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Review Paper

Carbon Credits – A Step to Sustainable Future of the World

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Abstract

Clean Development Mechanism (CDM), a flexibility mechanism of Kyoto Protocol, discusses trading and transferring of emission allowances between developing and developed nations. The shift to renewable energy options and low carbon technologies, in response to the concerns over energy security and climate change, is proceeding more slowly than many would like. CDM, a project-based system, aims to accomplish the overarching goals of the Protocol. It aims to encourage sustainable development in developing nations and intends to reduce the cost of compliance with the Protocol for developed nations. CDM Projects are designed for reducing greenhouse gases and increasing green cover on earth. It involves projects like energy efficiency, transport, methane recovery, industrial process changes, cogeneration, agricultural sector etc. CDM also known as "Carbon Trading" or "Carbon Credits" is the way of reducing carbon emissions and gain 'Certified Emission Reductions' (CERs) for a developing country in return to the technology, funds etc. provided by a developed country. In this process World Bank (WB) acts as a referee and provides carbon credits to developed countries. Recently held Carbon Bazaar'10 in New Delhi, India witnessed the presence of huge number of big industrialists and various government firms across the globe. This shows the concern of the world towards carbon credits. A "Zero Carbon Footprint" initiative carried out successfully at our college has been included in the paper. It includes the calculations of emissions by the raw materials used in the manufacture of the paper we use, computer we work on, the packaging of our groceries or the disposables such as cups, cartons and plastic bags from its production till its disposal, be it in their manufacturing process which consumes fossil fuel generated electricity or the transportation process which causes more emissions by way of vehicle exhaust. An equivalent number of plants were planted in the university premises which amounted to the net carbon emitted during the entire event. Some of the registered projects in India, included in this paper, show the initiation of our nation towards carbon credits. The emergence of a global carbon credit economy is likely to precede a global regulatory system governing climate change and will doubtlessly help to stimulate the emergence of such a global system.

Keywords: CDM, Kyoto protocol, project based system, carbon credits, carbon bazaar, zero carbon footprints.

Introduction

What is the clean development mechanism (CDM): Climate change convention is a United Nations agreement to stabilize greenhouse gases in the atmosphere, at a level that would prevent dangerous changes to the climate. The convention on climate change was agreed at the United Nations Conference on Environment and Development (UNCED) in Rio, 1992. To date, 186 countries have ratified the convention. To put the convention into operation, a protocol was outlined in Kyoto in 1997. The most important aspect of the Kyoto Protocol is its legally binding commitments for 39 developed countries to reduce their greenhouse gas (GHG) emissions by an average of 5.2% relative to 1990 levels. These emission reductions must be achieved by 2008–2012: the so called 'first commitment period'.

The developed countries with emission reduction targets are called the annex 1 countries, whereas those without targets are the non-annex 1 countries. The Kyoto protocol allows developed countries to reach their targets in different ways through 'Flexibility Mechanisms'.

These include: Bubble Mechanism: It refers to the European Union member countries that agreed to have a collective Quantified Emissions Limitations and Reduction Objectives (QELROs) of 8%, regardless of the actual individual countries' reductions. Emissions Trading: Trading of emission allowances between developed nations. Joint Implementation: Transferring emission allowances between developed nations, linked to specific emission-reduction projects. Clean Development Mechanism (CDM): The CDM is the only flexibility mechanism that involves developing countries. It allows developed nations to achieve part of their reduction obligations through projects in developing countries that reduce emissions or 'fix' or sequester CO2 from the atmosphere. It provides guidance to people in

developing countries who are responsible for establishing enabling policies and regulations in this area, as well as project developers.

Structure of the CDM: The clean development mechanism is a project-based system. This means that it accomplishes its objectives at the relatively fine-grained scale of individual projects that are validated by designated entities and registered with the CDM executive board (CDM EB), the mechanism's governing body, rather than at an industry or sector-wide scale. Each project wishing to participate in the CDM must prepare a Project Design Document (PDD) that explains in detail how its future emissions reductions will be real, additional, and not induce leakage. It must also prepare a monitoring methodology that explains in detail how it will monitor emissions reductions made by the project. A project may also utilize a previously approved monitoring methodology. Real emissions reductions are ones that are monitored with sufficient care to insure that they actually occur. Additional emissions reductions are ones that are in addition to any that would have occurred absent the CDM subsidy. Leakage of emissions occurs when emissions reductions that would have occurred within a project absent the CDM subsidy, instead occur outside it because of the subsidy.

All three of these concepts require that a hypothetical baseline of emissions be defined for each project, and in the case of leakage, the world outside the project. This baseline represents the timeline of emissions that would have occurred absent the subsidy provided by the CDM (and thus absent the emission reduction project). It is an attempt to represent the counterfactual of business as usual emissions in a world without CDM. The CDM project baseline is described in terms that vary by the project type. Nevertheless, several common variables can be seen in most PDDs.

Project proponents often describe the regulatory baseline, that is, the flux of emissions permitted by local law and regulation. They often describe the financial baseline, that is, the lack of an adequate return on investment without the benefit of the CDM subsidy. They often describe typical technologies applied by the type of project in the PDD and how the CDM subsidized project exceeds these local standards. Finally, they sometimes must describe a sectorial or national baseline for installations of the project type. Ultimately, the CDM project proponents must quantify the hypothetical emissions that would have occurred in the future without the CDM project subsidy. Of course, project proponents and environmental regulators do not live in a world without CDM.

They have, given the potential for foreign subsidies, acted strategically in order to maximize many projects' baselines and so maximize the potential for the generation of certified emission reductions (CERs). The fact that most industries involved in CDM projects are already highly regulated makes this strategy attractive and not difficult to implement. An environmental regulator faced with the choice of preventing an emission with a domestically costly regulation or allowing it to be prevented by domestic polluters being paid a subsidy from an extra-national entity will have obvious political incentives for selecting the international subsidy over new regulation.

The end product of the CDM process is the issuance by the CDM EB of an emissions offset to the project participants. This offset can then be sold to an annex 1 nation or a party within one that has obligations under the Kyoto Protocol. The offset, called a Certified Emission Reduction (CER), assuming that certain CDM facilities are established, may be used be annex 1 countries in lieu of emissions reductions within their territories for meeting emissions reductions targets. Private parties that have been assigned emissions allowances by their governments may also purchase CERs and use them as permits to emit in excess of their assigned allocations or as an alternative to purchasing allocations from other participants in their domestic market.

Goals of the CDM: The clean development mechanism was created with three goals: It aims to accomplish the overarching goals of the framework convention. It aims to encourage sustainable development in non-annex 1 nations. The CDM is intended to reduce the cost of compliance with the protocol for annex-1 nations.

The clean development mechanism is intended, according to the protocol, to help in accomplishing the goal of the convention of preventing dangerous interference with the climate system. It aims to do this by assisting developing countries in reducing their emissions of GHGs. Thus the CDM is a significant and indeed the only way in which Non-annex 1 signatories to the Kyoto protocol will contribute towards achieving its goals. A not unrealistic hopes for the CDM was that by providing non-annex 1 nations with financial incentives for low-carbon intensity development, these nations' development paths might be nudged onto more climate friendly paths and engaged for the long haul.

The second CDM objective, sustainable development, is left largely undefined by the protocol or the implementing directives of later conferences of the parties. To the extent that the provision has teeth, it is given them by the requirement under the CDM that the host country of a project must certify that it meets the Designated National Authority (DNA)'s standards of sustainability. Although some DNA's have prioritized particular types of projects, they have not rejected other types that would otherwise be capable of producing CERs.

The third CDM goal, lowering the cost of compliance for annex 1 parties, was thought possible for two reasons. The majority of additional energy capacity to be built up to and during the first compliance period (2008-2012) would be located in the developing world where rates of economic growth were highest and energy infrastructure was least developed.60 Also, the relative cost of prematurely retiring high-carbon emission intensity power plants is significantly higher than building new low- or zero carbon emission energy capacity. Thus if the CDM could be used to subsidize the substitution of new clean power capacity in the developing world for premature retirement of old dirty power capacity in the developed world, it could substantially lower the cost of treaty compliance with no change in environmental outcome since the location at which an emission reduction of a particular quantity of CO_2 takes place has no impact on the environmental benefit – lower atmospheric greenhouse gas concentrations.

CDM project types: Carbon credits or CERs are sold to entities in Annex-I countries, like power utilities, who have emission reduction targets to achieve. Type of projects, which are being applied for CDM and which can be of valuable potential, are:

Energy efficiency projects: Increasing building efficiency (Concept of Green Building/LEED Rating) e.g. Technopolis Building, Kolkata; Increasing commercial/industrial energy efficiency (Renovation and Modernization of old power plants); Fuel switching from more carbon intensive fuels to less carbon intensive fuels; and also includes re-powering, upgrading instrumentation, controls, and/or equipment.

Transport: Improvements in vehicle fuel efficiency by the introduction of new technologies; Changes in vehicles and/or fuel type, for example, switch to electric cars or fuel cell vehicles (CNG/Bio fuels); Switch of transport mode, e.g. changing to less carbon intensive means of transport like trains (Metro in Delhi); and; Reducing the frequency of the transport activity.

Methane recovery: Animal waste methane recovery and utilization; Installing an anaerobic digester and utilizing methane to produce energy; Coal mine methane recovery; Collection and utilization of fugitive methane from coal mining; Capture of biogas; Landfill methane recovery and utilization; Capture and utilization of fugitive gas from gas pipelines; Methane collection and utilization from sewage/industrial waste treatment facilities.

Industrial process changes: Any industrial process change resulting in the reduction of any category greenhouse gas emissions.

Cogeneration: Use of waste heat from electric generation, such as exhaust from gas turbines, for industrial purposes or heating (e.g. Distillery-Molasses/ bagasse)

Agricultural sector: Energy efficiency improvements or switching to less carbon intensive energy sources for water pumps (irrigation); Methane reductions in rice cultivation; Reducing animal waste or using produced animal waste for energy generation and any other changes in an agricultural practices resulting in reduction of any category of greenhouse gas emissions.

Carbon Credits

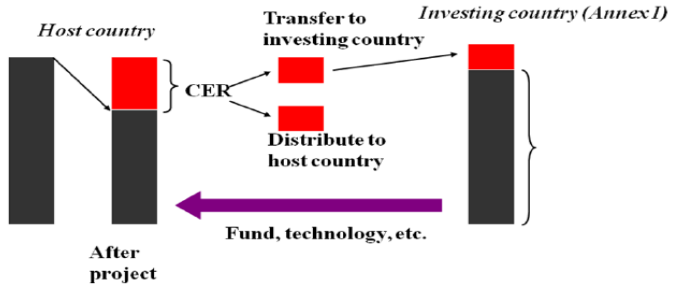

Figure-1
Mechanism Carbon Trading

Let us say that India decided to invest in a new power station, and has decided on a particular technology at the cost of X crore. An entity from an industrialized country (which could even be a company) offers to provide India with slightly better technology, which costs more (say Y crore), but will result in lower emissions. The industrialized country will only pay the incremental cost of the project – viz. Y minus X. In return, the "investing" country will get certified emission reductions‟ (CERs), or credits, which it can use to meet its Kyoto commitments.

This is a very good deal indeed – but for the investing country. Not only do they sell developing countries their technology, but they also meet their Kyoto commitments without lifting a finger to reduce their domestic emissions. Countries like the US can continue to pollute at home, so long as it makes the reductions elsewhere.

The World Bank has built itself a role in this market as a referee, broker and macro-manager of international fund flows. The scheme has been entitled clean development mechanism, or more commonly, carbon trading.

The carbon market creates transferable rights to dump carbon in the environment and vegetation far in excess of the capacity of these systems to hold it. Billions of dollars worth of these rights are to be awarded free of charge to the biggest

corporate emitters of greenhouse gases in the electric power, iron and steel, cement, paper and other sectors in industrialized nations who have caused the climate crisis and already exploited these systems most.

India is considered as the largest beneficiary, claiming about 31 per cent of the total world carbon trade through the clean development mechanism (CDM). It is expected to rake in at least $5 billion to $10 billion (Rs 22,500 crore to Rs 45,000 crore) over a period of time.

Carbon Bazaar 2010: Growing importance of combating climate change, May 10-11, 2010, New Delhi, carbon trading is picking up fast due to growing importance of combating climate change. The programme was one of a kind, providing a platform for major stakeholders in the carbon markets to discuss the way forward of this burgeoning market. Shri J.M.Mauskar, Additional Secretary, Ministry of Environment and Forests (MoEF), Govt. of India; Mr. Thomas Matussek, German Ambassador to India; Mr. Franzjosef. Schafhausen, Deputy Director General 'Environment and Energy' – BMU and Mr. Stefan Helming, Country Director, GTZ, India inaugurated the conference.

While the conference brainstormed on the new and pertinent issues like: Nationally appropriate Mitigation Actions: The German and India Perspective; Programme of Activities: Challenges and Opportunities; Experiences and Nightmares in Carbon Transaction; Small and Medium Enterprises: Potential Untapped; Existing and Emerging Sectors

Future of Carbon Market: Post Kyoto 121 B2B (business to business) meetings took place for direct business negotiations between buyers/ investors/ technology transferors from European nations mainly from Germany and the CDM project proponents from India. High level one to one meetings provided an insight to climate change issues and policies in Indian context and India's stand on these issues beyond 2012. Future areas of cooperation and core climate change issues pertaining to energy and environment in India were also discussed.

Figure-2
India A Leading Player in Carbon Bazaar

Expressing interest in India as a partner for CDM projects German Ambassador Thomas Matussek, inaugurating a two-day event 'Carbon Bazaar 2010', said: "India has a huge potential for CDM projects. Along with China, India has been a leading destination for CDM projects globally since the inception of the mechanism. India is also one of the leading countries with the highest number of registered protects until February 2010".

Stressing the pro-active role of the Indian government in facilitating international conventions, Deputy General of the German Ministry of Environment Franzjosef Schafhausen said: "The Ministry of Environment and Forest, Government of India, and the German Federal Ministry for the Environment have launched the CDM initiative in India to boost the market mechanisms and CER (Certified Emission Reduction) trading in India and also provide a meeting ground for the disparate market players".

The focus of this initiative is to facilitate the participation of the Indian CDM projects in the European Union's Emission Trading Scheme, thereby also becoming a part of the Global Carbon Market," he added. Additional Secretary of the environment and forests ministry Jairam Mauskar said: "India's CDM potential represents a significant component of the global CDM market".

"As on May 7 2010, 505 out of a total of 2,194 projects registered with the CDM executive board are from India. If all these projects get registered, they have a potential to generate 639 million CERs by the year 2012."

Figure-3
CFL Lighting Scheme - Bachat Lamp Yojana (BLY)

CDM's Best Example in India: CFL-for-bulbs to be world's biggest carbon credit project will shut out 40M tonnes of carbon from atmosphere annually. The project, which will allow the government, investors, discoms and CFL manufacturers to sell CFLs at Rs 15 each, instead of the

Rs 100 they currently cost on average, has been approved by the UN.

India had bagged the world's largest carbon credit project that will help replace 400 million incandescent light bulbs with energy saving CFL bulbs at dirt-cheap prices in a year while preventing 40 million tonnes of carbon from entering the atmosphere annually. The project, which will allow the government, investors, discoms and CFL manufacturers to sell CFLs at Rs 15 each, instead of the Rs 100 they currently cost on average, has been approved by the UN under the global carbon credit scheme called clean development mechanism.

The mammoth size of the project can be gauged from the fact that the world's second largest CDM project earns only about 1.5 million credits a year in comparison.

Almost half the households in India will immediately benefit from the scheme and as other areas get electrified; those villages will get added on. There are roughly 400 million light points at present in the country that we will provide the subsidized CFL bulbs for, said Ajay Mathur, director general of the Bureau of Energy Efficiency, which is the nodal agency for the grand project.

The scheme-called Bachat Lamp Yojna-works like this. The discom in a state decides to implement the scheme. It picks up a financial investor, which lends the upfront finance to buy the CFL bulbs at market price to replace the bulbs in the discom's area. The discom then distributes the bulb to its consumers at Rs 15 apiece and collects the regular bulbs, which it then destroys. For every ten bulbs that consumers use for a year, a tonne of carbon is prevented from escaping into the atmosphere as CFL bulbs use substantially less power than incandescent ones. For every tonne of carbon saved, the Bureau of energy efficiency, acting as the anchor, gets a carbon certificate from the UN, which it then hands over to the investor. The investor sells the carbon credit in the international market where buyers —such as manufacturers and power producers in Europe — buy the certificates to meet the greenhouse gas emission reduction targets the countries have set for them. At present, each certificate sells at around 10-12 Euros in the international spot market. BEE estimates that investors will be able to recover the rest of the Rs 85 per bulb by 5-6 years and by the 7th year, earn some on the top. BEE has in its scheme ensured that the CFL bulbs are of a standard that they last that long.

Several states and cities have been ready to take advantage of the scheme the moment it becomes operational. Kerala is one such state. It has already found investors and tied up with manufacturers to distribute roughly 1.5 crore bulbs in the state. In anticipation of the project clearance, it has begun distribution of the energy saving bulbs to consumers.

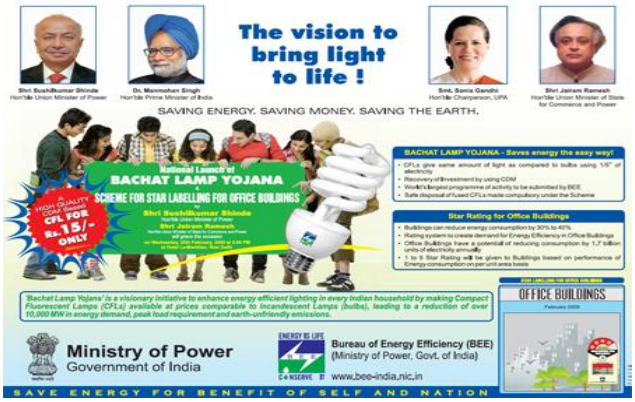

Figure-4

Failures of this CFL Lamp Yojna not being subsidized yet are: Average income of an Indian is not enough that he can buy a CFL lamp at Rs. 100 on average even during the trial phase. Government did not ensure that trial phase took place properly. On the contrary it focused on one class of people for trial phase. Manufacturers were not ready to manufacture CFL lamps at a MRP less than Rs.100.

Failures of CDM: The CDM is neither functioning well as a market for emissions reductions nor is it a successful subsidy. As a result, it is creating skewed but powerful political institutions and interest groups whose interests are not aligned with the ultimate goals of either the UNFCCC or the Kyoto Protocol. Given the relatively poor performance, at least initially, of other markets for atmospheric pollution, this result is perhaps not entirely surprising nor should it be seen as a reason to abandon the CDM.

The CDM fails as a market because it has animated accounting tricks that allow participants to manufacture CERs at little or no cost. It fails as a subsidy because the developed world has had to purchase these emissions reductions at an extremely high premium that bears no relation to their cost. The CDM, even as it is supplying CERs to developed world parties to the Kyoto Protocol at prices that are less than they would otherwise have to pay, is an excessive subsidy that represents a massive waste of developed world resources. It is probably too late to change the structure of the CDM in order to address its shortcomings prior to the end of the first commitment period.

Issues and Concerns over CDM

The Steps to Sustainable Change in the World: Ensuring a continued acceptance of CDM by developing countries requires taking fully into account these countries' concerns in the climate negotiations — or any international negotiation for that matter. There are at least five major philosophical concerns that underlie all of developing countries negotiating positions, and are the bases for their acceptance of any

international agreement. The concerns are protected sovereignty, trust, sustained and non-compromised development, transfer of resources and technology, and promotion of equity.

Sovereignty: Most of the developing countries are young countries, many of which obtained their independence from their Western colonizers in the 1950s. The legacy of colonialism renders them to be particularly sensitive to foreign influences. For them, sovereignty means not only in territorial terms, but also in terms of development, politics, and policy planning. Thus, the developing country governments seek some degree of supervision of the CDM process. The notion of "national sovereignty" has been applied to environmental concerns since the 1972 World Conference on Environment and Development in Stockholm, and reaffirmed in the FCCC and Principle 2 of the Rio Declaration.

Trust: Developing countries are reluctant to embark on a deal if they feel that the real motives are strikingly different from the stated ones, if the alleged real motives might hurt them, and if they feel that they might be betrayed in the future. The loss of trust that has occurred in the climate negotiations means that support for CDM cannot be taken for granted if it seems that others are benefiting more. In the climate change negotiations, distrust was enhanced by the US insistence for "meaningful participation from "key" developing countries. This call for developing country participation disregards the Climate Convention and the Berlin Mandate, agreements that the US actively participated in shaping. An overwhelming majority of developing countries reject any limitation of their future emissions. Exemption of developing countries from provisions to limit emissions is already included in the Convention, and was reaffirmed by the Berlin Mandate. This call broke developing countries' trust in the negotiating process. Even though CDM is officially accepted, this distrust is still effectively there, and could undermine the acceptance of CDM.

Sustained Development: Most developing countries are struggling to get out of poverty, which they view as caused partly by colonial exploitation. Alleviation of poverty and ensuring the availability of basic needs to their population are currently the main focus of their development process. This process is in no way to be compromised by foreign environmental interests. If CDM does not make its expected contribution to sustainable development, support for it is likely to erode.

Transfer of Resources: In pursuing development, developing countries need as much resources and technology as possible. Many developing countries expect substantial transfer of resources through CDM as a realization of support for sustainable development.

Equity: In dealing with more advanced, industrialized, and rich countries, developing countries are cautious. They tend to ask questions such as: Who will benefit more from this deal? Developing countries argue that if QELROs of annex 1 countries were assigned equitably (such as on a per capita basis), then the overall QELROs would be much deeper than the ones currently stipulated in the Protocol. More stringent QELROs would lead to more demand for flexibility mechanisms, including the use of CDM, to meet them. In turn, more demand upon CDM would induce more flow of resources from Annex I to developing countries.

For CDM to be fully accepted, there also needs to be an equitable geographical distribution of projects. CDM is understood to some extent as a vehicle for private investment: there is concern that projects will go where investors see the best opportunity for investment. Usually, these are countries where there is already a significant amount of Foreign Direct Investment (FDI). Africa, for example, only receives 3 percent of the world's FDI, and is thus expected to receive the least interest from investors. While CDM is accepted in principle, much still needs to be done to ensure its workability as a mechanism to serve its dual goals of emissions reduction and sustainable development.

The following points summarize the issues that need attention:

Credibility of CERs: The viability and credibility of CERs is determined by the credibility of the baseline, the calculation of additionality, and the soundness of the project itself. A non credible process of certifying the emissions reduction will threaten the CDM.

Determining a Baseline: The emissions reduction credited to CDM projects should be measured from hypothetical emissions that would have otherwise occurred without such projects. Given the dynamic of the developing economies, establishing a credible baseline is a great challenge.

Additionality: It is necessary to establish a fair and reasonable objective method to judge whether the investments in the projects would not have happened anyway without CDM.

New and Additional Funds under CDM: While CDM is claimed to be able to foster technology and resource transfer from annex 1 to developing countries, there is a potential conflict between the annex 1 and developing countries' interests. Annex I countries have incentives to channel these transfers as much as possible through CDM, as it will provide CER. Developing countries want to ensure that CDM provides transfers that are additional to normal foreign

direct investment (for private sector) and traditional development assistance (for public funds), and that their development priorities don't get short-changed.

Addressing Sustainable Development: Support for sustainable development has been repetitively asserted by the developing countries as the most important element of CDM. Yet, how CDM should provide for sustainable development needs to be clarified.

The Inclusion of Adaptation: The inclusion of an adaptation levy in CDM will increase the price of CER generated through CDM relative to ET and JI (One possible way to collect the adaptation levy is to put a "tax" on the price of CERs per ton). For this reason, developing countries propose to harmonize the three mechanisms — ET, JI, and CDM — so that each of them includes levy on the proceeds to cover adaptation.

Banking of Emissions Reduction: CERs from CDM after 2000 can be used towards meeting annex 1 countries' QELROs in the period between 2008 and 2012. This banking option is designed to encourage early action and does not exist in the other flexibility mechanisms.

The Inclusion of Forest Projects in CDM: Nowhere under the Article on CDM is forestry mentioned as a way to mitigate climate change. Already, however, a number of developing countries are prepared to offer CERs through forestry projects.

Involvement of Private Sector of Developing Countries: Article on CDM allows for private entities to be directly involved in CDM projects. Especially in developing countries where the private sector is yet to be adequately developed, the role of the private entities needs to be supported.

The Role of Developing Country Governments: Given the expectation that CDM will attract resource transfers between the private sectors, the role of the government needs to be defined. Developing country governments expect to play the oversight role, and will need to build criteria for project acceptance.

Bilateral or Multilateral Arrangement: It is not clear whether CDM will be undertaken on a bilateral or multilateral basis. Each of these options has its merits. While a multilateral approach may avoid unequal negotiating position between annex 1 and developing countries, a bilateral approach may greatly simplify the mechanism and in turn reduce transaction costs.

The Need for Capacity Building: Developing countries frequently express their concerns over their lack of capacity in assessing, evaluating, implementing, and monitoring CDM projects. They also express deep concerns on the limited awareness of these countries' major stakeholders on the whole issue of climate change and its implications. They assert that capacity building and information dissemination should be an important aspect of the implementation of CDM.

Some Registered CDM Projects

Rehabilitating Degraded Areas: Face Foundation in Malaysia: The Innoprise - FACE Foundation Rainforest Rehabilitation Project (INFAPRO) was the first large-scale forestry-based carbon offset project in the world. Its objective was to rehabilitate degraded areas by enrichment planting and forest reclamation, using indigenous tree species such as dipterocarps, fast growing pioneers, and forest fruit trees. It is a co-operative venture between the Sabah Foundation, a semi-government forestry organization in the state of Sabah, Malaysia, and the FACE Foundation of the Netherlands.

The total investment committed by the FACE Foundation amounts to US$ 15 million. It was expected that the project will sequester at least 4.25 million tonnes of carbon (15.6 million tonnes CO2) during its lifetime at an average cost of US$ 3.52 per ton of carbon (US$ 0.95 per t CO2).

The planting phase will last for 25 years and the forests will be maintained for 99 years. The long-term nature of the project should enable the maintenance and silvicultural treatments required to sustain growth rates during the project's life. It is expected that at the end of the first 60-year growth cycle, these forests will be exploited for timber, which belongs to the Sabah Foundation. However, timber harvesting will have to be done in a careful way, so that a healthy residual stand can again regenerate a well-stocked forest in order to maintain a carbon pool for the FACE Foundation, which has the exclusive rights to the carbon sequestered through the 99 years of the project.

As well as sequestered carbon, the project will produce over 4 million m^3 of sawn hardwood timber over the project lifetime. As the Foundation is a semi-government organization with the mandate of improving people's welfare in the state of Sabah, it is expected that the project will also generate considerable social benefits: it is expected to generate 230 jobs per year in the planting phase, as well as substantial research and training of Malaysian students.

This case study illustrates how the Kyoto Protocol's definitions of forestry could affect the eligibility of projects. If the current definition of afforestation and reforestation

used for activities in developed countries is strictly applied, this project may not be eligible under the Kyoto Protocol, since the areas to be rehabilitated have a dense canopy cover and would already be classed as 'forest'. Appropriate definitions of forestry would have to be adopted to enable the inclusion of a wider range of projects.

Scolel Té and the Plan Vivo system: In 1994 a group of researchers from the University of Edinburgh and El Colegio de la Frontera Sur in Mexico, undertook a study to ascertain whether sales of carbon services could improve rural livelihoods among indigenous farmers in Chiapas, southern Mexico. The study identified the need for a flexible but structured administrative framework to aggregate the carbon benefits from many small-scale activities. Individual farmers wanted the right to choose how and when to participate, and it was assumed that purchasers and regulatory authorities would require effective monitoring and verification procedures. Over the next 3 years, funding from UK DFID's Forestry Research Programme was used to develop an integrated planning, administration and monitoring system, based upon the requirements identified in the study. The system became known as Plan Vivo.

In 1997, the collaborating organizations secured the interest of a purchaser of carbon services. The pilot project, known as Scolel Té ('the tree that grows') began with an agreement to provide 18,000 tCO_2 'prototype carbon credits' per year, at a price of US$ 2.7 per CO_2 t(US$10 per tC) to the International Automobile Federation. These funds were used to provide farmers with carbon payments to cover the costs of establishing agro forestry systems, small-scale plantations and communal reforestation activities.

The Scolel Té project is now run by a trust fund – the Fondo BioClimatico – which has become a financially viable organization, whose income is derived from the sale of carbon services. There are currently over 400 individual participants from about 30 communities, representing four different ethnic groups and a wide range of agro-ecosystems.

The Plan Vivo system is now also being used in an agro forestry and bioenergy project in southern India, run by an NGO called 'Women for Sustainable Development'.

There are some Industrial Projects from India like the few given below:

Switching of Fuel from Naptha to Natural Gas in the Caustic Concentration Plant at Dahej Complex of M/s Gujarat Alkalies and Chemical Limited: The natural gas will be transported from the Gujarat State petroleum Corporation Ltd, Hazira Gas Field to GACL through pipeline. The generated power will be cater the requirements of Dahej Complex and the remaining will be wheeled through the state grid to the GACL Vadodara complex. The power plant has 2 Nos. of dual firing system equipped with GE designed turbines having rated capacity of 39.2MW.

Switching of Fuel from Natural Gas to Hydrogen in the CCU-II at Dahej Complex of M/s Gujarat Alkalies and Chemical Limited: GACL produces commercial caustic soda as Lye and Solid Flakes. In GACL Dahej complex membrane cell technology is deployed. The caustic soda lye is concentrated in the caustic concentration unit (CCU) to produce caustic soda flake and this activity is highly energy intensive. GACL installed CCU-II with dual firing burner which can run on either hydrogen or natural Gas. The hydrogen gas available from the caustic soda production process is fired in the burner by replacing the Natural Gas with an objective of reducing GHG emissions from the caustic concentration process.

Zero Carbon Footprint" at Nirma University

Audited by CED India: Carbon footprint refers to the emission of greenhouse gases such as carbon dioxide into atmosphere that we generate directly or indirectly. Carbon footprint is not only limited to the vehicle exhaust, but it involves almost everything we do, be it the paper we use, the computers we work on, the packaging of our groceries, or the disposables such as cups, cartons, and plastic bags that are so much a part of our life. Carbon footprint not only includes emission by the raw materials used in the manufacturing of these goods but also the whole emission starting from its production till its disposal, be it in their manufacturing process which consumes fossil-fuel generated electricity, or the transportation process which causes more emissions by way of vehicle exhausts. Technically carbon footprint is a measurement of all greenhouse gases we individually produce. It is measured in units of tonnes (or kg) of carbon dioxide equivalent. A carbon footprint is made up of the sum of two parts, the primary footprint and the secondary footprint. The primary footprint is a measure of our direct emissions of CO_2, from the burning of fossil fuels including domestic energy consumption and transportation (e.g. car, buses, plane, etc.). We have direct control over these.

The **Secondary Footprint** is a measure of the indirect CO_2 emissions from the whole lifecycle of products we use – those associated with their manufacture and eventual breakdown. To put it very simply the more we buy the more emissions will be caused on our behalf. Our decisions on the following add up to our secondary footprint:

We eat vegetarian food or non-vegetarian food. We buy / grow organic food or not, We use mostly seasonal food or not, We buy local food and goods or not, We buy second hand clothes or new, We think of packaging while buying

things or not, We buy new furniture and appliances or second hand, The things we use get recycled or composted or not, we try to avoid burning of fuel on transportation or not. We try to avoid use common vehicles for travel or not, We bring a bag when we go shopping or require a plastic bag from each shop. The direct consequence of increased carbon footprint is global warming and climate change.

Table-1
Individual primary footprint of the most common consumptions

Sr. No.	Particulars	Consumption Amount	Amount of CO_2 release in the atmosphere (kg)
1	Use of Electricity	1KWh	0.94
2	Kerosene	1 liters	2.52
3	LPG	1 liters	1.5
4	Travelling by car (LPG)	1000 liters	1500
5	Travelling by car (Petrol)	1000 liters	2320
6	Travelling by car (Diesel)	1000 liters	2630
7	Travelling by train by 1 person	1000 km	60

Over the past two decades the effects have become more marked. Considerable evidence exists that most of this warming has been caused by human activities. We have altered the chemical composition of the atmosphere through a buildup of greenhouse gases primarily carbon dioxide, methane, and nitrous oxide. This means that a 'cloud' is building up around the earth under which heat is accumulating instead of dispersing in the atmosphere.

If any considerable step is not taken then rising global temperatures will cause sea level to rise and alter local climate conditions, affecting forests, crop yields, and water supplies. It may also affect human health, animals and many types of ecosystems. Deserts may expand and some of our countryside may be permanently altered. Therefore, we need to recognize our personal impact on global warming. Calculation of 'Carbon Footprint' helps us to minimize our impact and show us how to make the right product choices in the future.

Calculation

Calculation has been done keeping in mind the footprint generated due to the whole organization of the event as well as on the event days. Organization has been considered from 1st January – 31st March, 2010 (90 days).

Table-2

Electricity calculations: Energy consumptions per day

Appliance	Units	Ratings (Watt)	Consumption (hrs)	KWh
Fan	5	60	6	1.8
Tube Light	20	40	6	4.8
Computer	5	80	4	1.6
Laptops	5	50	10	2.5
AC	2	1000	4	1.8
Miscellaneous	1	300	6	1.8
Total				20.5

Table-3
Energy Consumption on the event day (26, 27 March, 2010)

Appliance	Units	Rating (Watt)	Consumption (hrs)	K Wh
Fan	100	60	6	36
Tube Light	200	40	6	48
Computer	20	80	4	6.4
Laptops	100	50	10	50
AC	25	1000	4	100
Miscellaneous	5	100	6	3
Total				243.4

Electricity Calculation
88 x 20.5 = 1804
2 x 243.4 = 486.8

Total = 2290.8 which is roughly equivalent to 2300, Therefore, Carbon footprint generated due to electricity, 2300 (KWh) x 0.94 kgs of CO_2 = 2.162 tonnes of CO_2, (Assumed 1 KWh generates 0.94 kgs of CO_2), (Source:http://www.cedindia.org/2009/07/carbon-footprint-mapping/)

Transportation Calculation

Flights: 0.43 tonnes of CO_2, Assumed 5 flights from Mumbai to Ahmedabad, (Source:http://www.carbon footprint.com/businesscalculator.aspx?t=b)

Cars/Bikes: 7.83 tonnes of CO_2, Assumptions: Team of 50 people travelling 30 km each on a vehicle with an approximate mileage of 40 km/liter. Therefore, liters of petrol consumed = (30 x 50 x 90 days)/40 = 3375 liters of petrol. Therefore, carbon footprint: 3375 x (2320/1000) = **7.83 tonnes of CO_2** (Assume petrol car)

Trains: 12 tonnes of CO_2, Approximate number of people (outside Ahmedabad) travelling by train: 500. Average km travelled (to and fro): 400 kms. Therefore, carbon footprint:

(500 x 400) x 0.06 = 12 tonnes of CO_2. Therefore, carbon footprint generated due to transportation: 0.45 + 7.83 + 12 = 20.28 tonnes of CO_2. (Source:http://www.cedindia.org /2009/07/carbon-footprint-mapping/)

Energy usage by cooking: 0.6 tonnes of CO_2: Taking into account the meals for two days (lunch and dinner), amount of LPG consumed that will be around 20 commercial cylinders (20 liter each). Emission of CO_2 per liters = 1.5 kg of CO_2. Therefore, carbon footprint: (400 x 1.5) = 0.6 tonnes of CO_2. (Source:http://www.cedindia.org/2009/07/carbon-footprint-mapping/)

Table-4
The total carbon footprint generated in the span of 3 months

Categories	Amount of CO_2 emitted (tonnes)
Electricity	2.162
Transportation	20.28
Food	0.6
Miscellaneous (Assuming 25% of total)	7.68
Total	**30.722**

The 30.722 tonnes of CO_2 emitted during the span of 3 months was equivalent to 2000 plants that would nullify the effect of the above said carbon emissions. The plantation was done in the campus itself.

References

1. http://cdmindia.nic.in/cdm_india.htm
2. The Kyoto Protocol, http://unfccc.int/kyoto_protocol/items/2830.php
3. http://carbonfinance.org/Router.cfm?Page=FAQ&ItemID=24677#2
4. http://blogs.expressindia.com/showblogdetails.php?contentid=226814
5. http://economictimes.indiatimes.com/News/News-By-Industry/India-set-to-rake-in-100-billion-through-carbon-trading/articleshow/4465669.cms
6. http://economictimes.indiatimes.com/news/news-by-industry/et-cetera/India-a-leading-player-in-carbon-bazaar-Germany/articleshow/5914516.cms
7. http://en.wikipedia.org/wiki/Clean_Development_Mechanism
8. http://iis-db.stanford.edu/pubs/21211/Wara_CDM.pdf
9. http://indscanblog.com/
10. http://indscanblog.com/2010/05/03/carbon-bazaar-2010-an-event-for-carbon-trading/
11. http://unfccc.int/kyoto_protocol/mechanisms/clean_development_mechanism/items/2718.php
12. http://www.articlesbase.com/environment-articles/the-power-of-carbon-trading-in-india-893696.html
13. http://www.assocham.org/events/recent/showevent.php?id=261
14. http://www.cd4cdm.org/
15. http://www.cd4cdm.org/Publications/UNEP_CDM%20Baseline%20Meth%20Guidebook.pdf
16. http://www.cd4cdm.org/photocredits.htm
17. http://www.cdmcapacity.org/
18. http://www.cdmcapacity.org/CDM_Booklet_LR.pdf
19. http://www.cdmcapacity.org/case_studies.html
20. http://www.cdmcapacity.org/how_projects_developed/plan_vivo_popup.html
21. http://www.cdmcapacity.org/manual.html
22. http://www.cdmcapacity.org/what_is_CDM/index.html
23. http://www.cdmcapacity.org/what_is_CDM/rules_remain_decided_popup.html
24. http://www.cdmindia.com/
25. http://www.cdmindia.com/about-cdm.aspx
26. http://www.cogeneration.net/clean_development_mechanism.htm
27. http://www.energymanagertraining.com/CDM/HT-NewDelhi7May2010BuP6.jpg
28. http://www.energymanagertraining.com/CDM/HT02May2010_P10s.jpg
29. http://www.energymanagertraining.com/CDM/cdm_main.htm
30. http://www.energymanagertraining.com/CDM/cdm_main.htm#c
31. http://www.energymanagertraining.com/CDM/newsletter/2010/IssueNo83May2010.htm
32. http://www.gtz.de/en/weltweit/asien-pazifik/31162.htm
33. http://www.ieta.org/ieta/www/pages/index.php?IdSitePage=959
34. http://www.indiaenvironmentportal.org.in/category/thesaurus/climate-change/emissions-trading/clean-development-mechanism-cdm
35. http://www.teriin.org/ee/cdm/cdm.htm