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Distribution characteristics and prospects for CDM projects in China

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Abstract: As the 2012 end of the first commitment period of the Kyoto Protocol is fast approaching, there is a strong realisation that the Clean Development Mechanism (CDM) projects have no doubt been playing an important role globally, particularly in promoting clean development in China. Consequently, the prospects for the CDM market in the post-Kyoto era are attracting a lot of attention, including from the developing countries. Based on a review of international and domestic sources, the paper analyses the progress in the development of CDM projects both globally and China.

As at 2011, China has attracted the lion share of CDM investment with 45% of the world projects located in this country and they account for 63% of the global annual certified emission reductions under this mechanism. Due to the relative easiness of implementation, the main area of investment is new and renewable energy (representing 73% of China's registered CDM projects). China's fast economic development, open door investment policy, political stability, high educational and technological standards and reliable infrastructure are all encouraging the interest of foreign investors seeking to reduce their domestic carbon footprint. In order to facilitate the location of CDM projects, the Chinese government formulated a series of policies and regulations as well as establishing national coordinating groups for climate change, CDM Designated National Authorities and projects auditing boards, which are responsible for projects application, auditing and management.

There are however large differences in the regional distribution of Chinese CDM projects. with certain areas of the country, such as its western regions, still in need of development opportunities. Provinces, such as Yunnan, Sichuan, Inner Mongolia, Hunan and Gansu (located in central and western China) are attracting more projects because of their rich hydro and wind resources while there are very few projects in the eastern already developed parts of the country. This trend is consistent with the CDM's main goal to assist less developed regions to achieve a more sustainable development.

Finally and most importantly, this study poses the question about the future prospects for the CDM market in a post-Kyoto world. While China has so far proven to be a success story, in most recent times the amount of investment has started to slow down in the lead to this uncertainty.

Keywords: *Regional distribution, Types distribution, Influencing factors, Market prospect*

1. INTRODUCTION

In order to tackle climate change, the international community established the Clean Development Mechanism (CDM) as one of the three flexible mechanisms under the Kyoto Protocol of the UN Framework Convention on Climate Change. It allows developed countries to provide financial and technology support for developing countries in greenhouse gas (GHG) emission reduction projects in exchange for certified emission reductions (CERs) which they can count against their own Kyoto targets. Recently China became a global leader in the implementation of CDM projects. This has contributed significantly in reducing the global GHG emissions and has also been supporting the country's development of a low carbon economy. The CDM provides considerable joint benefits and motivation for a more sustainable development (Dechezleprêtrea et al., 2008).

China's GHG emission levels are expected to continue to increase with the country's growing per-capita energy consumption but it does not have any abatement obligations under the Kyoto Protocol. A growing number of international investors are interested in locating CDM projects there as the country recognises their importance in mitigating climate change. By August 2011, over 3000 projects have been approved by the Chinese government (NDRC, 2011). The favourable policy environment for low carbon projects is also confirmed by China's commitment to 40-45% reduction in its CO_2 emission intensity (per $GDP) by 2020 (against the 2005 level). This is a strong motivation for local governments and businesses to promote renewable energy projects. China's potential has been further enhanced by capacity building projects supported by organisations, such as the Asian Development Bank and UN. The effective implementation of capacity building projects enhanced China's domestic capacity of engaging in CDM activities. This paper investigates the progress made so far and explores issues related to future policy formulation.

2. CLEAN DEVELOPMENT MECHANISM (CDM)

The Clean Development Mechanism is one of the three international cooperation mechanisms for GHG reduction, which was established under the Kyoto Protocol and is also the only one which involves developing countries. The key meaning of CDM is that developed countries cooperate with developing countries by providing financial support and technology to implement CDM projects on effective reduction of GHG. The GHG CER volume from these projects is then used by developed countries to meet the Kyoto commitments. The CDM is regarded as a win-win cooperation mechanism because developed countries can dramatically reduce their domestic emissions while developing countries can obtain extra financial support and environmental friendly technology (Amin and Marinova, 2009). Despite being a relatively new phenomenon, there has already been a lot of research on CDM worldwide, including Haites and Yamin's (2000) audit of the CDM process and the difficulties foreshadowed by Sutter (2003) and Brown and Corbera (2003). Matsuhashi et al. (2004) and Dagoumas et al. (2006) showed providing case studies that CDM can improve a host country's sustainable development. By contrast, Olsen and Fenhann (2008) argued that CDM would not contribute significantly for sustainable development and that there is a need for international sustainability assessment in order to deal with the exiting systematic problems.

In China, Zhang (2006) examined some major CDM capacity building projects, Wang (2009) explored key managing issues related to CDM implementation and Ganapati and Liu (2009) illustrated the role of the Designated National Authority, set up to approve CDM projects. Further studies include Shin (2010) who analysed the impact of China's domestic conditions on the effectiveness of CDM projects implementation; Teng and Zhang's (2010) review of institutional arrangements to deal with risk and barriers faced by project sponsors; and Wang (2010) who studied technology transfer, including issues of compatibility between CDM's institution system, the Chinese domestic conditions and the international carbon market. The main focus of this study is to explore the current implementation of CDM projects in China and compare the Chinese CDM Market with global trends. It analyses the characteristics of the distribution and types of CDM projects together with future prospects for China's CDM market.

3. CHINA'S ROLE IN GLOBAL CDM ACTIVITIES

Since 2005 when the Kyoto Protocol became formally effective, many developed countries have been seeking opportunities to cooperate on CDM projects with developing countries. Within a short period of several years, the CDM market developed rapidly, its trade volume increased 62% between 2005 and 2007 and its trade turnover tripled (Wang, 2009; Lecocq and Capoor, 2005; Capoor and Ambrosi, 2006). However it slowed down in 2008: compared to 2007, its volume decreased by 30%, the relevant emission reduction turnover decreased by 12% and the CDM market volume in the global share of carbon market decreased from 18.5% in 2007 to 8% in 2008 (Capoor and Ambrosi, 2008). This was due to the delay in the regulatory aspects of registration and the problems caused by the global financial crisis. The supply of CDM in 2009 was consequently limited (Capoor and Ambrosi, 2009). China has been the largest location for CDM projects

in the world (Figures 1 and 2) with 46% of the total registered projects and 64% of total annual CERs (UNFCCC, 2011) providing a good opportunity for the county to develop a low carbon economy. In 2006 the top country according to the number of registered CDM projects was India, and Mexico had the largest amount of CERs (Table 1). As of August 2011, China is by far the largest player and South Korea ranks third (ahead of Mexico) according to its share of the global CERs at 3.72% (UNFCC, 2011).

Table 1 CDM projects activities in China, India, Brazil and Mexico

Country	Number of Projects			World Share (%)			Average Annual CERs (10,000 tons)			World Share of Average annual CERs (%)		
	2006	2009	2011	2006	2009	2011	2006	2009	2011	2006	2009	2011
China	33	616	1522	8	35	45	4604	18411	32087	44	59	63
India	125	450	707	29	25	21	1195	3600	5345	11	12	11
Brazil	80	160	194	19	9	6	1527	2070	2249	15	7	4
Mexico	63	117	129	15	7	4	4834	882	1046	5	3	2
World	428	1775	3355	100	100	100	10490	31161	50276	100	100	100%

Source：UNFCCC (2009 and 2011)

The CDM plays a very important role in assisting developing countries in the transition towards a low carbon future and mitigating climate change (Öko-Institut, 2007). China is proving to be the largest CDM host country because of its fast economic development, open door investment policy, political stability, high educational and technological standards and reliable infrastructure. Despite this, certain areas of the country, such as its western regions are still in need of development opportunities. The massive location of CDM projects in China since the very first project on the landfill gas recovery and utilisation in An Ding District of Beijing in 2004 (Gao et al., 2007), proves the true transformation of the country towards a low carbon economy with the help of the international community. In order to improve the efficiency of the CDM project application process, three years after Kyoto Protocol's ratification China issued *Measures for Operation and Management of CDM Projects in China* which provides clear descriptions of intuitional arrangements, required documents, application procedures and CDM priority areas (NDRC, 2005). China also established national coordinating groups for climate change, CDM Designated National Authorities and projects auditing boards, which are responsible for projects application, auditing and management. The government also formulated a series of policies and regulations for the CDM market. Within just a few years, China's CDM market experienced a repaid development and maintained a sustained interest from investors (NDRC, 2010).

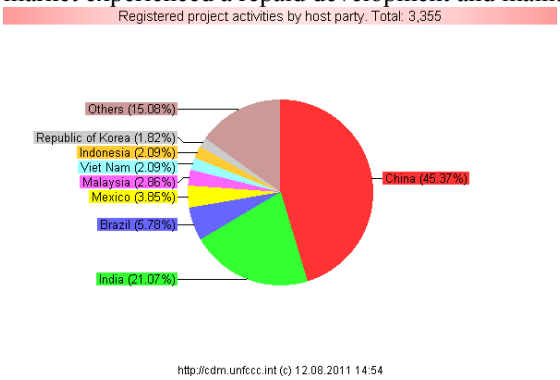

Figure 1 Registered projects by host country

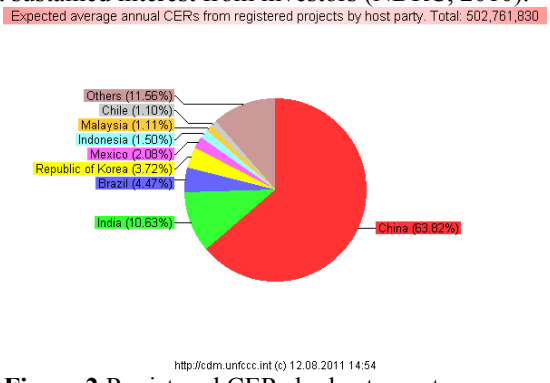

Figure 2 Registered CERs by host country

Figure 2 presents the global distribution of registered CDM projects by emission reduction types in 2009. The projects on new energy and renewable energy account for the largest proportion, namely 41%, but their CERs account for only 14% of the total. The HFC-23 (trifluromethane which is a potential GHG) and N_2O (nitrous dioxide, also a powerful GHG) decomposition projects account for 4% of total projects but they have been achieving the largest share of global CERs, namely 61% (Capoor and Ambrosi, 2009).

The situation in China is similar to the world trends (Table 2). The largest share (73%) of China's registered projects are in new and renewable energy. In many ways this is due to the relative easiness of the implementation methodology of renewable projects. The number of energy saving and energy efficiency projects ranked second for similar reasons, coupled with the implementation of the national energy saving and emission reduction plan which promotes energy conservation and improvement in energy efficiency. The

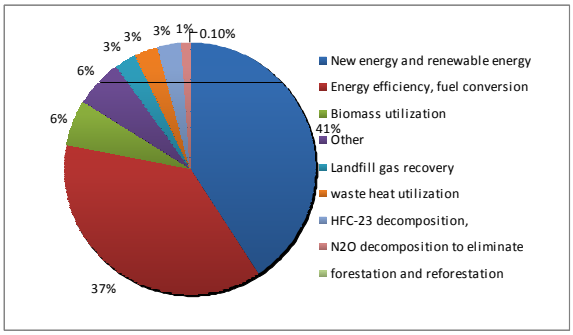

Figure 3 Global registered CDM projects by emission reduction type, 2009
Source: Capoor and Ambrosi (2009)

numbers of HFC-23 and N_2O decomposition projects were also small (2 and 4% respectively), but their contribution to emission reduction was very high, 35 and 13% respectively. What was needed to be done in many of these projects was to simply update the technology used in order to achieve larger volumes of CERs. However these projects are not helpful in increasing the employment and improving the environmental conditions in the host regions and therefore the Chinese governments do not encourage them. On the other hand, the complexity of the methodology of the waste heat utilisation projects was a significant reason for their low uptake.

Table 2 Distribution types of registered CDM projects in China, 2009

Emission Reduction Types	Projects number	Share of projects (%)	Estimated CERs (10,000 tons)	Estimated emission reduction (%)
New energy and renewable energy	442	73.1%	4994.80	26.0%
Energy saving and efficiency improvement	65	10.7%	1854.25	9.6%
Methane recovery and utilisation	39	6.4%	1784.63	9.3%
N_2O decomposition and elimination	25	4.1%	2460.10	12.8%
Burning replacement	12	2.0%	1172.64	6.1%
HFC-23 decomposition	11	1.8%	6679.84	34.7%
Others	6	1.0%	179.03	0.9%
Refuse-burning power generation	4	0.7%	115.98	0.6%
Forestation and reforestation	1	0.2%	2.00	0.01%
Total	**605**	**100%**	**19243.27**	**100%**

Source: Compiled from NDRC (2009)

4. CDM ACTIVITIES IN CHINA

The commitment and determination of the Chinese government to undertake CDM activities are manifested in the provided institutional support. In 2002, it established the National CDM Board (together with the CDM Designated National Authorities and projects auditing boards) and also reorganised the National Coordination Committee on Climate Change (NCCCC) which involves 8 key ministries and government departments. China also established 28 provincial CDM Service Centres, which enhanced the awareness of various CDM stakeholders at the local level. The two most important organisations in China are the National Development and Reform Commission (NDRC) and the Ministry of Science and Technology (MOST). They both have exerted strong coordination to ensure the implementation of CDM projects: NDRC is the pivotal governmental authority that regulates China's CDM activities and MOST influences the implementation and regulation of the CDM market. This has resulted in massive international cooperation in implementing CDM projects attracting the highest interest and number of projects. For example, the World Bank sponsored the methodology and technology for CDM activities, the Asian Development Bank supported small-scale CDM projects, the project sponsored by UN's Development Programme (UNDP) assisted capacity building for CDM projects in renewable energy, coal bed methane and energy efficiency (Zhang, 2006).

The first CDM project in China was approved in 2004, followed by standardisation and formulation of a series of policies and regulations for the CDM market. Figure 4 presents the trend in CDM projects approved by the Chinese Government. In 2005, with only 3 projects approved the CDM market was still in a primary developmental stage but in 2006, it grew quickly and 237 new projects were added. In 2007, the growth of the CDM market continued even more quickly and the number of the CDM projects approved in the third quarter was more than the total number in 2006. In 2008, CDM projects in all quarters were developing steadily, and a total of 769 projects were approved.

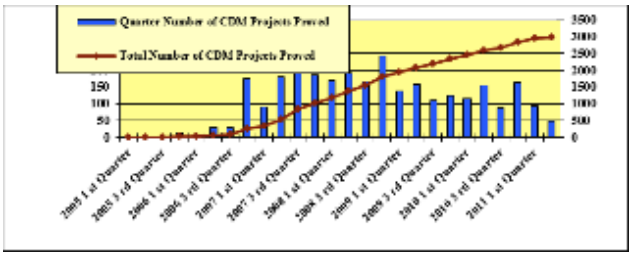

Figure 4 CDM projects approved as of 2.06.2011
Source: NDRC (2011)

In the last two years, due to concern about the uncertain situation in the post-Kyoto era and the global financial crisis, the CDM market had slowed down but with a steady development trend. Currently China's CDM market is developing positively and smoothly in all provinces of China and will contribute to China's transformation to a low carbon economy.

5. REGIONAL DISTRIBUTION OF CDM PROJECTS IN CHINA

There is an uneven geographical distribution between different provinces in terms of approved CDM projects. According to NDRC (2011), up to June 2011, over 38% of the approvals concentrated on five provinces: 327 in Yunnan Province, 283 in Sichuan, 223 in Inner Mongolia, 159 in Hunan and 156 in Gansu Province, which are all located in the central and west China. This is because there are rich hydropower and wind power resources in these provinces. However, the 3 municipalities, Beijing, Shanghai and Tianjin with well developed infrastructures and the leading technologies, are ranked the last four (along with Tibet) of all provinces. This outcome has proved the suggestion from Amin and Marinova (2009) that the spirit of CDM is to support sustainable development and encourage mutually beneficial transfer of appropriate technologies and believe that the CDM potentially offers a lot of technology transfer opportunities to the much poorer regions of the world to achieve a significant level of economic development and bridge the technological gap. The central and western regions of China with less developed economy attracted over 70% of total projects and 62% of total volume of CERs, which reflects the successful implementation of CDM projects.

Table 3 Regional distribution of registered CDM projects, 14.07. 2009

Regional total	Projects number	Projects %	Average provincial number of projects	CERs 10,000 tons	CERs %	Average provincial carbon emission
Western	300	49.59	25.0	4167	21.65	347
Eastern	138	22.81	13.8	9737	50.60	974
Central	125	20.66	20.8	3377	17.55	563
North-east	42	6.94	14.0	1961	10.19	654
National total	605	100.00	19.5	19243	100.00	621

Source: National Development and Reform Commission (2009)

According to NDRC (2009), as of July 14, 2009, China's total number of registered projects was 605, of which the number of projects on energy and renewable energy was 442, accounting for 73% (of which 80% were wind and hydropower generation projects) and their estimated CERs accounting for 26% of the total. The individual project emission reductions however were very low and despite the high number, emission reduction was low. There are three main factors contributing to the fast development of energy type CDM projects. First, water resources are very rich in Gansu, Yunnan and Guizhou provinces and in other western regions of China. Second, wind power resources are rich in Beijing, Shandong and Hebei provinces. Due to the lower cost of generating electricity and many existing projects in hydropower and wind power, which were in design stage, they were easily converted into CDM projects. Third, in order to achieve a low carbon economy, China's government policies encourage the country to consume new and renewable energy, and improve energy efficiency and structure making the energy field a priority area for CDM approvals.

In response to central government, local provincial governments and cities set up relevant policies and regulations to stimulate the CDM markets. However, due to regional disparities, the CDM development was very different (Tables 3). The average provincial number of registered CDM projects in the western region was the highest at 25 compared to the national average of 20. The 12 western provinces hosted the largest number of CDM projects: 300 or 50% of total China. This is due firstly to the resources advantages, particularly the rich water and electricity resources, in the western region, and secondly to the preferential policies of the central government. The Great Western Development Strategy has accelerated the growth of the region, promoted the infrastructure construction and environmental protection (Luo et al., 2007). The CERs contribution of the western region however was low at only 22% of the national level. The CERs contribution by the eastern region was the highest but it had a much smaller number of projects. This low number is due to the weak economic conditions, limited technology level and weak financing capabilities of the projects' owners. The central region had the highest average provincial number of projects, namely 21.

Table 4 compares CDM projects and relevant CERs in the eastern, central and western regions of China. Projects in the 3 areas of new and renewable energy, energy efficiency improvement and methane to market

account for 94% of the total and 74% of the relevant CERs in China. The new and renewable energy projects alone account for over 70% of the projects and over 50% of the CERs. The area of HFC-23 decomposition, which has only 11 projects distributed mostly in the eastern region, represents 13% of total CERs. Unlike the economic development trend favouring East China, the development of the CDM market has been in the opposite way with the CDM projects in the west accounting for 48% of total projects. However, the CERs of west China are approximately equal to that of east China which accounts for only 27% of the CDM projects. It is interesting to also mention that the 49 newest CDM approvals (as in August 2011, NDRC, 2011) cover 7 unilateral projects which is a sign of China's ability, willingness and ambition to tackle climate change.

Table 4. Number of active CDM projects and CERs ($ktCO_2$) in China, June 2011

Project Type	East China		Central China		West China		Total	
	Projects	CERs	Projects	CERs	Projects	CERs	Projects	CERs
New and renewable energy	475	52398	402	43727	1252	169175	2129	265301
Energy saving and efficiency improvement	188	30244	204	31775	86	10893	478	72911
Methane recovery and utilisation	54	9440	105	36731	46	9309	205	55481
Alternative fuel	26	21733	15	2978	6	765	47	25476
Garbage burning power	21	6040	1	95	16	4737	38	10872
N_2O decomposition	8	12081	8	9094	12	4134	28	25308
HFC-23 decomposition	10	64733	/	/	1	2066	11	66798
Forestation and reforestation	1	1	/	/	3	116	4	117
Others	25	3408	12	1449	13	3087	50	7944
Total all types	808	200076	747	125849	1435	204282	2990	530208

Source: NDRC (2011).

6. CONCLUSION AND PROSPECTS

The analysis of China's CDM activities shows that the country is leading the global CDM market. This achievement is mainly credited to China's sound government guidance, reasonable organisational arrangements and positive capacity building at the macro and micro levels. The regional distribution of the CDM projects shows that the poorer western China hosts the largest number of projects. This trend is consistent with the CDM's main goal to assist less developed regions to achieve a more sustainable future. However the total amount of emission reductions in western China have not yet reached even half of that in the eastern region and this needs to be improved. In addition, China's CDM projects are highly concentrated in the area of new energy and renewable energy. The CDM mechanism should be used also to develop and encourage other types of projects, such as biomass power generation and improving energy efficiency which can help China achieve a more balanced sustainable development. There is a need for central and local governments to provide policies that help abate this regional imbalance.

After 2012, in the post-Kyoto era, the future of the global CDM market is uncertain. The voice from the UN Climate Change Conference of the Parties' sixteen session in Cancún in 2010 has not been impressively in favour of new emission reduction targets or significant financial support from developed to developing countries to tackle climate change. However, under pressure from the changing carbon market and increasing concerns about the deteriorating environment, the global importance and urgency of collaborative actions are recognised. China, as the top global emitter, is considered to be a significant player and is expected to have a vital role in cutting down global GHG emissions, particularly through CDM projects. No matter what will be the future prospects for China, both opportunities and challenges exist for the current and future owners of CDM projects. China should use its opportunities promptly by formulating more effective policies and regulations and developing quality new CDM projects to become a real winner in the global competitive CDM arena as well as in its transformation to a low carbon economy.

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