

From Cleaner Production to Carbon Management: Lessons from the implementation of cleaner production in China and its implications on the promotion of carbon management

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Abstract

Cleaner Production (CP) is defined by the United Nations Environment Programme (UNEP) as “the continuous application of an integrated preventive environmental strategy to processes and products to reduce risks to humans and the environment”. Since 1994, UNEP in cooperation with United Nations Industry Development Organization (UNIDO), started to promote the application of CP by enterprises in developing and transition countries by setting up National Cleaner Production Centers (NCPCs) and National Cleaner Production Programmes (NCPPs). The China National Cleaner Production Centre (CNCPC) under the State Environmental Protection Administration (SEPA) was established in December 1994 with an aim to promote China’s CP research and consultation. In 1995, CNCPC launched the “Ten, One Hundred, One Thousand, Ten Thousand” programme which aimed to promote CP in 10 heavily polluting industrial sectors in 100 cities throughout China. The target is to have CP in place in 1000 enterprises and train 10000 people in CP concepts and methods. Since then, the Chinese government has seriously considered a cleaner production law, which signified its intention to shift away from traditional reliance on end-of-pipe solution as the principle environmental protection strategy. The Cleaner Production Law was later passed in the National People’s Congress and became effective in 2003.

By examining currently available literatures, this paper gives a brief overview of the Chinese national CP strategy, listing its ongoing efforts to promote CP, including partnership with international development assistance organizations to conduct demonstration projects and training courses, mandating proposed industrial development projects to include CP audits in the environmental impacts statements, establishment of a national environmental labelling program. CP in China has further been promoted by implementation of international treaty such as Montreal Protocol and supply chain pressure in international trade. Lessons on successes and failures of all these initiatives are drawn and factors that motivate or deter business from CP are identified.

Climate Change is currently the most critical global environmental issue. Governments have continuously been called to act before it is too late. As China is set to become the largest emitter of greenhouse gases in the very near future, China are under international pressure to control its greenhouse gas emissions, although at present, it is not required by Kyoto Protocol to reduce its emissions. Similar to CP, climate change initiatives in China is mainly a result of the central government’s adoption and promotion. To demonstrate its commitment to climate change, china’s Premier, Wen Jiabao, heads himself a task force to deal with energy efficiency and greenhouse gases emissions. Energy efficiency improvement is one of important measures for reducing CO₂ emissions. Industry is the main energy consumer and CO₂ emitter in China. In 2007, the central government has mandated key state-owned enterprises and provincial governors to pledge to achieve a 20% reduction of energy consumption (relative to economic output) over a period of five years. It is the strategy of the central government to implement such reduction through dominant state-owned enterprises.

The aim of this paper is to identify the similarities and differences between the existing climate-related initiatives in China with those related to CP. Perceptions of the businesses in China on both issues will be discussed. Lessons are to be drawn from the implementation of CP in China and this will have implications to the future development of climate-related initiatives and the promotion of carbon management among Chinese business. Recommendations are given to suggest possible policy direction in the future.

Introduction

Since the launch of the Open Door Policy at late 1970's, China has experienced tremendous economic growth. Annual economic growth rate has been maintained at around 9%. Behind the scene of this economic miracle, China's resource-intensive and largely unrestrained mode of economic development has placed heavy pressure on its natural resources and caused widespread environmental degradation and pollution. For example, according to a study by the Chinese Institute of Environmental Science and Tsinghua University, acid rain caused by sulphur dioxide has cost China an annual economic loss of over 110 billion yuan (approx. US\$13.3 billion) while atmospheric pollution led to loss of 2 – 3 % of China's GDP (People's Daily, 2003).

Cleaner production (CP) is a strategy of continuous application of approaches and technologies to industries with an emphasis on source reduction and process changes. Seen as a tool to maintain economic development while minimizing damages to the environment, the concept of CP was warmly welcomed by the Chinese government since its introduction to the country in early 90's. CP aims to shift the focus from pollution control to pollution reduction. It was promoted by the United Nations specifically to developing countries, encourage them to adopt energy and resource efficient technology to help reducing impacts to the environment (UNEP, 1990). Initiatives on CP in China, such as demonstration cities and projects, CP audit, etc, have achieved some successes. However, after 15 years of efforts, CP practice is still not widely adopted in China, especially among small and medium enterprises (SMEs). The barriers will be discussed in this paper.

Compared with CP, policies in relation to climate change have a much shorter history in China. With Kyoto Protocol coming into force in 2005, more frequent occurrences of extreme weather and increasing evidences for global warming, climate change has received immense international attention. As China is already the second largest greenhouse gas emitter and is set to overtake U.S. in the near future, the Chinese government is under heavy international pressure to show its commitments on mitigating climate change. As a result, climate change has swiftly risen to become part of China's national agenda. The acknowledgement of the importance of climate change issues by the State Council prompted the set-up of a climate change leading group at national level that is led by Premier Wen Jiabao in 2007. Since the set-up of this leading group, there have been a number of institutional developments at all levels of governments, from provincial, prefectural to county level. In this paper, these institutional developments and policies and measures to address climate change, in particular those affecting business, are highlighted.

Although China's political system is a unitary system, and both CP and climate policies are implemented with a traditionally top-down approach, the way in which these policies are carried out and how they affect businesses differ from each other and therefore, the effectiveness and results differs. It is this paper's purpose to examine the governance systems for these two issues within the same political system. Similarities and differences on how they affect businesses in China are drawn. Lessons are to be learnt from the effectiveness of CP policies which have been implemented in China since early 90's, so as to shed lights on the potential effectiveness of climate policies in China and give recommendations to the future direction for development.

By examining currently available literatures, this paper first gives a brief overview of China's

national CP strategy, listing its ongoing efforts to promote CP. Lessons on successes and failures of all these efforts are drawn and factors that motivate business to adopt or deter them from CP are identified. It is then followed by a brief description of energy policy in China, as energy policy plays a key role in climate policies. The energy efficiency target set in the Eleventh Five-year Plan and how it was implemented are discussed. Initial responses by the 50 largest companies in China to climate policies, in particular this energy efficiency target, are examined. Finally, how businesses are affected by CP and climate policies are compared. Recommendations to policy direction in the future are given as conclusion.

Cleaner Production in China

CP is defined by the United Nations Environment Programme (UNEP) as *“the continuous application of an integrated preventive environmental strategy to processes and products to reduce risks to humans and the environment”* (UNEP, 1990). In 1994, UNEP, in cooperation with United Nations Industry Development Organization (UNIDO), started to promote the application of CP by enterprises in developing and transition countries by setting up National Cleaner Production Centers (NCPCs) and National Cleaner Production Programmes (NCPPs) (UNIDO, n.d.). China was among the very first countries that set up NCPC. The China National Cleaner Production Centre (CNCPC) was established in December 1994 as part of the State Environmental Protection Administration (SEPA). The key areas of work of CNCPC are to coordinate with SEPA to formulate national cleaner production law, regulation and management methods, to develop cleaner production audit management systems and train national auditors, to develop local cleaner production centres by providing technical supervision and capacity building. CNCPC is also responsible for various areas of research on cleaner production (2007a).

Shortly after the establishment, CNCPC launched the “Ten, One Hundred, One Thousand, Ten Thousand” programme in 1995. This programme aimed to promote CP in 10 heavily polluting industrial sectors in 100 cities throughout China. The target is to have CP in place in 1000 enterprises and train 10000 people in CP concepts and methods. Since then, the Chinese government seriously considered a cleaner production law, which signified its intention to shift away from traditional reliance on end-of-pipe solution as the principle environmental protection strategy. Almost a decade later, the Cleaner Production Promotion Law was passed in the National People’s Congress and came into effect in 2003 (NDRC, 2006). CP’s importance is also reflected in China’s Agenda 21 published in 1994, in which CP is regarded as a key strategy to achieve national sustainable development goals. In addition, CP is an integral part of China’s national strategy to establish a “Circular Economy”. Many of the items covered by the “Circular Economy Law” that was passed in 2008 are already required by the “Clean Production Promotion Law” (McElwee, 2008)

According to Zhang and Chen (2001), the development of CP practices in China can be viewed as two phases. For the first phase (1992 – 1997), the focus is at company level. Work in this period included the introduction of CP methodology, personnel training and demonstration. The main objectives in phase I were to raise awareness through training and demonstration projects, develop training materials, form institutional framework for promoting and coordinating CP practices, conduct CP audits and promote bilateral cooperation.

The main instrument for the implementation of CP in China is a systematical and technical

approach – the CP audit. CP audit team has to be first created within the company to evaluate the company's environmental performance. The team sets the goal and implements the necessary measures. Audit report is then forwarded to local government, which will then commission an expert team to carry out the inspection on site.

Five strategies have been identified by national and local governments and selected enterprises to encourage adoption of cleaner production. They are: strategy for international cooperation; CP demonstration strategy; national priority industries strategy; cleaner energy development strategy; and production and awareness building strategy (Fang and Côte, 2005).

Efforts and Results

There was some evidence of success for the implementation of cleaner production in China. Implementation of 308 out of 492 CP options generated within 15 paper mills has resulted in satisfactory environmental improvement, implying an implementation rate of 60% (Fang and Côte, 2005). Across the country, the adoption and implementation of CP methodologies has led to cuts of 20% to 50% in pollutant emissions in audited plants as well as 20% to 50% of production cost savings (Wang, 1999). Electroplating sector in China adopting CP has also increased their profits while improving environmental benefits (Ortolano et al., 1999). The application of CP in Taiyun City also illustrated the potential co-benefits of CP in reducing greenhouse gases (Mestl et al., 2005).

From 1993 to 2000, there have been 15 bilateral or multilateral comprehensive cooperation projects focusing on CP, creating numerous projects in industries and enterprises (CCICED, 2000). Local and industry-based CP centers were established by the CNCPC, creating an institutional network. In May 1999, a national demonstration program is launched. Ten cities and five industrial sectors were selected to carry out pilot projects. By the end of 2001, around 700 CP demonstration projects have been carried out in 24 provinces around the country (Hicks and Dietmar, 2007).

In spite of strong interest in CP and the potential benefits as illustrated from CP demonstration projects and activities in Phase I, CP has not been widely adopted in China as expected. The first decade of implementation revealed major challenges on the promotion of CP: a prevailing end-of-pipe approach and lack of institutional capacity on different government levels. Therefore, in Phase II (from 1997 onwards), the focus shifted from training and auditing facilities at company level to the formation of policy framework at government level to overcome the obstacles encountered in Phase I.

Barriers

Although the concept of CP has been introduced in China since early 90's, Hicks and Dietmar (2007) pointed out that improving environmental performance of China's industries are still faced with difficult challenges as CP is not widely adopted. Key factors include difficulties in mainstreaming CP, insufficient institutional resources due to a lack of institutional framework, as well as limited financial and technical resources of small and medium-sized enterprises, and the difficulty in establishing a CP services market. Similarly, Fang and Côte (2005) pointed out a number of barriers for CP implementation in China.

- Low environmental awareness and misconceptions of CP

- Technology barriers
- Institutional barriers
- Policies, laws and regulatory barriers
- Internal barriers within enterprises

These barriers are described briefly below.

Low environmental awareness and misconceptions of CP

The misconception that environmentally sound projects always cost more still prevails in China. Although it was shown in many case studies that CP can bring win-win situation in financial and environmental terms, managers are still not easily convinced. Also, for government agencies at different levels, environmental protection is considered as the sole responsibility of local environmental protection bureaus and SEPA. When decision-makers are faced with short-term conflicts between economic development and the environment, environment is easily sacrificed.

This situation has changed since the launch of the Cleaner Production Promotion Act. Article 17 of the Act gives the environmental protection bureaus the authority to publish the names of polluting companies in the mass media. Article 31 further mandate non-compliant companies to periodically announce the details of their emissions to the public. Since the Act was implemented, many provincial EPBs have published and criticized underperforming enterprises and the media is encouraged to denounce these companies' polluting activities (CSR Asia, 2005). Environmental awareness at both public and enterprise level has therefore risen sharply.

Technology barriers

Technology barriers refer to the obstacles in the technology transfer and the localization of technologies. One key issue affecting technology transfer is the lack of protection of intellectual property in China (The World Bank, 2007) that is prohibiting both local innovations as well as technology transfer from developed countries.

Institutional barriers

Local EPBs are sometimes more influenced by local governments than by SEPA, whereas policies by SEPA are not implemented thoroughly at local levels. Officials at local EPBs might have a more imminent interest in pleasing local political leaders who are more concerned with industrial development over environmental issues.

Policies, laws and regulatory barriers

In principle, CP has been well embedded in the nation's industrial development policies. However, it must be noted that these policies emphasize quantitative growth and growth of scale. Although the CP Promotion Act has come into effect in 2003, most of the existing environmental regulatory instruments are largely based on an end-of-pipe approach, which means that the focus is on meeting emission standards instead of reducing emissions through process improvements.

Also, as the name implies, CP Promotion Act focuses on promoting the adoption of CP among industries. However, the law does not specify the methodology and extent to which CP should be implemented. It is left to managers of enterprises to interpret the meaning of CP. In essence, CP should concern the environmental impacts throughout the whole life cycle of a product from resource extraction to product disposal. However, most of the existing efforts are focused on the

production process only.

Internal barriers within enterprises

By Chinese environmental protection law, enterprises are supposed to integrate environmental laws into their business plans and establish an accountability system for environmental issues. Yet, in most cases, this system only appears on papers. Environmental issues are outside management agenda and there is no mechanism or incentives for enterprise to improve processes and upgrade facilities.

Climate Policy in China

Under the direct leadership of the Environmental Protection Committee of the State Council, a National Coordination Group on Climate Change was set up in 1990, based in China Meteorological Bureau. In October 2003, with the approval of the State Council, the National Coordination Group on Climate Change Strategy (NGGCCS) was officially established, with office located in the National Development Reform Commission (NDRC)¹. The Group is comprised of 13 agencies, including Ministry of Science and Technology, Ministry of Foreign Affairs, Ministry of Finance, Ministry of Commerce, Ministry of Agriculture, Ministry of Construction, Ministry of Communications, Ministry of Water Resources, State Forestry Bureau, Chinese Academy of Sciences, State Oceanic Administration and Civil Aviation Administration of China. As a coordination group, its policy making power was limited.

The Chinese government has taken the issue of climate change seriously but never as a priority issue. For example, the word for climate change (Qihou Bianhua) or global change (Quanqiu Bianhua) was not even mentioned in the five-year plans until recently, in the Eleventh Five-Year Plan for National Economic and Social Development² (2006 – 2010). In Chapter 26, Section 2 (development and utilization of climate resource), the central government asked “to strengthen monitoring, prediction, and assessment of anthropogenic influence on weather, atmospheric composition, and climate change”. Local governments, from provincial down to county and community level so far have shown little interest or awareness of the climate change issue, not to mention policy-making on the issue. However, some local governments have, in recent years, become interested in the potential economic benefit that the Clean Development Mechanism (CDM) would bring.

It is worth noting that the central government treats the issue of climate change as part of the national strategy on sustainable development, a major decision made in 1993, one year after the Rio Earth Summit where the UNFCCC was conceived. Thus, climate change has never been a standalone issue in the national policy agenda. The government quickly recognized the close link

¹ The National Development and Reform Commission (NDRC) is a macroeconomic management agency under the State Council, which studies and formulates policies for economic and social development, maintains a balance of economic aggregates and guides the overall economic system restructuring.

² The Five-Year Plan for National Economic and Social Development, or in short, the Five-Year Plan, is to “*arrange national key construction projects, manage the distribution of productive forces and individual sector’s contributions to the national economy, map the direction of future development, and set targets.*” (China.org.cn. n.d. *What Is the Five-Year Plan* <http://www.china.org.cn/english/MATERIAL/157595.htm> [accessed 28 March 2009].) The 1st Five-Year Plan was implemented in 1953.

of the issue to other problems facing economic growth and environmental protection, particularly, with energy consumption. The government found great consistency between the control of greenhouse gas emissions and energy-saving, a nationwide effort started in the late 1970's in striving for the "four modernizations". In fact, such efforts resulted in the doubling of energy efficiency in the twenty years from 1981 through 2000.

On June 4, 2007, NDRC issued China's National Climate Change Program, the country's very first global warming policy initiative. It indicated that Chinese government acknowledged the importance of addressing climate change issues and it will adopt measures ranging from laws, economy, administration and technology to reduce greenhouse gas emissions (2007b). The Program lists first list out China's effort and achievements in mitigating climate change in the past, which includes:

- 1) Restructuring the economy, promoting technology advancement and improving energy efficiency;
- 2) Optimizing energy mix by developing low-carbon and renewable energy;
- 3) Launching national wide tree-planting and afforestation campaign and enhancing ecology restoration and protection;
- 4) Effectively controlling the growth rate of population through family planning;
- 5) Strengthening laws and regulations, and policies and measures relevant to addressing climate change;
- 6) Further improving institutions and mechanisms;
- 7) Attaching great importance to climate change research and capacity building;
- 8) Strengthening education, training and public awareness on climate change.

The Program further pointed out the principles, guidelines and objectives of China to address climate change and went on with China's policies and measures to address climate change, which can be classified into five aspects: greenhouse gases mitigation; adaptation; climate change science and technology; public awareness on climate change; and institutions and mechanisms. Within the area on greenhouse gas mitigation, the focus is on energy production and transformation, energy efficiency improvement and energy conservation, industrial processes, agriculture, forestry and municipal waste.

Policies and measures related to *energy production and transformation* includes strengthening existing energy legal system, improve national energy program, implement Renewable Energy Law and promote conditions favourable for renewable energy development and GHG mitigation, promote energy price reform and optimize energy mix, promote the innovation and efficiency improvement in various power generating technologies, both renewable and non-renewable, including nuclear power. All these policies and measures are expected to have major influence on the energy and utilities sector.

Policies and measures related to *energy efficiency improvement and energy conservation and industrial processes* are expected to have implications for a wide range of industries. They include improving existing energy-saving regulation and standards, strengthening the supervision and monitoring of energy conservation efforts, compelling the phase-out of energy intensive and backward processes, technologies and equipments, promoting energy-labelling, developing market for energy-saving service, adjusting industrial structure, formulating fiscal policies for energy-saving products, and strengthening the development and dissemination of energy conservation technologies in key sectors. Last but not the least, continuing on the efforts

of 10 key energy conservation priority programs in the Medium-and-Long-Term Energy Conservation Plan is also considered as part of efforts to mitigate greenhouse gas.

As seen above, energy is a key part of the climate change program in China. The following gives a brief overview of the energy policy development in China.

Energy Policy in China

As early as 1980s, Chinese leaders already acknowledged that the country's industry was highly energy inefficient and was an obstacle for the economy to move forward. Since then, the Government of China adopted the principle of "equal treatment to development and conservation with immediate emphasis on the latter", making energy conservation as a matter of strategic importance in energy policy. They adopted a number of measures to promote the efficient use of energy. 1996 has seen the establishment of Renewable Energy Law and a year later, Energy Conservation Law came into effect.

One of the energy saving measures in China is to produce new energy efficiency standards for various products. These new energy efficiency standards help to reduce carbon emissions both locally and internationally through exports. One example is room air conditioners (RACs). According to analysis (Lin and Rosenquist, 2008), new standards for RACs are expected to result in cumulative reduction in carbon emissions of over 300 million tons by 2020, which is about the size of European commitment under the current Kyoto regime. New power plants are said to be avoided due to peak demand savings of 20GW.

According to statistics (China Electric Power Statistical Yearbook, 2005), power generation has doubled from 1990 to 2000. As China has set the target to quadruple the GDP from 2000 to 2020, and given that energy system in China is largely coal-based, it can be expected that greenhouse gas emissions can increase relatively fast in the coming decades (IPCC, 2000). Although China has been aware of the issue of energy efficiency and has adopted a number of measures, energy efficiency in China is still lagging behind many developed countries. Therefore, there is substantial potential in energy savings through eco-efficiency both at production (Kroeze et al., 2004) and end-use.

Similar to other developing countries, greenhouse gas mitigation issues have not been high on the political agenda in China as problems related to reducing common air pollutants such as SO₂, NO_x, and PM₁₀ are more imminent (Cai et al., 2008). It is not until recently when the urgency for tackling climate change is highly advocated at international levels and China is predicted to surpass US to become the largest greenhouse gases emitter in the very near future that China starts to be under huge international pressure to tackle its carbon emissions. China's climate policies and its commitment are regarded as critical by many countries for the success in the post-Kyoto regime. Some Chinese scholars (e.g. Chen, 2005) used historical data and different energy models to demonstrate that China has done a great deal in the past centuries to reduce energy consumption and this effort had and will contribute greatly to mitigate climate change effect. The establishment of the 1996 Renewable Energy Law, the 1997 Energy Conservation Law, Tenth and Eleventh Five-Year Plans, and the ambitious objective of achieving a 20% decrease in energy intensity by 2010 (compared with 2005) has showcased the efforts of the Chinese government in developing a sustainable energy future (Cai et al., 2008). Therefore, it is

argued that, based on the common but differentiated principle, China should not accept a cap on the carbon emissions in climate negotiation in the future.

Institutional Framework to Address Climate Change

To demonstrate China's commitment to climate change, National Leading Group on Climate Change (NLGCC) was established by the State Council in June 2007, headed by premier, Wen Jiabao. NLGCC was to replace its predecessor – NCGCCS, and number of member agencies enlarged from 13 to 27. The role of the leading group is to study and devise national climate change strategies, directions and measures, unify national actions on climate change, research on international cooperation and negotiation processes, coordinate solutions on key issues in responding to climate change (Daily, 2007). It is worth noting that the composition of this leading group is basically the same as that of the National Leading Group on Energy Saving and Pollutant Reduction. Although these two groups have different groups and set up secretariats in different agencies, both groups are led by premier and comprise the same agencies. Therefore, it can be seen that the Chinese government made close link between climate change and energy saving and pollutant reduction. The leaders of China treat these issues as integrated in their policies and actions. The NLGCC works under the supervision of National Development and Reform Commission. For energy saving measures, the implementation lies mainly on NDRC while pollutant reduction is the responsibility of the State Environmental Protection Administration (SEPA).

Actions on Local Level

In China, government system is a top-down unitary. Local governments are supposed to implement decisions made by the central government. How far the local government goes in implementing decisions from the central governments depends on their motivations, capacity and constraints.

Local political leaders' performance is evaluated by higher levels of governments and economic growth of the region they govern is one of the key indicators. Therefore, promoting local economy is one of the key ways for local political leaders to get promoted. As climate change mitigation efforts are mainly related to reducing energy usage and was believed to slow down economic growth, there is basically no incentive for government to reduce greenhouse gas emissions (Pan, 2003). However, there has been a sudden turn-around in terms of the climate-related initiatives by provincial and prefectural governments shortly after the creation of the NLGCC by the central government. At the same time, NDRC issued China's National Climate Change Program, the country's very first global warming policy initiatives (China.org.cn, 2007).

Beginning from mid-2007, the central government mandated all local provinces to establish special task forces to lead efforts on climate change (Qi et al., 2008). Plans for climate change mitigation and adaptation were developed by many provinces. These provinces include Xinjiang, Hubei, Fujian, Beijing, Liaoning, Shandong, and Jianxi (Qi et al., 2008). A few provinces even initiated research programs on climate change and adaptation, including Guangdong, Qinghai, Sichuan, and five provinces in western China. Gansu Province even invited Canadian scientists to conduct research on the impacts of climate change on the ecosystem in the region in September 2007.(Qi et al., 2008)

Until March 2008, eight provinces and autonomous regions have formed leading groups on climate change adopting the model of the central government. Among these eight leading groups, seven are called Leading Group on Energy Saving, Pollution Reduction and Climate Change. The exception is Qinghai, which has set up a leading group on climate change but has none for energy saving and pollution reduction.

For other provinces, either Leading Group on Energy Saving or Leading Group on Energy Saving and Pollution Reduction is set up after the creation of the NLGCC. Provinces that do not include the term “climate change” in the name of the leading group nevertheless stated that their responsibility includes climate change issues. Provincial governments also request prefectures to establish their leading groups on climate change. Therefore, with just a few months, a dramatic institutional development on climate change was seen in China, beginning from central government to the provincial and prefectural levels.

Greenhouse gas mitigations are also achieved in China through the use of Clean Development Mechanism (CDM) in the Kyoto Protocol. Currently, China is the largest supplier of CDM-based certified emissions reductions (CERs). CDM provides strong incentives for local government for involvement in climate change mitigation. Provincial governments have shown to be quite serious about CDM as seen in their institutional set-up. The national CDM office resided within the NDRC. At provincial level, governments have their own offices within the Provincial Development and Reform Commissions and have developed regulations and guidelines for CDM project development. Back in 2006, Shanxi province has already set up a leading group on CDM, which has its secretariat in Shanxi Development and Reform Commission and is led by the vice provincial governor. Guizhou Provincial government established a Joint Council, consisting of 11 provincial ministries, to lead and coordinate CDM projects (Government, 2006). By September 2007, CDM promotion centers were established in 27 provinces by the provincial governments to help with the development of CDM in China. The interest in CDM projects also extend beyond provincial governments to prefectural and county level governments.

National Goal on Energy Efficiency in the Eleventh Five-year Plan

In 2006, the goal of 20% reduction in GDP energy intensity was set in China’s 11th Five-Year Plan. To reach this target, quotas have been allocated to all provinces and major state-owned enterprises (SOEs). Provincial governments also distributed the quota among their prefectural governments and SOEs in the province. To make the system effective, provincial governments developed performance evaluation systems and linked performance evaluation to the promotion of local government officials and even leaders of state-owned companies. These quotas are then naturally passed down to county level governments. For example, Shandong province government signed accountability contracts with 17 city governments and 103 energy-intensive enterprises in the province. Failure to reach the target of emission reduction would mean that city governments and enterprises would be vetoed from any awards and honours. In addition, leaders of SOEs will not be entitled to any annual rewards (NDRC, 2007). Governors of Shandong and Gansu provinces were quoted saying that they would resign if they could not meet the energy saving and pollutant reduction targets assigned by the central government (China Review News Agency, 2008). Under this system, there is high political pressure on government officials and it has become their personal interests to implement the country-wide energy savings targets.

Response of Chinese Enterprise to Climate and Energy Policies

Business is the key energy user and plays a key role in greenhouse gas mitigation. As climate change receives greater attention by the Chinese government, businesses in China, like their counterparts in other parts of the world, are expected to react in one way or the other. For a preliminary inquiry into this question, this paper will focus on the responses and strategies of a small sample of Chinese listed companies. This research will cover constituent companies in the Hang Seng China 50 Index (as at 31 August 2008), which comprises all companies whose primary listing is on:

- * the Shanghai Stock Exchange; or
- * the Main Board of the Hong Kong Stock Exchange

The constituent companies comprise the largest 50 companies in terms of 12-month average total market capitalization. As for companies' responses and strategies on climate change, information will be collected by searches in company disclosed information (websites, reports), and the media (using keyword search in www.google.com and www.baidu.com - the most popular search engine in China). The research will discover if administrative measures (in particular, allocation of emission reduction quotas) by the central government is effective in driving companies to respond actively to climate change challenges and the responses and attitudes demonstrated by different sectors within China.

Sectoral distribution of companies

Table 1 shows the distribution of the Hang Seng China 50 Index (the Index) constituent companies by sector. It can be seen that the finance sector dominates the Index, with 12 companies included. It is followed by the manufacturing sector (6) and the energy sector (5). Both the telecommunication and insurance sectors have four companies included in the Index.

Sector	No. of companies
Finance	12
Manufacturing	6
Energy	5
Telecommunication	4
Insurance	4
Transportation	3
Real Estate	3
Transportation infrastructure	2
Utilities	2
Construction	2
Metals and Mining	2
Airline	1
Conglomerates	1
Food	1
Business Services	1

Retail	1
Total	50

Table 1. Sectoral distribution of Hang Seng China 50 Index Constituent Companies (as at 31 Aug 2008)

Information disclosure with regard to climate change

Of the 50 companies, 17 companies have published CSR or sustainability reports. Out of these 17 companies, only 6 of them (35.3%) have mentioned about climate change in their reports. For the 33 companies not producing related reports, only 2 mentioned about climate change in their websites. In total, only 8 companies (18%) in the Index have actively mentioned about climate change either in their reports or websites. It is worth noting that 4 of the 8 companies are from the energy sector. The remaining consists of a telecommunication company (China Mobile Ltd.), 2 manufacturing companies (Baosteel and Wuhan Iron & Steel), 1 utilities company (Datang Power).

Eight companies, mainly Energy, Utilities and Manufacturing companies are found to mention about energy reduction efforts in their reports as a result of the energy efficiency target set by NDRC in the Eleventh Five-year Plan. The observation that the effect of the energy efficiency target is only concentrating on the energy intensive sector is logical since quotas to reach the energy efficiency targets are distributed to key state-owned energy intensive enterprises but not to the service-oriented sector.

Chinese banks are rather reactive on the response to climate change issues. Out of the 12 companies in the finance sector, half of them have issued CSR or sustainability report. Yet, none of the reporters is found to address the issue of climate change in their reports. Also, it is worth noting that no information in relation to climate change was found for the two securities companies in the Index. They seem to show no interest at all to climate change issues.

According to the report "Corporate Governance and Climate Change: The Banking Sector" issued by Ceres investor coalition, Bank of China and ICBC, which were included in the survey, were the lowest scorers among the world 40 biggest banks. It can be conclude that, in contrary to the global trend that many financial institutions taking the lead in climate change initiatives, the finance sector in China does not see the importance of including climate change in their business agenda.

This research also looked into the response of Chinese enterprises to the Carbon Disclosure Project (CDP). As for the CDP6 (2008), questionnaires have been sent to 32 of the 50 companies. 11 companies have either answered the questionnaires or provided information. 15 of them did not respond and 6 of them declined. Of the 11 responding companies, 7 of them did not respond in CDP 2007. This may indicate that awareness on carbon issue has slightly risen among Chinese enterprises. However, it is worth noting that there is no necessary linkage between disclosure of climate-related information on website or reports with the response to CDP. Companies such as Datang Power and Sinopec have addressed the issue of climate change in their reports but did not respond to CDP6 questionnaires. Also, China Mobile has started implemented Green Action Plan since 2006, in which they pledged to reduce 40% reduction in power consumption per business unit by 2010 compared to 2005 level. However, they have either declined or not

responded to the questionnaire since they were included in the survey in 2003.

Given that many of the listed companies are still directly or indirectly owned by the Chinese government, the rise of climate change on the political agenda should have caused concern among leaders of Chinese enterprises. However, China's first National Climate Change Programme and the set-up of the NLGCC have not caused a significant rise of awareness or actions on climate change issues among Chinese enterprises in general, except energy intensive companies. It appears that the largest listed companies in China are rather passive on the issue of climate change. It may reflect the fact that the management are not aware of the issue or they may not be prepared to react to it. Also, as China most likely will not accept any restraint on its carbon emissions in the near future, businesses in China do not see a potential carbon constraint and there is no need to address the risk associated with that. Therefore, climate change is not on the agenda of most of the leading businesses in China.

Comparing the Implementation of Cleaner Production and Energy Efficiency Target

CP in China is implemented by the CNCPC which is under the supervision of SEPA. As for achieving energy efficiency target, it is the work of the National Leading Group on Climate Change, under NDRC. As can be seen from the responsible agencies for these two issues, cleaner production is regarded more as an environmental issue while energy efficiency is regarded as an economic issue. Increasing energy efficiency is on the top agenda in China's national strategy.

CP is introduced country-wide in China through awareness building and capacity building. It required managers in the industry to accept the concept and adopt CP practices in their factories. CP audit was developed by CNCPC as a mechanism to implement CP at factories. To make CP audit successful, awareness of CP among factory managers had to be increased. There must be a paradigm shift from end-of-pipe pollution control to pollution prevention and efficient use of resources. CP audit team had to be formed and necessary skills built, since CP is multi-facets and concerns processes ranging from resources acquisition, production, waste treatment, product packaging, utilization, transportation and disposal. In addition, local government also needed to be equipped with knowledge to conduct external audits. Demonstration projects are also used to set as a learning model for other enterprises. Due to the nature of CP, which emphasizes on integrated preventive environmental strategy on processes and products, there are no mandatory targets for pollutant reductions.

For energy savings and energy efficiency as part of climate policy, awareness has already been built among Chinese enterprises after the introduction of CP. To a certain extent, energy efficiency can be seen as part of the objectives of CP. Therefore, the concept of energy saving is already widespread when the national energy efficiency targets were announced during the Eleventh Five-year Plan. When individual energy-intensive enterprise was identified and required to sign contracts with NDRC on commitments to reduce energy intensity, awareness on energy savings and energy efficiency is further heightened, as failure to reach target set would mean ban from any awards, which would affect the performance evaluation of enterprise leaders.

The top-down allocation of energy efficiency target bundled with political accountability means that targets are set and distributed to every individual enterprise in a highly efficient way.

Compared with the implementation of CP, awareness is not an issue any more. Also, the communication of targets set by the central government to key enterprises ran at a much faster rate than that of CP.

At the early stage of promotion of CP, key enterprises are engaged with CP for demonstration projects or bilateral cooperation. The speed of spread of the concept depends on the resource availability, in particular manpower, of CNCPC. Also, enterprises depend on the supports of CP centers or foreign cooperating institutions for solutions and know-how. It is worth-noting that implementing CP does not mean that enterprises are given specific targets to reduce a particular pollutant. It is up to discretion of the factory manager to implement certain measures only if the benefits are proved to out-weight the cost of investment for cleaner production.

The introduction of CP at key Chinese enterprises has induced enterprises to form CP working groups, with top management of the companies as group leaders, and technical staff is involved to examine the whole production process. Capabilities were therefore built up. When it comes to achieving energy efficiency target, enterprises are left on their own to find the solutions and existing management structure on cleaner production is swiftly utilized to achieve such target. It can be expected that the rate of process innovation will be higher as there is a pressing need for enterprise to reduce energy consumption. Existing energy consuming procedures must be reviewed to achieve the goal.

Both literature review on CP and the research on climate response from listed Chinese enterprise indicated that effect of both policies can only reach a rather limited number of Chinese enterprises – mainly large enterprises that are state-owned and energy intensive. For energy efficiency, the responding companies are mainly from energy, manufacturing and utilities sector. As from the literature on CP, small-and-medium enterprises are said to suffer from insufficient financial resources and technical knowledge. Initial investment on new technology required for cleaner production deters many factories owners from adopting the concept of cleaner production. The idea that cleaner production means higher cost is still deeply-rooted in minds of company managers. Also, conducting CP audit requires the technical know-how and expertise. With limited human resources, SMEs might find it difficult to allocate additional manpower for CP audit.

Discussion: Implications for promoting carbon management among enterprises

Comparing CP and energy efficiency target, CP took a much longer time for the idea to be disseminated across industries, while energy efficiency targets are swiftly allocated to managers of key enterprises. Although it can be said that CP has built up capabilities among factories for energy savings and energy efficiency, it is the accountability system that poses a strong political incentive for enterprise leaders to fully utilize such capabilities within firm to achieve energy efficiency targets. As the performance evaluation for these leaders are linked to whether targets are achieved, it is naturally in their interest to fulfil the targets. In contrast with the use of legislation and regulation, this kind of accountability system seems to be far more effective, especially for state-owned enterprise. In the past, political affiliation of the enterprises with the government has often undermined the rule of law. State-owned enterprises are often found to have a poorer environmental performance than other foreign-owned enterprises or community

owned enterprises This is because enterprise leaders have a strong bargaining power with government authorities when it comes to environmental issues (Wang and Jin, 2007).

For implementing CP in China, a new institutional framework focusing on its promotion and capacity building has been set up. As for achieving energy efficiency targets, the existing political framework and political affiliation between key state enterprise and the central government are utilized. What can be said is that the former is necessary for knowledge dissemination and raising awareness, while the latter acts as a motivation for key enterprises to follow. Both institutional set-ups are shown to achieve different ends and it is argued that both of them are needed to achieve an effective environmental, in particular, climate policy.

Both CP and energy efficiency targets are found to have far less effect and influence on SMEs, which are largely privately-owned and hide under public's radar. Denouncement of polluting companies by some local government in the public media has certain deterrent effect. Research in other parts of the world shows that SMEs are notoriously difficult to reach and influence and the key motivating factor behind SME's environmental consciousness is compliance with existing legislation (Studer et al., 2006). Therefore, effective enforcement of laws and regulations and the rise of fines for polluting companies are the most efficient tools to improve environmental performance of SMEs. Nevertheless, government must provide assistance on technological transformation and related financing.

For future climate policy, both a knowledge and awareness raising framework such as the one for CP should be set up, alongside with the accountability system such as that used for energy efficiency. The working groups on energy efficiency and climate change at provincial level that have been set up at the order by the central government have already formed a preliminary institutional framework. These working groups must not remain as a political showcase but developed regional expertise and knowledge on mitigating and adapting to climate change. A national network on climate change focusing on awareness raising and capacity building must be set up. Our research has found that only key energy intensive enterprises have responded positively to the energy efficiency targets and recognized the needs to reduce carbon emissions. Awareness of SOEs in other sectors seems to be very low. In order to raise their awareness and encourage them to prepare for a transition to low carbon economy, all state-owned enterprises and listed companies should be mandated to develop carbon accounting and management (even reduction) plan.

Also, similar to energy efficiency targets, the political accountable system should be widened to include other aspects of the environment. Performance evaluation of political leaders at local governments should be linked to a basket of environmental indicators and not just energy efficiency targets. Ideally, it should be linked to green GDP, which better reflects the quality of life of the citizens but received great political resistance.

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