CLEAN DEVELOPMENT MECHANISM

K.S. KAVI KUMAR

DISSEMINATION PAPER - 13

Centre of Excellence in Environmental Economics
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Clean Development Mechanism

1.0 Introduction

The Kyoto Protocol adopted in December 1997 creates legally binding obligations on Annex-I countries (mostly developed countries) to reduce their greenhouse gas (GHG) emissions. The Protocol entered into force on 16th February 2005 after the necessary number of ratifications in the member countries of the UNFCCC. The Protocol stipulates that Annex-I countries reduce their GHG emissions by about 5% from their 1990 levels in the first commitment period 2008-2012.

The clean development mechanism (CDM) outlined in Article 12 of the Kyoto Protocol formalizes one of the much discussed greenhouse gas emission abatement strategy, namely generation of carbon permits in developing countries (where the abatement costs are expected to be relatively lower than those in the developed countries) with developed country investment. However, CDM is only one of the various flexibility options outlined in the Kyoto Protocol to help Annex-I countries in meeting their emission reduction commitments.

The Protocol consists of the following flexibility options towards satisfying the cost effectiveness criteria in meeting the emission reduction commitments of Annex-I countries:

a. The quantified emission reduction commitments of Annex I countries refer to aggregate emissions of six greenhouse gases: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride.[1] The ability to trade off emissions reductions between the six gases represents *what* flexibility option to the Annex I countries.
b. A number of mechanisms are introduced in the Protocol to help the Annex-I Parties in meeting their commitments in a cost-effective manner. Together these mechanisms provide the *where* flexibility option for the Annex I parties. The Protocol clearly states that the flexible mechanisms

[1] Emissions of each of the gases are to be converted to CO_2-equivalents and aggregated using global warming potentials (GWP) developed by the IPCC.

can only be supplemental to the domestic action and also stipulates that by 2005 'demonstrable progress' must be made by the Annex I Parties in their efforts to meet their emission reduction commitments.

Joint Implementation (JI) - Without explicitly using the term JI, Article 6 of the Protocol outlined a mechanism through which Annex I Parties can acquire emission reduction units from another Annex I Party by engaging in projects that reduce emissions or enhance removals by sinks. As both the host and donor countries engaged in the project activity have explicit emission reduction commitments to meet, the accounting procedure in this mechanism is fairly straightforward.

Clean Development Mechanism (CDM) - This mechanism is defined in Article 12 of the Protocol and it enables Annex-I countries to earn certified emission reductions (CERs) from project activities in the developing countries to contribute to their compliance with GHG reduction targets. In contrast to the other mechanisms of the Protocol, the Annex I Parties can bank their CERs acquired in the period 2000-2007 and use them towards meeting their commitments in the first commitment period. Absence of emission reduction targets on the host countries is expected to complicate the determination of baseline emission levels in the CDM projects. Another feature of the CDM projects is that they attract an additional surcharge (compared to their counterparts under JI mechanism) to cover the costs of operating the mechanism and to help developing countries which are particularly vulnerable to climate change.

Emissions Trading (ET) - Article 17 of the Protocol outlined a mechanism that allows emissions trading between Parties with emission reduction commitments. As the Annex I Parties are the ones with emission reduction commitments, the trading is likely to be between them. However, it is also possible that the non-Annex I Parties that voluntarily accept emission reduction targets can also participate in the emissions trading.

c. The Annex I countries are given specific emission abatement targets in the first commitment period to be fulfilled over a five year period, 2008 to 2012. Provision of five years to fulfil the commitments is expected to provide the *when* flexibility option to the Annex I countries. Other features

of the Protocol that provide the *when* flexibility option include: provision for carrying forward the unused emissions in the first commitment period to the subsequent commitment periods; provision for using the credits obtained under CDM during the period 2000-2007, in the first commitment period.

The CDM has the potential to assist developing countries in achieving sustainable development by promoting environmentally friendly investment from developed countries. The purpose of the CDM, as outlined in the Kyoto Protocol, is to assist parties not included in Annex-I of the Protocol in achieving sustainable development and in contributing to the ultimate objective of UNFCCC, and to assist parties included in Annex-I in achieving compliance with their quantified emission reduction commitments. The CDM allows governments or private entities in developed countries to implement emission reduction projects in developing countries and receive credit in the form of 'certified emission reductions' (CERs) which they may use to meet their national reduction targets.

The CDM offers the industrialized countries an opportunity to reduce emissions anywhere in the developing world and to use these reductions towards meeting their own GHG reduction commitments. The funding channeled through the CDM should assist developing countries in reaching some of their economic, social, environmental and sustainable development objectives, such as cleaner air and water, improved land-use, accompanied by social benefits such as rural development, employment generation, and poverty alleviation. From the developing country perspective, the benefits of CDM would include:

- Inflow of capital for projects that assist in moving towards low-carbon economic development
- Providing scope for technology transfer
- Prioritizing investment in projects that meet sustainable development goals
- Providing local environmental benefits

2.0 Rationale for CDM

In a competitive market economy, private producers choose the level of energy inputs to equate the marginal value product of energy with the marginal cost of the energy input. However, this formulation excludes the externality costs imposed by the use of energy. Thus, the social cost of energy equals not only the private price of energy, but also social damages resulting from the energy use that are not part of the market price. In the case of fossil fuels, the social costs include the economic damages that result from greenhouse gas (GHG) emissions into the atmosphere. Economic theory suggests that the social optimum uses less energy than the private optimum as a result of these higher costs.

One major practical hurdle to emission control is that energy substitutability is much higher when choosing among industrial equipment at the time of an initial investment, than after the equipment is already in place (that is, retrofitting is often very costly). Economists term this situation one of "putty-clay" technology. Initially, the capital-energy ratio is malleable (putty); once in place, however, there may be no substitutability at all (clay). In terms of economics of climate change and development this has important implications: (a) Since it is very costly to retrofit equipment, essentially all of the efficient energy saving must be achieved on new installations. As these installations come gradually over time, the optimum adjustment is slow and rises over time. (b) For the same reason, the proportionate adjustment will be larger in faster-growing economies, since such economies will tend to have a higher effective turnover of the capital stock. Thus, one might expect a larger optimal proportionate reduction of energy use—relative to a baseline that assumes no corrective taxation—in developing countries as opposed to developed countries.

The second point – which provides basis for CDM – could be illustrated through a simple example outlined in Sachs et al. (1999). Suppose that there are two kinds of power plants. The first type emits 1 unit of carbon per kWh, and the second emits only 0.75 units per kWh. Initially, economies 1 and 2 both use only the first type of power plant, which is the private sector optimum. Now suppose that with the introduction of an optimal corrective emissions tax, the optimum choice shifts to power plants of the second type. Economy 1 is a mature, advanced economy – akin to developed countries. The

overall energy use is constant, though 5 percent of every power plant depreciates each year and must be replaced. All new installed capacity is of type 2. Economy 2 is a dynamic, fast-growing developing country. While each power plant depreciates at 5 percent per year, the economy's overall energy use also grows by 5 percent each year for the next 30 years, and all replacement investment plus incremental capacity are of type 2. Now suppose that the optimum corrective tax is put in place in year 1. The average emission intensity of the two economies can be worked out as shown in table 1.

Table 1: Average Emission Intensity - Illustration

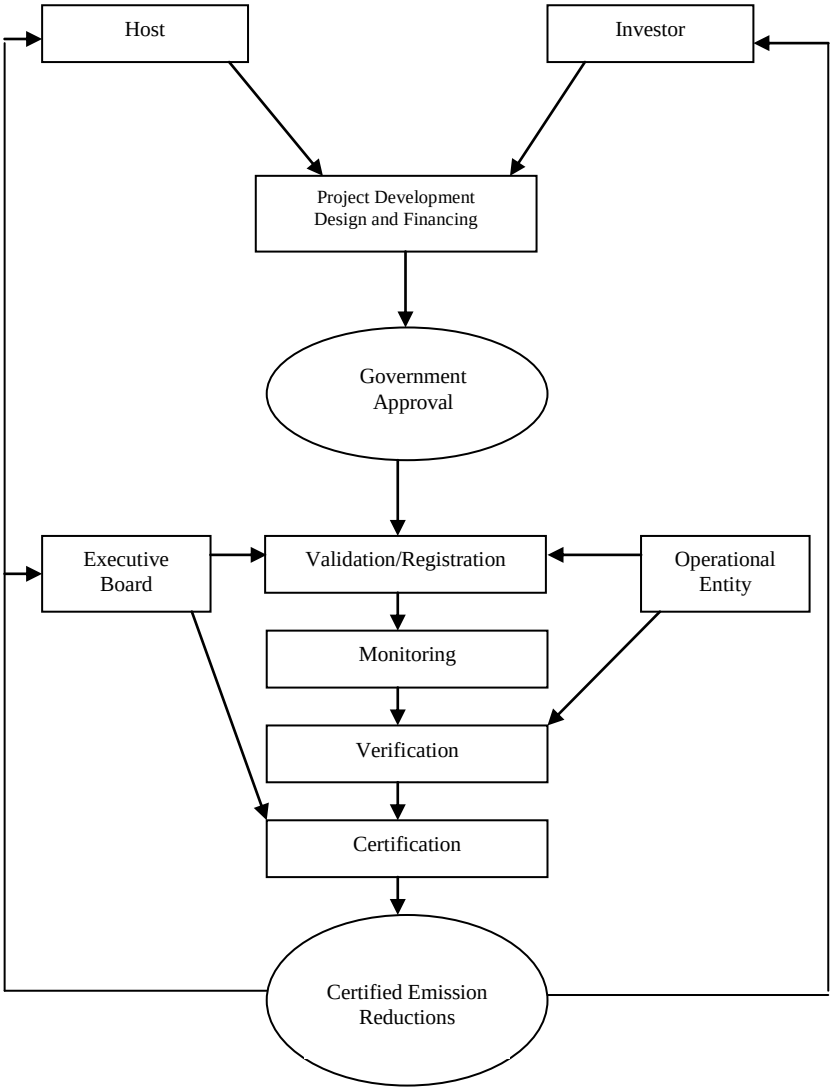
Year	**0**	**1**	**5**	**10**	**15**	**20**	**25**	**30**	**…**
Economy 1	1	0.95	0.94	0.90	0.86	0.84	0.82	0.80	0.75
Economy 2	1	0.98	0.90	0.84	0.81	0.78	0.77	0.76	0.75

In the long run, both economies have a twenty-five percent reduction in carbon emissions per kWh of electricity. In the mature economy, it takes about 13 years to reach half of the total adjustment, and only 80 percent of the long-run adjustment is completed within 30 years (because 21 percent of the power plants still in use are of type 1). In the fast-growing developing country, it takes just 6 years to make half of the long-term adjustment, and by year 30, 96 percent of the long run adjustment has been made. Just 5 percent of installed capacity is of the original, high-emission type 1. Thus, more scope exists for emission abatement to take place in fast growing developing countries, compared to developed countries with stable and low growth.

Further, the marginal abatement cost of GHG rises in level of abatement. The developed countries, using more efficient technologies, hence face higher abatement costs, compared to the developing countries using relatively less efficient technologies. This also provides a rationale for the Annex-I countries to explore GHG emission mitigation options in developing countries.

3.0 CDM Project Cycle

The CDM project cycle is a series of actions that are needed to establish an activity as a CDM project and get CERs from it in accordance with established rules and procedures for the CDM. Figure 1 gives a schematic of the CDM project cycle.



(Source : http://vnvfor.nic.in/cc/cdm/cycle.htm)

Figure 1. CDM Project Cycle

Project Design : This step involves developing a Project Design Document (PDD), which is a standard format describing how the activity intends to fulfil the pre-requisites for registration as a CDM project. The PDD consists of a general description of the project, its proposed baseline methodology, a timeline and crediting period, a monitoring methodology, calculation of GHG emissions by source and stakeholder comments. The host country Designated National Authority (DNA) must issue statements on the PDD indicating that the government of the host country participates voluntarily in the proposed activity and that the project assists the host country in achieving sustainable development.

Validation and Registration : Validation is a process involving an independent evaluation of the project activity by an external auditor known as a Designated Operational Entity (DOE), which is hired by the project participants. The DOE reviews the PDD in order to determine whether the project meets CDM requirements.

Once a project activity has been validated by a DOE a validation report is forwarded to the Executive Board (EB) for registration as a CDM project. The registration of a project will be final within eight weeks after the date of receipt by the EB unless at least three members of the EB request a review of the project activity.

Monitoring: Once the project is operational the emissions that occur from the activity must be monitored. This is done according to the monitoring plan submitted and approved in the PDD, which indicates the method used for measuring emissions from the project and how data relevant for these calculations will be collected and archived. The information on emission reductions must be included in a monitoring report estimating the amount of CERs generated and submitted to a DOE for verification.

Verification and Certification: Verification is the independent review of the monitoring report submitted by the project participants. A DOE different to that involved in the validation process carries out verification. The DOE must ensure that the CERs have been generated according to the guidelines and conditions agreed upon during the validation of the project. A verification

report is then produced. The same DOE that verified the project also certifies the CERs generated by the activity.

Certification is the written assurance from the DOE that the project achieved the stated level of emission reductions and that these reductions were real, measurable and additional. The certification report constitutes a request to the EB for issuance of CERs. Unless a project participant or at least three members of the EB request a review within fifteen days, the EB will instruct the CDM registry to issue the CERs.

Several issues regarding the implementation of CDM projects have been sorted over the past several years through negotiations and these include :

- While both large and small scale projects can be implemented under the CDM, the CDM Executive Board has issued fast-track prompt start procedures for small-scale project activities. The objective of this fast tract mechanism is to enable small scale projects to be pursued without the need for going through the rigorous and expensive approval and assessment processes as required for larger scale proejcts. The small-scale activities icnlude (URC, 2004) :
    - Renewable energy project activities with a maxium output capacity equivalent of up to 15 megawatts
    - Energy efficiency improvement project activities that reduce energy consumption on the supply and/or demand side, by upto 15 gigawatt hours per year
    - Afforestation or reforestation projects that are expected to result in net human induced greenhouse gas removals of less than 8 kilotonnes of CO_2 per year and are developed or implemented by low-income communities or individuals
    - Other project activities that both reduce anthropogenic emissions by sources and directly emit less than 15 kilotonnes of CO_2 equivalnet annually.
- Only afforestation and reforestation (A&R) projects are eligible under the sinks projects category. The maixum use of CERs from A&R projects should be less than 1% of the 1990 emissions of the Party. Other sinks like

revegetation, forest management, cropland management and grazing land management are not allowed under the CDM but only as Joint Implementation projects in Annex-I countries. Avoided deforestation is allowed for normal small-scale CDM projects – e.g., where it can be proved that installation of efficient wood stoves reduce the deforestation.

- A unilateral CDM project would enable a non-Annex I party to undertake a project with all participants being national of the host country and no Annex-I party being directly involved. The CERs created for this project could then be sold in the carbon market. This type of projects will avoid the need for wating to look for investment in a CDM project by a party from Annex-I country. Unilateral CDM projects have been approved in the 18th Meeting of the CDM Executive Board.

- Bundling – which involves combining a number of small projects in one PDD – of projects is now allowed. Bundling helps to reduce the transaction costs. Project may be bundled as long as the total size is below the limits for a single project as listed for small-scale project types described above.

Some of the contencious issues related to the CDM project approval include fulfilling additionality criteria and determining baseline emissions. The official website of CDM (http://cdm.unfccc.int) provides information on detailed approved methodologies and several useful resources. The following box provides a brief description of some of these issues through a simple illustration.

Adoption of Precalcinator in Dry Process Cement Plants

Here the case of adoption of precalcinator in an existing dry process plant is considered to illustrate how various CDM criteria could be addressed.

Project Aim: To introduce precalcinator in an existing dry process cement plant to reduce its thermal power consumption and hence CO_2 emissions.

Description of Technology: Precalcination is a process of treatment of the raw meal before feeding to the main kiln. In the precalcination process the preheated raw meal is heated at a lower temperature than in the main kiln. Amount of calcination achieved in this process is about 85-90%.

Status quo of the technology: Most of the new cement plants in India have come-up with precalcinator kilns. Analysis of kilns set-up during the period 1981 to 1991 shows that of the 27 dry process kilns, 15 have incorporated precalcination technology, 8 of them are operating with 5 stage preheater, and one has gone for 6 stage preheater. The cement plants that have gone for the precalcinator and other technologies have benefited from reduced energy consumption and improved kiln life. However many of the small plants still find it financially not viable to go for this technology. Also, the technology to a large extent is still imported from foreign companies. The proposed project would benefit the domestic companies in obtaining much needed financial resources to adopt better technology and the collaborating foreign company would benefit because of lower CO_2 abatement cost it faces in the domestic company.

Baseline: Since CDM projects are expected to consider project level baselines only, typically the CO_2 emissions from an existing dry process plant without precalcinator kiln will be considered as baseline here. However, as the proposed technology already exists in other Indian plants, one might want to consider the average CO_2 emissions from cement industry as baseline.

Real, measurable and long-term environmental benefits: Lesser thermal energy requirement in the cement plants with precalcinator kiln implies lower coal consumption and hence lower CO_2 emissions. Hence the project achieves real and measurable CO_2 emission reductions.

Compatibility with national development priorities: The project matches with the national priorities because:

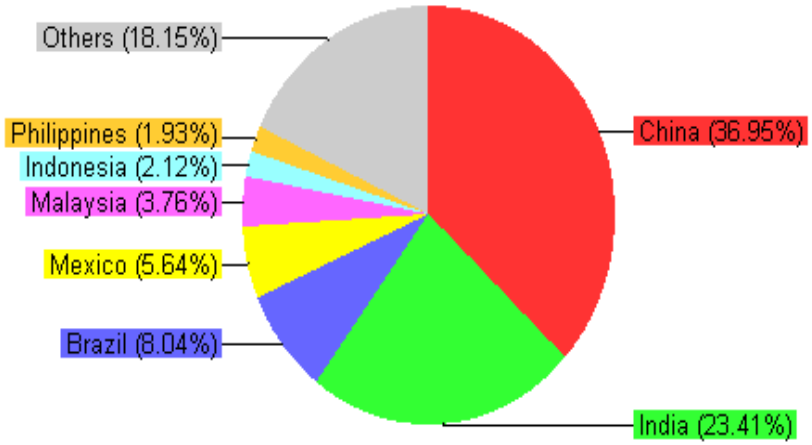
- It targets energy conservation;
- It contributes towards modernization of cement industry;
- It can make use of low grade coal which is abundant in India;
- It results in exhaust gases that contain lesser nitrous oxides and hence benefits local environment.

Offset additionality: The project is expected to bring about real and measurable benefits in CO_2 emission abatement.

(Source : Babu *et al*, 2003)

4.0 Overview of Registered CDM Projects

As of April 2010, more than 2100 projects are registered as CDM projects. China continues to dominate with a share of more than 36 percent, followed by India (23 percent), Brazil (8 percent), Mexico (5 percent), Malaysia, Indonesia and Philippines. Figure 2 shows distribution of the registered CDM projects across host countries.



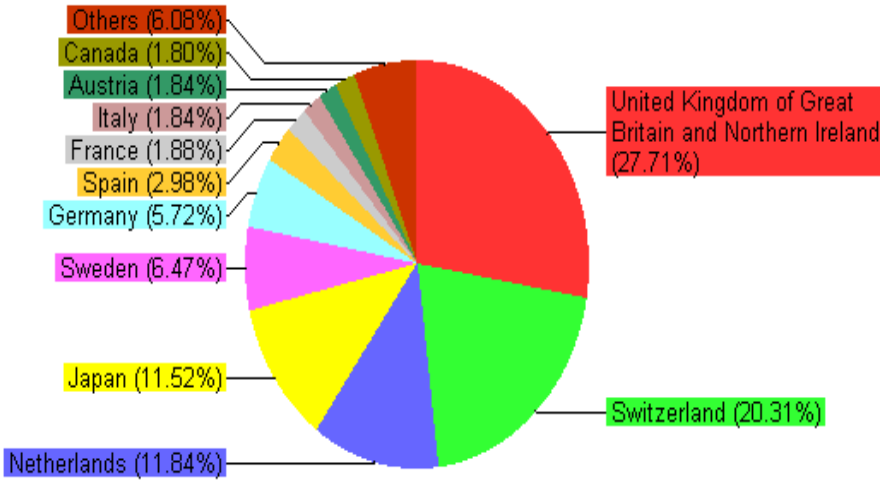
(Source : http://cdm.unfccc.int)

Figure 2. Distribution of Registered CDM Projects across Host Parties

In terms of the expected average annual CERs from the registered projects, China is likely to get almost 60 percent of the total CERs, followed by India (12 percent) and Brazil (6 percent). In terms of the regions, Asia and Pacific countries dominate the CDM projects with a lions' share of more than 75 percent. Latin American countries come next with close of 22 percent of the registered CDM projects. African countries are still to make their presence felt through CDM projects. While the large projects continue to dominate (56 percent of the total CDM projects), the thrust given to the small-scale projects

is showing results with a considerable improvement in the share of such projects over time.

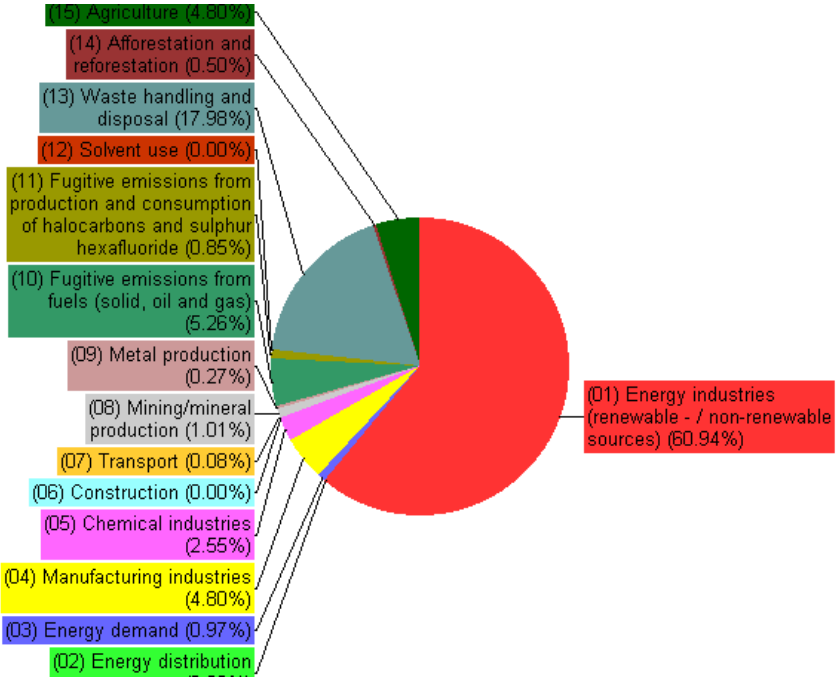
Europe in general is investing largely in the CDM projects. As shown in figure 3, close to 80 precent of investor parties of the registered projects are from Europe. Japan, Canada and Australia are other major parties in terms of the CDM investments.



(Source : http://cdm.unfccc.int)

Figure 3. Distribution of Registered CDM Projects across Investor Parties

Figure 4 presents a distribution of the registered projects according to the sectoral scope or type of activity. It should be noted that some of the projects belong to more than one sectoral category. The highest number of projects (61 percent) have been registered under ‘energy industries’ (including renewable and non-renewable sources), followed by ‘waste handling and disposal’ (18 percent).



(Source : http://cdm.unfccc.int)

Figure 4. Distribution of Registered CDM Projects According to Sectoral Scope

5.0 National Issues Related to CDM

There are few crucial issues that developing countries must address with regard to CDM projects and these include:

- National Institutional Structure – it is the authority within the host country to evaluate potential CDM projects and give approval for the projects. The national CDM authority must have open communication with the government agencies of the sectors relevant to the CDM to ensure that the national interests are strictly followed in the selection of CDM projects.
- Synergy between CDM projects and National Sustainable Development Priorities – the Kyoto Protocol stipulates that the CDM projects must assist

developing countries in achieving sustainable development in order to fulfill the eligibility criteria. However, it is in the self interest of the host country not see the sustainable development dimension merely as a requirement of CDM. National authorities can use the sustainable development criteria to evaluate key linkages between national development goals and CDM projects and ensure selection of projects that enhance such synergies.

- Establishment of Sustainable Development Criteria – One way of establishing a linkage between CDM projects and national sustainable development criteria is through the use of project evaluation indicators that reflect specific CDM project issues such as financial costs and GHG emission reductions as well as development criteria including economic, social, and environmental sustainability dimensions.

India has made significant progress in terms of establishing the necessary institutions to promote CDM projects and has also taken care to align the projects with the national interests and sustainable development goals. Several studies have indicated that India has considerable potential to attract CDM projects and the statistics given in the previous section substantiate this. In terms of future prospects, India would continue to attract CDM projects in the power sector and for enhancing energy efficiency in industries. Transport is another sector that could attract large CDM projects. Though India emits considerable amounts of GHGs other than CO_2, given the dispersed nature of such emissions (for example, methane from livestock and agriculture), the potential for CDM projects to abate these emissions is relatively minimal (Gupta, 2003).

6.0 CDM Market – Status and Prospects

The CERs generated through the CDM projects are transacted in the carbon market. A study of the carbon market would reveal the demand and supply issues related to the project based emission reductions. Two new multilateral funds have been recently launched by the World Bank – the Community Development Carbon Fund and the Bio-Carbon Fund. In addition, there are CDM funds established by Japan, the Netherlands and several other European countires. These funds serve as potential buyers of CERs in the market. In

addition, many governments have used several vehicles in CER procuement including government own tenders, through banks and through multilateral institutions. Bilateral transactions are also emerging. For instance, the governments of Canada and the Netherlands have signed memoranda of understanding with several Latin American countries for the development of projects and supply of CERs. Table 2 provides a list of CER procurement funds.

Table 2 : List of CER Procurement Funds

Multilateral Funds	• Prototype Carbon Fund (US$ 180 million) • Community Development Carbon Fund (US$ 100 million) • Bio-Carbon Fund (US$ 100 million)
Government Funds	• Dutch Government's Certified Emission Reduction Unit Procurement Tender (CERUPT) Program • Finish CDM/JI Pilot Program (Euro 20 million) • Sweden International Climate Investment Program – CDM • Spanish Carbon Fund • Austria JI/CDM Procurement Program
Own Tenders (through Commercial/Develo-pment Banks)	• Rabbo Bank (Dutch Government) • Japanese Bank of Industrial Cooperation (Japan CDM Fund – 4 billion Yen) • Development Bank of Japan (Japan CDM fund – 3 billion Yen)
Own Tenders (through multilateral institutions)	• World Bank (The Netherlands Clean Development Facility – Euro 70 million) • IFC (IFC-Netherlands Carbon Facility – Euro 44 million)
Bilateral Transactions	• Canadian Government with Colombia and Chile • Dutch Government with Bolivia, Coloumbia, Uruguay and Ecuador

The carbon market report 2009 (Capoor and Ambrosi, 2009) reports that the average price of a CER in 2008 was US$ 16.8 – which registered a 17 percent increase over the average price in 2007. The report also suggests that the financial crisis and lingering questions about the post 2012 climate regime have weakned the market for project-based emission reductions, especially in the second half of 2008. The stalemate at Copenhagen and the continuing uncertainty surrounding the emerging shape of the global climate regime could perhaps keep the momentum low on CDM in the short-run. However, in the long-run the CDM would continue to play a crucial role in GHG emission reduction and facilitate low-carbon development in the developing countries.

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Centre of Excellence in Environmental Economics

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Madras School of Economics

Madras School of Economics was founded in 1993 as a private post-graduate institution for teaching and research in economics. MSE offers a two-year Master's program in Economics and Financial Economics affiliated to Anna University, and a Ph.D programme affiliated to both Madras and Anna Universities. MSE has undertaken a large number of research projects since its inception, including the World Bank sponsored Capacity Building Programme in Environmental Economics. The World Bank project involved research, training, curriculum, and overseas fellowship components which were coordinated by MSE. Subsequently, the Ministry of Environment and Forests approved the proposal to set up a Centre of Excellence in Environmental Economics at MSE. MSE has also been designated as an ENVIS Centre in Environmental Economics under the Environmental Information System (ENVIS) of the Ministry of Environment and Forests, Government of India. A dedicated program on Trade and Environment, with support from the Ministry of Environment and Forests, Government of India, has also been started recently at MSE.

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