		**Direct**
	Population Affected	**Deaths (person)**	**Economic Loss (100 million yuan)**
National Total	40653.7	2475.0	2042.1
Beijing	8.6	2.0	0.6
Tianjin	32.2		2.2
Hebei	1145.8	35.0	30.0
Shanxi	1323.3	20.0	39.4
Inner Mongolia	436.5	31.0	24.6
Liaoning	406.5	53.0	61.7
Jilin	311.5	5.0	36.7
Heilongjiang	307.3	129.0	36.1
Shanghai	152.8	7.0	17.0
Jiangsu	938.1	75.0	84.5
Zhejiang	2731.9	90.0	345.9
Anhui	3417.7	112.0	151.1
Fujian	2182.6	253.0	237.8
Jiangxi	2374.8	104.0	96.1
Shandong	1474.9	32.0	75.9
Henan	1614.8	36.0	81.5
Hubei	3456.8	171.0	70.1
Hunan	3794.4	169.0	87.3
Guangdong	1201.0	117.0	63.1
Guangxi	1888.7	137.0	91.2
Hainan	883.3	37.0	117.2
Chongqing	2047.2	56.0	32.8
Sichuan	2349.2	222.0	108.1
Guizhou	2055.9	137.0	23.1
Yunnan	2343.7	239.0	37.4
Tibet	46.2	14.0	2.3
Shaanxi	1073.6	78.0	53.0
Gansu	160.1	32.0	8.8
Qinghai	266.8	26.0	5.6
Ningxia	123.6	1.0	4.6
Xinjiang	52.1	53.0	8.5
Xinjiang Production & Construction Corps	51.8	2.0	7.9

Appendix 5: Identified GHG emissions reduction options for China, 2010
Source: Wetzelaer et al (2007)

Mitigation option	Potential [Mt CO_2/yr]	Costs [$/tCO2]
Agricultural products and forestry		
- Forestry Rotation and Regeneration options	31.9	-143.6
- Seeding or dry nursery and thinnig planting	6.8	1.9
- Multinutrient block	7.5	32.9
- Ammonia treatment straw	12.6	60.5
Electricity		
- CFBC (Circulating Fluidized bed combustion)	0.5	-2.0
- Renovation and reconstruction of conventional thermal power plant	13.9	2.9
- Supercritical coal	2.5	5.4
- Hydro power	20.7	20.0
- Natural gas	0.4	22.1
- Scrap & Build (modify smaller coal power plants)	35.6	8.3
- Modification option (modify larger coal power plants)	9.2	28.3
- IGCC and other advanced conventional thermal power technologies	1.3	28.8
- Biogas and other biomass energy	9.2	35.2
- Wind energy (Grid In)	2.6	36.8
- Wind Power	0.5	57.4
- Fuel-switching (Coal to Natural gas)	45.6	61.5
- Solar thermal	0.6	99.6
Residential		
- Energy-saving lighting	39.6	-8.7
- Demand side management	2.9	-4.3
Iron and Steel		
- Cutting ratio of iron/steel in steel & iron industry	9.5	-24.0
- Pulverized coal injection into blast furnace	0.3	-4.9
- Continuous casting of steel making	7.7	-3.8
Rest of Industry		
- Renovation of kilns for wet cement production	13.2	-12.8
- Cement (innovation of wet process kilns)	0.3	-12.4
- Cement (dry kilns replacing wet kilns)	0.3	-10.2
- Comprehensive process renovation of synthetic ammonia	11.4	-7.6
- Industrial boilers (optimizing combustion)	84.3	0.3
- Industrial boilers (operational improvement)	77.0	0.3
- Industrial boilers (prefuel process)	40.3	0.3
- Anaerobic technology for wastewater treatment and energy recovery in alcohol plants	5.5	3.0
- Industrial boilers (high-efficiency boilers)	22.0	4.8
- Technical renovation of motor for general use	99.4	-27.0
Total identified potential	*615*	