

Special Feature on the Kyoto Protocol

The Kyoto Protocol: An Indian Perspective

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This article describes the Clean Development Mechanism (CDM) policy of India, provides estimates of potential for a few sectors, and voices India's concern about the CDM. In particular it covers the problems of determining CDM baseline, transaction costs, and risks that have to be borne by the developing countries and determining a fair price for carbon dioxide (CO₂). It argues for more effective technology transfer and points out that, if interpreted incorrectly, CDM rules can discourage climate-friendly policies in developing countries. It suggests that the developing countries should learn how to play the CDM game in order to secure better deals.

Keywords: CDM game, CDM baselines, CDM transaction costs, CDM risks, India's CDM policy and potential.¹

1. Introduction

The 1992 United Nations Framework Convention on Climate Change (UNFCCC), although not fully satisfactory, was important for developing countries. It recognized the need for their development and the need to curtail greenhouse gas emissions (GHGs) in order to reduce the threat of climate change. Subsequently, the 1997 Kyoto Protocol brought developing countries closer to the ambit of GHG reduction by making it attractive for them with the proposal of the Clean Development Mechanism (CDM). Despite the fact that the protocol is not yet ratified, a number of activities have already been launched in many countries. These range from the establishment of institutions like the CDM Executive Board at the UNFCCC, the designated national CDM agencies in various countries, and a number of consulting firms that deal with issues ranging from GHG reduction issues to identifying CDM projects and methodologies for baselines and so on. Each year, numerous training programs, workshops, and consultations take place involving policy makers, experts from public and private sectors, non-governmental organizations (NGOs), and academic organizations. The effort invested into these activities suggests that the Kyoto Protocol is seen as worthwhile.

As for India, the impact of the Kyoto Protocol has to be assessed in the context of the following questions:

- What GHG emission reductions can be obtained from the country's key sectors?

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- What could be the impact of India's domestic policy on GHG emissions reduction?
- What new technologies has India obtained so far?
- What and how much additional resources have flown into India?

2. India's approach

2.1. *Warming up to the CDM*

Given these basic issues, here we quickly recap the thinking of the Government of India on the CDM. After initial reluctance to even join the pilot project phase of activities implemented jointly (AIJ), and after great deliberation on participation in AIJ,² the Government of India decided to set up the AIJ Working Group under the Ministry of Environment and Forests (MoEF), and issued a set of guidelines for submission of AIJ projects to the government. After lengthy debate since 1997 on the issues and options, a broad consensus seems to be emerging in regard to operationalizing the CDM. This is reflected in the much thinner consolidated text that emerged after the twelfth session of the Subsidiary Body on Scientific and Technological Advice (SBSTA-12) in June 2000. The government set up the Expert Group on Kyoto Protocol mechanisms to crystallize the views in the country.³

There has been a shift in India's stance towards accepting the CDM, conditional on the clarification of the principles and modalities of its operation. A joint statement between India and the United States in March 2000 underlines this shift in "cooperation on energy and environment." Stressing the desire to promote clean energy, it called for development of cleaner and more energy-efficient technologies. The statement said that by 2012 the Government of India hoped to increase the share of renewable energy to 10 percent of the capacity addition in electricity generation.

The following are the key elements of India's stance on the CDM:

1. The use of flexible mechanisms to meet commitments should be supplemental to domestic effort and an upper limit to their use should be defined.
2. Carbon sinks should not be included in the CDM.
3. Criteria for CDM projects:
 - The host country should be the sole judge of its own national sustainable development criteria.
 - Project activities should promote the transfer of technology.
 - Capacity building should be incorporated into all CDM projects.
 - Baselines will be defined on a project-to-project basis.
 - Funding for project activities shall be additional to official development assistance (ODA), Global Environmental Facility (GEF), and other financial commitments of developed country Parties.
4. The "share of proceeds from certified project activities" shall be a stipulated percentage of the differentials of the costs incurred by the developed country in reducing GHG emissions through

2. J. Parikh was a member of this committee.

3. J. Parikh was a member of this committee as well.

- project activities in a developing country, as well as of the project costs that would have been incurred had the GHG reduction activity taken place in the developed country funding the project(s).
5. The terms and conditions for sharing certified emissions reduction (CER) credits and funding will be mutually agreed upon by the developed and developing country parties.
 6. The operational entities that certify emission reductions shall be designated by the COP/MOP.⁴
 7. A national system of monitoring, verifying, and reporting under the CDM shall be established.

India established its own designated national agency (DNA) cell in 2003—called the National Clean Development Mechanism (CDM) Authority—within the Ministry of Environment and Forests, with representatives from other government ministries. The process of attracting CDM projects has begun and is now picking up steam. Every year a number of workshops are held to build awareness and capacity in support of project preparation, and there is now considerable interest among policy making bodies, the business community in the public and private sectors, NGOs, as well as universities and research institutions.

2.2. CDM projects in India

The status of CDM projects forwarded by India to the Executive Board is shown in table 1.

Table 1. Key information on CDM projects forwarded by the GOI (as of August 2003)

Project name	Credits purchaser	Project description	Total GHG reduction (tCO ₂ eq.) ^a
Biomass-based (bagasse) ^b cogeneration power plant, Karnataka	Unknown	Biomass co-generation in sugar mill; 26 MW	696,167
Suzlon Wind Project	CERUPT	Wind 15 1-MW turbines; 15 MW	360,000
Tamil Nadu Wind Project	CERUPT	Wind; 17 0.85-MW turbines; 14.45 MW	308,030
Enercon wind farm	CERUPT	—	2,000,000
Tamil Nadu Biomass Project	Swedish Energy Agency	Biomass (cotton stalks, rice husks etc); 18 MW	800,000
Biomass project, Maharashtra	CERUPT	Biomass; agricultural waste power plant; 7.5 MW	378,000
Kalpataru Biomass Project, Rajasthan	CERUPT	Three biomass plants, on mustard crop residues; 20 MW	1,150,000
OSIL waste heat power project	Japan Ministry of Environment	10-MW waste heat recovery	314,404

^aTonnes of carbon dioxide equivalent.

^bBagasse is a by-product of sugar cane production.

4. Conference of the Parties to the Convention, serving as the Meeting of the Parties to the Kyoto Protocol.

As can be seen, only six projects have been forwarded. Of these three are wind power projects and three are biomass projects using agricultural wastes to generate power. The total CERs generated add up to 5.41 million tonnes of CO₂ equivalent. Since these CERs are calculated over the lifetime of the plants (i.e., ten years) the reduction in GHG emissions is only 0.06 percent of India's comparatively very low emissions.⁵

The total value of the CER credits at US\$3 per tonne of CO₂ is \$16.23 million dollars over the lifetimes of the projects. Thus, so far the inflow of resources is meager.

Have these projects led to any technology transfer? This is not clear as India already has a vigorous wind power program, and burning biomass waste in a gasifier is also not likely to involve much high-technology content.

This is, however, just a beginning and the future scope may be large. There are a number of barriers that need to be overcome. However, if CDM projects are to make any sizable impact, and that can only happen after large-scale activities occur in various domains such as fuel-switching in the cement, transport, and service sectors (i.e., hotels, hospitals, and so on).

3. CDM potential in India

India holds considerable potential for CDM projects. We illustrate this with case studies of two sectors: cement and wind energy.

3.1. GHG emissions mitigation potential in the cement sector

Recent average economic growth rates in India is above 6 percent. Such rapid development leads to a construction boom when the growth rate ranges from 8 to 10 percent. Thus, although India emitted a total of about 778 million tonnes (Mt) of CO₂ from all activities in 1995 and about 1,000 Mt in 2000, the share of the cement industry to the total CO₂ emission increased from 4 percent to about 5 percent. The present annual growth rate of the industry (8 to 10 percent) and its trend suggests that the growth in CO₂ emissions might continue. The expected massive upsurge in the long-sought development of infrastructure in the coming years, however, may lead to a quantum jump in growth of cement capacity and production levels. This will provide opportunities to use the CDM to reduce CO₂ emissions on a large scale.

There are a number of ways in which the greenhouse gas "intensity" of cement could be reduced. Thus, cement manufacture could potentially be a fruitful target area for CDM projects.

The main steps in cement manufacture are (1) preparation of the raw materials, (2) production of an intermediate clinker, and (3) grinding and blending of clinker with other products to make cement. Clinker production is the most energy-intensive of these steps and is also the source of process CO₂ emissions, which can account for half or more of total emissions from cement manufacture.

5. $100 \times 5.41 \div (10 \times 251 \times 44 \div 12) = 0.06 \%$.

Potential CDM project types in the cement sector can be divided into two broad categories: energy-related and non-energy related. Energy-related GHG emissions from clinker manufacture could be reduced by doing the following:

- increasing the energy efficiency of cement production, e.g., optimizing heat recovery or installing an efficient pre-heater;
- changes in the production process, e.g., changing the process by which raw materials are ground, mixed, and fed into kilns from wet to dry; or
- changing the input fuel, e.g., using an increased proportion of waste fuels or other forms of renewable energy.

In addition, process CO₂ emissions per tonne of cement produced could be significantly reduced by blending (mixing) clinker with an increased proportion of other products (additives) in cement. This can be done in some cases without incurring significant incremental costs, and potential GHG reductions from cement blending may outstrip those from energy-efficiency projects by a significant margin.

To estimate the potential for GHG reduction from the cement sector, six scenarios are proposed to calculate accumulated CO₂ emissions from India's cement industry up until 2015. The scenarios are made under two alternative assumptions of growth in cement production: one is business as usual (BAU) at 8 percent and the higher end is at 12 percent. Two energy-efficiency scenarios are developed for each of these cases.

Table 2 presents the projected cumulative carbon emissions from 2000 to 2015 under the six scenarios with BAU and high growth rates in cement production. With a BAU growth rate in cement, an emissions reduction of around 10 percent is possible by undertaking a conservative energy improvement strategy. A reduction of emissions of around 27.5 percent can be achieved by the end of 2015 by adopting a more rigorous target for energy-efficiency improvement. With a high growth rate in cement production, however, total emissions with BAU energy-efficiency measures would reach 2,255 Mt of CO₂, which can be reduced to around 1,925 Mt with a conservative energy-efficiency improvement program. A higher energy-efficiency target would aid in bringing down these emissions by around 31 percent to 1,556 Mt of CO₂. In both growth-rate scenarios, cumulative process-generated emissions are found to be higher than emissions from energy use. The process-generated emissions in the high-growth scenario are around 60 percent higher than in the BAU scenario.

Increasing efficiency in the construction industry by optimizing the use of materials as well as by implementing technologies that use less energy-intensive materials could be important in reducing CO₂ emissions. The use of conventional construction techniques has the potential and technologies available to reduce the use of energy-intensive materials, thereby reducing CO₂ emissions. The gain in terms of emissions reduction through the use of these techniques, which use less brick and cement, is around 21 percent.

Generally, less energy-intensive techniques are more labor-intensive. In a country like India, where cheap labor is widely available, less energy-intensive techniques can be used. This will have the dual advantage of reducing construction-related emissions while generating employment.

Table 2. Total CO₂ emissions from 2000 to 2015 in the six scenarios, in millions of tonnes^a

Year	BAU growth in cement				High growth in cement			
	BAU ^a	Scenario I ^b	Scenario II ^c	Process-generated emissions	BAU_H ^d	Scenario III ^e	Scenario IV ^f	Process-generated emissions
2000	43.63	42.90	41.07	68.57	47.67	45.47	43.63	72.23
2001	90.93	88.73	84.33	143.00	100.47	95.70	90.93	152.53
2002	141.53	137.50	129.07	223.30	160.23	151.80	142.27	242.37
2003	196.17	189.93	176.37	309.83	227.70	214.50	198.73	343.93
2004	254.83	245.30	225.13	403.33	304.33	285.27	261.43	459.43
2005	317.17	303.97	275.73	503.80	391.97	365.20	330.73	590.70
2006	384.27	366.30	328.53	612.33	492.07	456.13	407.37	740.67
2007	456.50	432.67	383.90	729.67	606.10	558.43	492.43	911.53
2008	534.23	503.80	441.47	856.17	736.27	674.30	586.30	1,104.77
2009	618.57	580.07	502.33	993.30	883.30	804.10	690.07	1,324.03
2010	709.50	661.47	565.77	1,141.43	1,050.13	950.03	803.73	1,571.17
2011	808.50	749.47	633.23	1,302.03	1,238.23	1,112.83	928.40	1,850.20
2012	916.30	844.80	704.37	1,476.20	1,450.17	1,295.07	1,064.80	2,163.70
2013	1,034.37	947.83	779.90	1,665.77	1,688.50	1,498.57	1,214.03	2,516.07
2014	1,163.43	1,059.67	860.57	1,871.47	1,956.17	1,724.43	1,376.83	2,910.60
2015	1,305.70	1,181.77	946.73	2,094.77	2,255.37	1,975.23	1,553.57	3,350.23

^aBAU = Business-as-usual (BAU) growth in cement production and BAU-specific energy consumption

^bScenario I = BAU growth in cement production and a conservative target for specific energy consumption

^cScenario II = BAU growth in cement production and an optimistic target for specific energy consumption

^dBAU_H = High growth in cement production and BAU-specific energy consumption

^eScenario III = High growth in cement production and a conservative target for specific energy consumption

^fScenario IV = High growth in cement production and an optimistic target for specific energy consumption

Using an elaboration of this model, Tiwari et al. (1996) have explored the possibilities of substituting cement for reducing CO₂ emissions and increasing employment. This shows that the potential for substitution is large and also that the potential for CDM projects is large and quite varied.⁶

3.2. Wind power

a. Potential for wind power in India

A comprehensive wind power program was launched in India in the mid 1980s. Active involvement of electric utilities and industry has led to the creation of an industrial base and infrastructure that has contributed to the large-scale commercial development in this sector. India is now recognized as a leading country in the world for the development and utilization of renewable energy, particularly wind power. In fact, wind power generation has emerged as one of India's most successful programs in the renewable energy sector.

6. The substitution of cement is discussed in detail later in the paper.

India's wind power potential was assessed at around 20,000 megawatts (MW) by initial estimates (TERI 2000). It has since been re-assessed at 45,000 MW, assuming 1 percent of land availability for wind power generation in potential areas (MNES 2003). The present exploitable technical potential is limited, however, to 13,000 MW, on account of the limitations of grid capacity in the state electricity grids, because penetration of more than 20 percent could result in grid instability. The technical potential will go up with the augmentation of grid capacity in the potential states.

With an installed capacity of over 1,700 MW, India is the fifth largest wind power-producing nation in the world (MNES 2003). Most of this capacity, 1,639 MW, has come about through commercial projects from private investment. Based on the experience gained so far, the addition of another 1,500 MW of wind power capacity is planned during the nation's tenth five-year plan (2002–2007). The GHG savings accrued from using renewables must be examined in comparison to corresponding electricity generation from fossil fuel-based power plants.

b. Baseline determination

Thermal power plants are direct sources of GHG emissions in the power generation sector, whereas hydro and nuclear plants do not contribute (directly) to GHG emissions. Thus performance analysis of thermal power plants is essential to more accurately estimating an emissions baseline for wind power projects. The performance of thermal power plants varies widely, even among those of the same type and using the same quality of fuel and technology. The parameters that influence the emissions of individual plants essentially involve the type of fuel used; its heat rate, measured in kilocalories per kilowatt-hour (kcal/kWh) or specific fuel consumption; and auxiliary consumption of fuel. The availability of data on these parameters along with others is critically important for the accurate estimation of an emissions baseline.

CO₂ emissions from thermal power plants have been estimated here using (1) heat rate and (2) specific fuel consumption. Heat rate data followed by the specific coal consumption for the year 1996/1997 has been used. In cases where these values were not available, then the values of heat rates recommended in the Central Electricity Authority (CEA) norms were used. In the case of gas-based power plants, the heat rates provided in the CEA norms were used for estimation of CO₂ plant emissions. It is evident that use of these norms would lead to a conservative estimate of emissions, since in practice the heat rates or specific fuel consumption values for power plants are normally higher than the norm. Furthermore, the emissions resulting from secondary fuel consumption, in the case of coal power plants, is not used in baseline estimations, as they constitute only 2 to 3 percent of emissions from primary fuel.

The baseline CO₂ emissions for the northern, western, southern, eastern, and northeastern regions are estimated to be 1.07 kg/kWh, 1.02 kg/kWh, 1.02 kg/kWh, 1.38 kg/kWh, and 0.63 kg/kWh, respectively. Based on these estimates the CERs for wind power generation in India has been estimated and presented in table 3. The CERs that can be generated are nearly 82.59 million tonnes of CO₂ equivalent per year. This potential can be realized, however, only if an appropriate policy environment is created at local, national, and global levels.

Table 3. Certified emissions reductions (CERs) on the basis of the technical potential of wind power generation in India

No.	State	Region	Potential		Baseline emissions (kgCO ₂ /kWh) ^a	Certified emissions reductions per year	
			Gross potential (MW)	Technical potential (MW)		Gross potential (tCO ₂ eq.) ^b	Technical potential (tCO ₂ eq.)
1	Andhra Pradesh	Southern	8,275	1,750	1.02	14.79	3.13
2	Gujarat	Western	9,675	1,780	1.02	117.29	3.18
3	Karnataka	Southern	6,620	1,120	1.02	111.83	2.00
4	Kerala	Southern	875	605	1.02	1.56	1.08
5	Madhya Pradesh	Western	5,500	825	1.02	9.83	1.47
6	Maharashtra	Western	3,650	3,020	1.02	6.52	5.40
7	Orissa	Eastern	1,700	680	1.38	4.11	1.64
8	Rajasthan	Nothern	5,400	895	1.07	10.12	1.68
9	Tamil Nadu	Southern	3,050	1,750	1.02	5.45	3.13
10	West Bengal	Eastern	450	450	1.38	1.09	0.80
Total			45,195	12,875	1.38	82.59	23.52

^aKilograms of carbon dioxide per kilowatt-hour.

^bTonnes of carbon dioxide equivalent.

4. The issues

A complex institutional structure to implement the CDM is now in place in India, but a number of problems exist. These relate to the present paradigm, baseline setting, high transaction costs, the difficulties of getting small projects approved, the problem of getting a fair CER price in a world of asymmetric information, poor technology transfer, and the disincentives these provide for effective climate policy. Before we look at these issues, next we briefly describe the institutional set up.

4.1. The commercial paradigm

When joint implementation and activities implemented jointly (JI/AIJ) were first proposed, there was initially an element of cooperation and partnership between the developed and developing countries. Increasingly though, this arena is being left to market forces where the commercial approach is taken, such that CER buyers come only to purchase credits and do not participate in projects. In such a market-based framework, both sides need information and fair pricing and trade volumes to effectively sustain the markets. Some of the problems identified with the current paradigm are as follows:

- a. The onus of proposing CDM projects is on the host country, i.e., developing countries. In fact the entire burden—starting from filling out forms, to ensuring that projects meet all criteria, as well as getting projects certified and monitored—rests also on the developing countries. What was meant to be a cost-effective way of reducing the burden on the industrialized countries is turning out to be a transfer of that burden to developing countries, i.e., the seller of CER credits.

- b. There exists considerable asymmetry in information and bargaining power, so the outcome can be highly inequitable if the CDM project is not properly implemented.
- c. Developing countries are bound to reveal all of their costs to potential CER buyers from industrialized countries. On the other hand, not even minimal information is sought from the purchasing countries. As a result there is complete asymmetry in the system, where the industrialized countries (i.e., CER buyers) know details about the developing country's costs, while the industrialized countries reveal nothing about their own costs. The developing countries often do not have the vaguest idea about buyers' needs and costs. Fair markets cannot function in such an environment of asymmetric information, and sellers are left open to exploitation. Moreover, the entire consumer's surplus is likely to be kept by the industrialized countries, as there are no guidelines on sharing the benefits.
- d. Under the current procedure, there is no guidance about what amount needs to be paid to the developing country. While all the information is sought from the seller about costs, the seller does not know the *value* of it. For example, diamonds or crude oil are not sold at the cost of extraction; their value is another matter altogether.
- e. Most of all, a big potential buyer, the United States, is currently outside the system. If the US enters the market it is expected that the present market price of about \$5 per tonne of carbon could be \$25 per tonne.
- f. When it comes to local environmental governance, e.g., regarding air and water pollution, the rules in these very same countries are fairly strict and enforced on all, i.e., polluters must pay. When it comes to global pollution (GHG emissions), however, the rules are neither voluntarily accepted nor does a mechanism exist to discipline defaulters.
- g. Hundreds of CDM consultants, project advisors, traders, and certifiers are waiting in the wings to get a piece of the CDM pie by providing services. They should be paid fees on the basis of percentage of the surplus accruing to the developing country and not the stated value of their time. Only then will they work to get a fair deal for their developing country clients.

Should one rush to implement the CDM before the rules are fair and a system of global governance is established? One hopes that there is clarity about the system so that a fair and fast way to reduce emissions is established.

4.2. Baseline setting

For the trade in GHG credits between an Annex I country and a developing country the determination of a baseline has many pitfalls. As per the UNFCCC, developing countries do not have any GHG emissions reduction obligations nor any emission quotas. Any emissions reduction that qualifies for trade is measured from a hypothetical baseline.

If a national level baseline is decided, then that determines a national level quota, but developing countries are not willing to accept such commitments not required by the UNFCCC. There is yet another problem: What should be the economic growth rate on which the baseline is projected? While India's growth rate over the past decade has been a bit more than 6 percent per year, India aspires to a double-digit growth rate. This is not unrealistic. China has had such a rate of growth over a couple of decades.

India's baseline would be very different if a 6 percent growth rate is assumed instead of a 10 percent growth rate. If the baseline is set on the present trend growth rate of 6 percent, India's ability to grow faster would be compromised, which would be contrary to the spirit of the UNFCCC.

Baseline determination by sectors such as steel, cement, etc., have different problems. Painuly (2003) has shown how the guidelines presently in force lend themselves to different interpretation. For example, the range in CERs for a 60-MW wind power project in Zafrana, Egypt, was shown to vary from 1,475 to 1,843 for a ten-year credit period, depending on whether the average of all plants, the last five years' plants, or the most expensive plants were considered as being replaced. The Intergovernmental Panel on Climate Change (IPCC 2001a) reports that the range of uncertainty in estimates of emissions reduction—because of the counterfactual nature of the baseline (based on a number of AIJ energy sector projects)—to be between ± 35 percent and ± 60 percent, depending on the project type. Baseline determination also involves trade-offs between the transaction costs of certification, adjustments for increased emissions at other locations caused by the project (leakage), moral hazard, and changes over time in contextual economic, technological, and institutional conditions (IPCC 2001b).

It makes a big difference whether one takes average emissions, marginal plant emissions, or the emissions of the worst plant. The problem of baseline setting is also tied up with the problem of transaction cost. The choice between project-specific and multi-project approaches involves a trade-off between transparency, error, and transaction costs. The project-by-project approach results in relatively low error, but it can also lead to lower transparency and high transaction costs. On the other end of the scale, national-level benchmarks may result in high error but are also relatively transparent and involve low transaction costs. There is also a trade-off between environmental stringency and investor incentive. The greater the complexity of baseline methodologies, the higher will be the associated transaction costs and, consequently, the lower will be the incentive to develop and invest in CDM projects.

4.3. High transaction costs

Table 4 shows the transaction costs involved in reducing GHG emissions and the burden they impose on the host country, i.e., developing countries. It is also worth noting that under the system of CER trading, most of the costs of getting CERs certified fall on the host country. The purchaser merely comes and buys them after they are generated.

High transaction costs are particularly critical for small renewable energy projects, which otherwise have significant benefits for the host country. Absolute transaction costs are relatively independent of project size but would be proportionately lower for large CDM projects. For small projects, in particular, the transaction costs associated with a lengthy and elaborate project approval process could outweigh the benefits from the CERs generated (IEA/OECD 2001).

Administrative costs can be reduced by bundling similar small projects into a single project that is still eligible for fast-track procedures (e.g., bundling together 15 projects of 1 MW each).

Appropriately designed fast-track procedures can help improve administrative feasibility (including monitoring and reporting requirements) and reduce transaction costs, but they cannot completely eliminate such costs. Even with the use of simplified baselines and simplified project design documents,

registration and measurement and verification (M&V) costs would still need to be incurred. The development of simple and standardized baselines for renewable energy projects, however, will help developing countries like India maximize the potential opportunities available through the CDM by encouraging priority projects that meet national environmental and developmental goals, as well as technology needs. Simplification of baseline assessment for small projects is an important means of reducing the transaction costs for a CDM project.

Table 4. Transaction cost components

Transaction cost components	Description
1. Project based (JI, CDM): Pre-implementation	
Search costs (H)	<ul style="list-style-type: none"> • Costs incurred by investors and hosts as they seek out partners for mutually advantageous projects
Negotiation costs (H)	<ul style="list-style-type: none"> • Includes those costs incurred in the preparation of the project design document that also documents assignment and scheduling of benefits over the project time period. It also includes public consultation with key stakeholders
Baseline determination costs (H)	<ul style="list-style-type: none"> • Development of a baseline (consultancy)
Approval costs (H)	<ul style="list-style-type: none"> • Costs of authorization from host country
Validation costs (H)	<ul style="list-style-type: none"> • Review and revision of project design document by operational entity
Review costs (H)	<ul style="list-style-type: none"> • Costs of reviewing a validation document
Registration costs (H)	<ul style="list-style-type: none"> • Registration by the UNFCCC Executive Board/JI Supervisory Committee
2. Project based (JI, CDM): Implementation	
Monitoring costs (H)	<ul style="list-style-type: none"> • Costs to collect data
Verification costs (H)	<ul style="list-style-type: none"> • Cost to hire an operational entity and to report to the UNFCCC Executive Board/Supervisory Committee
Certification costs (H, I)	<ul style="list-style-type: none"> • Issuance of certified emission reductions (CERs for CDM) and emission reduction units (ERUs for JI) by the UNFCCC Executive Board/Supervisory Committee
Enforcement costs (H, I)	<ul style="list-style-type: none"> • Includes costs of administrative and legal measures incurred in the event of departure from the agreed transaction
3. Trading	
Transfer costs (H, I)	<ul style="list-style-type: none"> • Brokerage costs
Registration costs (H)	<ul style="list-style-type: none"> • Costs to hold an account in national registry

Source: PricewaterhouseCoopers 2000; Dudek and Wiener 1996.

4.4. Risks borne by the host country

In the CER trading regime almost all the risks—project risk, financial risk, baseline risk, price risk, CER market risk, and future price of CERs—are all borne by the project developer in the host country. The CDM is an activity full of risks and low margins for a host country. In going from the previous

cooperative-type ventures between North and South to commercial agreements, most of the risks have been gradually transferred to the host countries. These include the following:

- *Risk of project rejection.* The extensive preparatory work is not rewarded.
- *Risk of baseline reduction.* This reduces CDM benefits and compromises economic viability by reducing margins. Once the baseline is agreed, it should not be revised subsequently for the same project.
- *Financial risk.* The host country has to raise the capital. Fluctuations in interest rates pose risks, which have to be borne by the host country. Such risk may be high for a long-term activity like the CDM.
- *Risk of project failure.* Project failure risk is also borne by the host country if GHG reductions do not materialize due to unexpected circumstances. This can happen because of equipment failure, forest fires, and legal disputes on GHG savings.
- *Policy risk.* When government policy changes, project viability may be affected—a risk also borne by the host country.

4.5. Asymmetric information—Getting a fair price

Figure 1 shows what kind of price and gains could result from trading. In the figure, line OQ represents the amount of emissions reduction commitment of Annex I countries.⁷

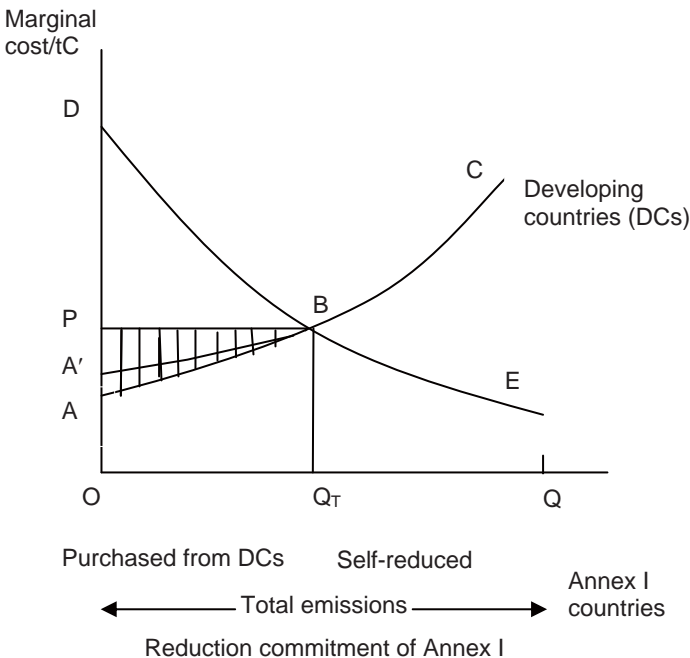


Figure 1. Carbon trading: Who gains what

7. Annex I countries are the industrialized countries and economies in transition listed in Annex I of the UNFCCC.

As the developing countries have many low-cost opportunities to save GHG emissions (the “low-hanging fruits”), their marginal cost-curve is relatively flat, as shown by curve ABC, which is a supply curve for CERs. For Annex I countries the marginal cost of abatement is given by EBD when reductions are measured from Q to O.

- Under a competitive market, B, Annex I countries will abate emissions themselves by the amount QQT, and the amount OQT will be traded at market price P
- Developing countries would get a producer surplus of area ABP
- Annex I countries will get a consumer surplus of PDB
- In a bilateral project-by-project negotiation, where the developing country project developers know little about the opportunity costs of Annex I country buyers, they are likely to get only AA'B. The rest will accrue to the industrialized country.

Painuly (2000) has argued that developing countries are likely to get only about 20 percent of the total producer and consumer surplus even in a competitive market, and much less under bilateral project-by-project trading.

Should the developing countries then not opt for such trading? That would be a wrong conclusion. If technical progress in the future lowers the demand drastically, then these low-hanging fruits would bring even less. The low-hanging fruits would then just appear to have rotted. In any case, money in the bank now is better than the same amount in the future. Developing countries, however, can themselves use these low-hanging fruits in the future, so their long-term opportunity cost may be higher than the short-term marginal cost. To account for such opportunity costs, they should insist on the development of a futures market, so one can know how much the low-hanging fruits are going to be worth in the future.

The developing countries should resist bilateral negotiations between project parties. This is because in the current system the entire details of CO₂ savings in the host countries are made public. The developed countries know fully the marginal costs of developing countries, but the developing countries do not know the true opportunity costs of developed countries. A well-functioning market, along with a futures market, is their best bet to get a good price, but development of such a market will take time. Meanwhile, a global carbon price floor should be announced for emissions trading, and all developing countries should not trade below this price. India may do so unilaterally for its own projects.

4.6. Perverse policy incentives

A major problem arises from the concept of *additionality* of costs and emission reductions. At present, only those reductions qualify that are not a part of the policy of a country. Thus, for example, if India takes a policy decision that 10 percent of new power generating capacity has to come from renewables, then a renewable power plant would not qualify as a CDM project. The same plant in another country that does not have such a policy can earn CER credits for it. There is, thus, a perverse incentive not to follow globally environmental responsible policy. It thus discourages a country like India from following environment-friendly policy and encourages countries to play strategic games.

For example, India has large potential for wind power generation, and the number of CERs that can be generated could be nearly 82.59 million tonnes of CO₂ equivalent per year, as shown in table 3. The

government's push for renewables may be motivated by a desire to not be too dependent on imported fossil fuels—and is in effect subsidizing this push in various ways. Disqualifying renewables from gaining CDM benefits punishes the very initiatives needed to create a supportive policy environment, a necessary condition for producing the desired multiplier effects. Therefore, policy decisions taken after ratification of the Kyoto Protocol should be exempt from such disqualifications.

4.7. Technology transfer

India's government has placed major emphasis on technology transfer. The reasons for linking the CDM with technology transfer are obvious. One of the major purposes of the CDM is to initiate the process of emissions reduction and awareness about the climate change problem in developing countries, but the project-by-project approach of the CDM may not lead to significant reductions compared to the large increases in emissions anticipated in developing countries. Thus, fossil fuel-efficient policies and processes should be institutionalized through technology transfer. To ensure this, each CDM project should have a training and capacity-building component built in to acquire CERs. A CER should be credited if efforts are expended in such a way that the developing country could operate and even replicate the technology. In the absence of this, incentives to bring in successively new technologies will not be there. In fact, "semi-efficient"—and not the very best—technologies might be repeatedly installed even in the same country but at different places. If the CDM allows profiting from technology diffusion, there will be a temptation to profit as much as possible from the same technology. Technology innovation needs to be ensured by considering how many CERs can be given for the same technology or up to what period, so that at the end of that period even better technologies may be introduced. One way to ensure this is by suitably changing technology baselines upwards gradually. Other concerns regarding the CDM could be that there will be greater demand for fossil-fuel saving technologies. This may increase the price of efficient technologies. Thus, "green" technologies may be more expensive, as they will be more in demand over "brown" technologies. To ensure their wide adoption—rather than making them expensive—there should be incentives such that they are adopted widely. If barriers are created around the projects and people are allowed to earn a premium, then rent-seeking behavior may occur (Parikh 1998).

For completeness, we summarize the various steps involved in the process of technological change and upgrading. The main components are need assessment, technology selection, technology transfer, utilization of technology to its designed performance, adaptation of technology to specific conditions, improvements in technology beyond its designed performance, and development of new technologies.

With this scheme in mind, let us now examine the issues relating to technology transfer and what kind is needed. So far, to a large extent, discussions on the transfer of environmentally-sound technologies have mirrored earlier debates centering on legal, institutional, and financial arrangements governing the access of developing countries to the technologies developed in the industrialized world.⁸ As a result a whole range of issues have been downplayed or ignored, such as the following:

8. Northern countries have generally stressed the need to ensure adequate financial compensation to inventors (i.e., recognition of IPRs); that technology be provided on non-concessional (commercial) terms; that the range of technologies under consideration be limited, in particular by separating the climate change convention from other issues; and a preference for working through existing institutions to channel funds to support technology transfer activities, particularly the GEF.

- the type of needs of a developing country
- the requirements of appropriate or better technologies to meet those needs
- the available expertise, i.e., the capacity building needed to ensure effective transfer
- the factors affecting adoption, assimilation, and adaptation of imported technology

A key constraint facing developing countries is the difficulty of matching their needs with appropriate technological solutions that reduce GHG emissions. These constraints are all the more binding in new and emerging fields where trends in technology development are uncertain, corporate secrecy prevails, and sources of supply may span several industrial branches.

In their early critiques of technology transfer, the developing countries focused mainly on reducing what they considered the excessive costs of technology transactions and the many restrictive clauses imposed on recipients by the suppliers. Increasingly, the focus of attention has shifted from the costs and characteristics of imported technologies to include the factors affecting the creation and maintenance of technological capabilities in developing countries.

Two factors are crucial in determining the extent to which technology transfer contributes to building indigenous technological capabilities. First is the intensity of contact between the supplier and the recipient. Active and ongoing contact between the two is crucial to the effective transfer of skills and knowledge. This does not mean that direct equity involvement of suppliers is essential. Far more important than the contractual form of a transfer is the extent of knowledge acquisition and training. Unfortunately, recipient firms and countries too often undermine or ignore training. The second factor in strengthening local capabilities is the strategic orientation of the recipient enterprise. These efforts require sound knowledge before transfer, a rigorous search for sources, and intensive participation at all stages of project planning and implementation.

Thus the ultimate goal of any action in the field of transfer of environmentally sound technologies should not be just to apply particular technological solutions, but also to enhance the capabilities of developing countries to assess their needs and then select, import, assimilate, adapt, and develop the appropriate technologies. This is a matter of enhancing “generic” technological capabilities rather than pursuing actions related to specific environmental technologies. In fact, provision for capacity building in the long run should be made mandatory in any technology transfer, with crosschecks built-in for verification.

Sound technology choice is the backbone of any strategy for effective international technology transfer. Unless developing countries have the proper knowledge to make informed choices among technological options, there is a risk that the efforts to promote international technology transfer may become overwhelmingly supplier-driven and geared more to transferring technologies that are available, rather than being geared to technologies actually required by developing countries. Among the disadvantages that developing countries face is the information available to them as well as their technical capacity to evaluate particular technologies.

To summarize, we need to think about potential answers to the following questions:

- What are the GHG-reducing technologies that may be most useful to developing countries?

- What are the various steps involved in effective technology transfer? How can they result in capacity building in developing countries?
- If technology transfer has generated significant capabilities, what are the barriers/factors militating against their widespread diffusion?

With this perspective, we see that the CDM is unlikely to bring any real and significant technology transfer unless special steps are taken. Also, pricing of technology is critical and we should try to introduce competition here. We suggest the creation of a technology acquisition fund for bringing in new technology and competitive pricing. Every CDM or JI project should be required to make a specific contribution to the technology acquisition fund of the host government, which is free to buy technology from anywhere in the world. This can not only moderate excessively high charges for technology but also bring in new technology.

5. Conclusion

What are the implications of this analysis? India has embraced the CDM and is now looking beyond small-scale projects such as renewables and thinking of large emissions projects in cement, power, transport, and so on.

In conclusion, the impacts on developing countries of the commitments of Annex I countries to comply with emissions reduction targets *prima facie* are marginal. Economies importing capital-intensive products from Annex I countries are likely to have adverse second-order impacts. In such a scenario, there is a case for increased South–South trade, with increased flows from countries with a large industrial base. Higher costs in Annex I countries will have a two-fold effect on developing economies in the long term: (1) more rapid evolution of their indigenous industrial base, and (2) positive environmental transitions that accompany development.

In order to make sure that even the few projects undertaken under the CDM promote sustainable development, host countries need to set up domestic institutions and build capacities to vet, approve, and monitor projects. This needs to be done in a way that does not create bureaucratic bottlenecks and hurdles that discourage projects. Maintaining a designated national agency office is likely to be an additional managerial burden on developing countries, which may be worthwhile for only handful of countries.

Mechanisms with well-defined rules and procedures with specified thresholds seem to be the most attractive. A country could even set a threshold price for CERs. The current CDM regime does not establish fair pricing, due to the asymmetry of information that host countries have about the purchasing countries. On the other hand, all details from the host countries are available to the purchasing countries.

Baseline determination should leave room for incentives. When a climate-friendly policy framework is created by a host country, it loses the benefits it would have enjoyed without that framework. This situation is problematic. All GHG-favorable policy decisions taken after 1997 should be rewarded rather than being disqualified from the CDM.

The high transaction costs of CDM projects preclude many small projects. This is a great handicap to developing countries, particularly small countries. Mechanisms need to be evolved to approve a bundle of many small projects at once.

Effective technology transfer through CDM projects requires special efforts. It's important to note that not all CDM projects involve high technology. A technology acquisition fund could be created in which all CDM projects are required to contribute. The host country could then use these funds to buy technology from anyone, not necessarily from the project sponsor.

The developing countries should realize this and try to make the best of a poor bargain. Trading in CERs is like trading any other commodity, and to trade in a commodity market requires expertise. Developing countries need to learn the CER trading game. To do so would require participation in the CDM. This capacity will be useful later.

In the end, developing countries have only one path to get a fair deal: Be economically strong, unite among themselves, and negotiate from strength. Only then, is the simplest solution of equitable allocation of global environmental space likely to be accepted by the world community.

The CER market for the foreseeable future will be a buyer's market. If "hot air" is traded too, it will be even more so; developing countries should therefore resist the inclusion of "hot air."⁹ They also should not compete with each other in a "race to the bottom."

A global system of fair allocation of tradable emission quotas for all is required. The only fair allocation of the global environmental space is on a per capita basis. The desirability of distributing permits (quotas) on a per capita basis is recognized at least in the long run (Manne and Richels 1993). The belief that "all men are created equal" was voiced eloquently in the US Declaration of Independence and was a message "heard around the world." If a new climate agreement is negotiated so that population counts are fixed in the year of that agreement, the South will not benefit from population growth thereafter, and the North will have an incentive to not procrastinate in negotiations—but to try to arrive at an agreement as early as possible.

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