

India, CDM and Kyoto Protocol

With the impending ratification of the Kyoto Protocol by Russia, the treaty will come into effect, marking a landmark event in efforts at climate change. It is clear that countries like India will be affected by any global architecture for greenhouse gas (GHG) abatement that emerges. Despite near-term uncertainty about the size of the clean development mechanism market and the price of certified emissions reductions (CERs), it is very likely that India will be a major player. In the long run India along with other developing countries may take on some commitments especially where emissions trading may be an important component of the GHG abatement architecture. It is, however, important that we understand and address the problems in using a market-based approach to environmental management in India, particularly with respect to monitoring and enforcement.

SHREEKANT GUPTA

On September 29, 2003 president Putin inaugurated the World Climate Change Conference in Moscow amid growing speculation that Russia was about to ratify the Kyoto Protocol (KP). The buzz in climate policy circles is understandable since Russian ratification implies the Protocol will come into effect, a landmark event in global efforts to address climate change (the scientific term for global warming). It will also mark an end to years of speculation on the fate of the treaty that has seen many ups and downs. In 1997, at Kyoto the world's industrialised countries had agreed in principle to cut their emissions of heat-trapping (greenhouse) gases or GHGs, mainly carbon dioxide (CO₂), by about 5 per cent from 1990 levels, over a five-year period from 2008-2012. In March 2001, however, soon after George Bush was sworn in as president the US announced it was pulling out of the agreement dealing what was perceived as a mortal blow. Since the US (with 4.5 per cent of the world's population) accounts for 25 per cent of the world's energy consumption and about 20 per cent of GHG emissions, it was believed that without the Prince of Denmark there could be no Hamlet. Nevertheless,

the European Union (EU) countries decided to go ahead and much attention has since been focused on making the Kyoto Protocol happen. In order to make the targets legally binding, at least 55 countries among 185 signatories to the UN Framework Convention on Climate Change (UNFCCC) have to ratify the Protocol. In addition, these must include industrialised countries (Annex I Parties to UNFCCC in climate-speak) accounting for 55 per cent of that group's carbon dioxide emissions in 1990. Since the US accounts for 36 per cent of Annex I emissions, Russia with another 17.4 per cent holds the key to ratification. Now that Russia has finalised the documentation needed to ratify the Protocol it seems only a matter of time before the treaty becomes a reality. Earlier, in September this year as the Russian Duma (lower house of parliament) reconvened after its summer break, the Russian deputy minister for Natural Resources, Irina Osokina was quoted as saying she saw no further obstacles to ratification by the Duma.¹

As the Protocol comes to pass, its so-called 'flexibility mechanisms', namely, emissions trading, joint implementation (JI) and the clean development mechanism (CDM) policies are being widely discussed in the context of GHG abatement. Both JI and CDM, are project-based

mechanisms that are included in the Kyoto Protocol under Article 6 and Article 12, respectively. JI enables countries with specific emission reduction targets under the Protocol (that is, the industrialised or 'Annex B' countries which were also referred to above as Annex I countries!) to obtain credit for implementing GHG reduction projects in other Annex B countries. CDM is broadly similar but pertains to GHG abatement projects implemented by industrialised countries in non-Annex B (or developing) countries such as India, China, Brazil, etc. Article 17 of the Protocol allows emissions trading among Annex B countries only. At present, countries such as India are not part of the emissions trading regime since it has no binding targets to reduce GHGs under the Protocol. In other words, the main mechanism by which developing countries figure in the Protocol is through hosting CDM projects.

Here we examine what all this means for India, particularly the linkages among these mechanisms. In the long-run whether developing countries (DCs) such as India will take on commitments to reduce GHGs and whether they will take part in a global emissions trading system is something that only time will tell. It is clear, however, that these countries will be affected by any global architecture for GHG abatement that emerges. In this context, this paper reviews recent developments (at the climate meetings of Bonn and Marrakesh and beyond) and the implications of these for India. It examines the market for KP flexibility mechanisms, particularly emissions trading and CDM. For instance, it has been argued in light of various concessions, the market for CDM projects will be small (compared to GHG emissions in developing countries) and that it will be characterised by low demand and low prices [Halsnaes 2002, Jotzo and Michaelowa 2002].

I GHG Emissions in India

It may be useful to briefly review the nature and composition of GHG emissions in India.² India has the world's second largest population and is the world's sixth largest emitter of carbon dioxide (CO₂). It is estimated that India emitted 908 million tonnes of CO₂ in 1998, 4 per cent of the world's total [UNEP 2002]. However, per

capita emissions of CO₂ are 0.93 MT per annum were well below the world average of 3.87 MT per annum. The rate of growth of GHG emissions in India is 4.6 per cent annually, compared to a 2 per cent world average.

The most recent and most comprehensive national GHG inventory for India was prepared under the Asia Least-cost Greenhouse Gases Abatement Strategy (ALGAS) project of the Asian Development Bank (ADB 1998). In sum, its main findings were: (i) on a CO₂ equivalent basis, CO₂ emissions account for 53 per cent of the total emissions, whereas methane (CH₄) and N₂O contribute 39 per cent and 8 per cent respectively; (ii) the energy sector is the main emitter of CO₂, accounting for 87 per cent of total CO₂ emissions, the rest coming from the cement industry (4 per cent) and land conversion (9 per cent), and (iii) biomass burning and agriculture sector are the main sources of CH₄ and N₂O emissions with a small portion contributed by the transport sector (TERI 2001).

Further, among sectors of the economy that account for CO₂ emissions from energy, prominent are fuel combustion in industry (41 per cent), electricity production (34 per cent) and transport (17 per cent). The main source of energy in India is coal mainly used for producing electricity and industrial energy requirements, and accounts for 62 per cent of CO₂ emissions. During 1990-95 emissions in electricity grew at 8.6 per cent annually and industrial sector emissions grew at an annual rate of 4.7 per cent.

With respect to CO₂ emissions, therefore, the focus of CDM projects (and/or emissions trading in future) has to be in electricity production, industry and transport. The industrial sector consumes about 50 per cent of the total commercial energy produced in the country. The most energy-intensive industries are fertilisers, iron and steel, aluminium, cement, and paper and pulp, collectively accounting for about two-thirds of total industrial energy consumption. There is significant scope for improving energy efficiency in these sectors as also in electricity production and transport [see TERI 2001 and RFI 2003 for details].

I Issues and Prospects for CDM

As mentioned earlier, under CDM, developed countries (or firms in those countries) can fund GHG abatement projects in developing countries where abatement costs are much lower. In turn, the developed countries receive credits

(‘certified emission reductions’ or CERs) that can be used to offset their emission reduction obligations [for details see Toman 2000, Karp and Liu 2000 and Babu 2003 among others]. There are two issues relating to CDM that are important in the context of incentive-based policies. First, CDM will be implemented on a project-by-project basis – the basic rationale for undertaking a CDM project is the difference in marginal abatement costs (MACs) between the host country and the Annex B country. A key feature of a market, however, is a competitively determined price that is missing under CDM.³ Thus, unlike a tradable permit market where inframarginal units of abatement are also sold at the prevailing market price, this may not always be the case under CDM and division of gains (the difference between MACs) could be an important issue for CDM projects. Some researchers have suggested that rather than receiving a competitive market price for emission reductions, developing countries may simply be paid the actual cost of abatement, perhaps with some markup [Chander 2003]. On the other hand, Babu and others (2003) posit that the total gains from CDM as well as the share of developing countries will depend on their relative bargaining power vis-à-vis developed countries. This result holds whether CDM projects take place between individual firms across countries or through bilateral negotiations between governments. Thus, while a project-specific basis for defining and creating CERs under CDM may imply bilateral transactions (between firms or governments), a situation where the host country is required to accept payment at its MAC (or a small mark up over it) is only one of a set of possible outcomes. The actual outcome would depend to a considerable extent on how well CDM itself is defined as an institution and how well market institutions (e.g., brokerage for secondary transactions) evolve.

The second issue vis-à-vis CDM as an incentive-based policy is that if developing countries took on emission reductions in future, implementation of low cost abatement projects (the so-called low hanging fruit) now would leave them with higher cost options later. As Karp and Liu (op cit), however, point out the main problem with CDM is not that the most lucrative projects would be taken up first (as they should be) but the possibility that the host country receives inadequate compensation. The latter of course, is a function of the way CDM is set up as argued above. Thus, if host countries could create

and bank their own CERs (if they thought the current price was too low) this would solve the problem.⁴ More fundamentally, the question facing developing countries in this context is whether to cash in on CDM opportunities now or to wait. In any event, it would perhaps be more desirable to have global emissions trading where developing countries such as India could sell their emission reductions at a competitive market price. This is discussed in greater detail below. In passing, it should be noted that even if competitive trade in emissions were not established, developing countries (other than energy exporters) would still benefit from the implementation of the Kyoto Protocol since international prices of fossil fuels would fall due to cuts in Annex B consumption [Babiker et al 2000]. This would facilitate faster economic growth in developing countries [Chander 2003].

We now turn to an examination of the likely nature and extent of India’s involvement in CDM activities. There have been several recent exercises post-Marrakesh to estimate CDM potential and likely prices of CERs [Chen 2003; Halsnaes 2002 and Jotzo and Michaelowa 2002]. The overall consensus of these studies is that the inclusion of sinks, hot air and withdrawal of the US have changed the picture considerably. Nevertheless, it is also agreed that a host of factors could lead to wide variations in future carbon quota prices and CDM potentials. Broadly, one may classify these factors as either affecting supply or demand in the market for CDM projects. For example, carry-over of assigned amount units (AAUs) by transition economies to the subsequent commitment period would reduce effective supply of hot air thus increasing demand for CDM projects (and price of CERs). A similar impact could work through the supply side if carry-over of CERs reduced the effective supply of CDM projects. Other factors that could impact on CDM would be the extent of domestic action in Annex B countries, the extent of market power exercise by Russia and Ukraine, transactions costs, and such like. We do not go into details of these scenarios but refer the reader to the studies cited above. As an illustration of the impact of these factors, however, Jotzo and Michaelowa (2002) estimate in their standard case about one-third (32 per cent) of effective emission reduction requirements of 1.2 Gt/CO₂ per year would be met through CDM projects at a price of US \$ 3.78 per tonne of CO₂.⁵ But in the same study the share of CDM in the global carbon market could vary

from as much as 44 per cent to 15 per cent across different scenarios. Similarly, the international price of CO₂ according to the study could range from US \$ 6.24 to US \$ 1.33 per tonne of CO₂ depending on the assumptions used. As and when the Kyoto Protocol comes into force and as negotiations for the second commitment period commence and unfold, it will become clearer which of these scenarios will prevail.

Irrespective of this, the relative ranking of marginal abatement costs and transactions costs will most likely determine the distribution of CDM projects across countries. Thus, countries that rely heavily on coal for their energy needs and/or countries where the major energy users (e.g., power plants and heavy industries) are relatively energy-intensive and inefficient would have the greatest potential for large and cheap CDM projects [Jotzo and Michaelowa op cit]. By this token, both China and India can expect a relatively large share of the CDM market – together, they are projected to account for about 60 per cent of non-sink CDM projects (47 per cent and 12 per cent respectively). It is, therefore, certain that whatever the nature and scope of CDM projects that emerges globally, major coal-based GHG emitters such as China and India will play an important role.

Sector-specific studies conducted for India indicate a significant potential for CDM projects in the power sector and in enhancing energy efficiency in industries (to the tune of about US \$ 1.05 billion each) over the next decade [CRISIL 1999]. The investment potential for CDM projects in the transport sector is estimated at US \$ 23.5 billion over the same period (op cit). In contrast, non-CO₂ gases such as methane that are an important constituent of GHG emissions (39 per cent), come from widely dispersed sources mainly in the agricultural sector. Thus, livestock and paddy cultivation account for 42 per cent and 23 per cent, respectively of total methane emissions in India. It is generally believed given the dispersed nature and small size of such sources, they will not be cost-effective as CDM projects.

I **Looking beyond CDM: Equity and Tradable Permits**

In the short-run, if emissions trading among Annex B countries is realised (under the Kyoto Protocol or otherwise) India would stand to gain even if it remained outside such an arrangement, at least during

the initial commitment period. As noted earlier, a decrease in fossil fuel demand by industrial countries triggered by cuts in CO₂ emissions would lead to a reduction in world energy prices and benefit major energy importers such as India [Babiker et al, 2000]. In effect this would facilitate faster economic growth in developing countries other than energy exporters [Chander 2003]. In addition, developing countries such as India also stand to gain through arrangements such as the CDM.

Looking at the long-term horizon, international negotiations to decide on the architecture of GHG abatement regime beyond 2008-2012 will start in earnest by 2005. Even though India's annual per capita emissions are well below the global average, in the aggregate its emissions are large and growing rapidly. Thus, it is quite likely that India in particular (and developing countries in general) will have to take on some commitments to reduce GHG emissions. In fact, some experts have argued "the size of its (India's) aggregate emissions makes its participation in any future developing country commitment regime a *foregone conclusion*." [Sagar 2002, p 3925, emphasis added]. If India decided to accept a voluntary national commitment (which is what it would need to do to participate in Article 17 emissions trading) the basis for establishing this commitment would be vital. In addition to the widely discussed (but unlikely) per capita criterion another possibility would be a 'growth baseline'.⁶ It could also retain the option just to participate in project-based credit trading. In the long-run, however, there would have to be some international consensus on allocation based on equity, however that were defined. Cazorla and Toman (2000) provide a useful survey of various concepts of equity and how these concepts could be applied in the context of climate change. According to them, while the concept of equity can be interpreted in many ways, "any criteria that might be used to distribute current and future burdens of GHG mitigation *must be based, explicitly or otherwise, on some concept of equity*" [op cit: 5, emphasis added].

In particular, an allocation based on the per capita rule would give India permits in excess of its actual emissions much like Russian "hot air", which would be a financial windfall, at least in the short run.⁷ For instance, on the basis of the per capita criterion, India could potentially increase its emissions in 2010 by 722 per cent over the 1990 level [Gupta and Bhandari 1998, Table 6]. Actual emissions, however, may

not increase even three times over the same period.⁸ This creation of Indian "hot air" may not be acceptable internationally and some compromise may be required.⁹ As an extreme case, if all developing countries were successful in obtaining more emission allowances through a per capita criterion than what a 'no-regrets' baseline would provide, huge amount of tropical hot air would be generated undermining the UN Framework Convention on Climate Change [Philibert 2000]. Even if a tighter cap on global emissions were agreed upon but allocated on a per capita basis, large financial transfers could result from countries with actual per capita emissions above this allocated level, to countries with actual per capita emissions below it. It is unlikely that there would be international consensus on such transfers.

In this context, however, it should be mentioned that such worse case scenarios may not come to pass. For instance, as we argue below technical progress in abatement technology may depress permit prices and revenues for the South. Similarly, experience with the US sulphur dioxide trading programme and with the nascent GHG market have led some to predict that prices for GHG permits will be below US \$10 per tonne of CO₂ in 2010 [Springer and Varilek 2003]. Thus, resource transfers to developing countries associated with emissions trading will be relatively low.

A recent study by Leimbach (2003) provides new insights on how the equal per capita allocation principle of emission rights influences the intertemporal path of emissions and the distribution of mitigation costs in the long run. For a variety of assumptions, the study shows that several developing countries (particularly India and those in sub-Saharan Africa) could benefit considerably from joining an international emissions trading system, thereby becoming potential collaborators in post-Kyoto climate agreements. The important variables considered are: (i) the point in time at which a complete per capita distribution of emission rights is realised (that is, early as in the year 2025 or late as in the year 2100), (ii) the share of allocated emission rights that can be sold (all or sale is limited to 30 per cent), and (iii) the portion of emissions that can be covered by purchased emission rights. As expected, the highest gains for African countries and for India arise if the per capita rule takes effect sooner than later (op cit).

This result is corroborated by an earlier study by Manne and Richels (1995) that compares the impacts of a faster and slower

a large potential buyer such as the US came on board later. With fungibility across flexibility mechanisms and with eventual participation of India in an emissions trading regime, the CERs could be merged and traded along with permits. Thus, notwithstanding the vexatious problem of initial allocation of permits, it is possible to view India's participation in CDM activities as a bridge to taking part in full-blown emission trading in future.

Another way to think about long-run convergence of CDM and emissions trading would be to approach the issue from the other end, that is, to examine how a system of international emissions trading would be implemented by India, if it were to participate. Presumably, total permits allocated to India, howsoever this allocation were determined, would have to be distributed internally. If these permits were not sold, auctioned or grandfathered (or otherwise distributed in some hands-off manner) to firms, but instead were given away by the government to firms on a case by case basis in return for specific GHG abatement activities (with surplus permits retained by the government) this would de facto become a project-based mechanism. In effect, then the government could convert its (presumably generous) emissions cap into an 'exactly fitting cap' domestically and attain it through CDM type project-based mechanisms.

With regard to convergence in the short-run, as argued earlier both India and China offer the greatest scope for a large class of CDM projects. But is also true in general that countries with stronger institutions and better capacity for CDM, with a more streamlined project approval process and lower transaction costs would have a competitive edge in acquiring and implementing CDM projects. Thus, it is these areas that India should focus and improve upon and this is where CDM and emissions trading could be linked in the short-run.

A possible organising principle here would be to conceive of CDM projects as broadly and at an aggregate level as possible. For instance, an umbrella CDM project for abating GHG emissions for coal-based thermal power sector as a whole could lower transaction costs and also garner a large flow of funds. There could be two possibilities here. First, an aggregate reduction in emissions could agreed upon ex ante (say by an association of industry or power producers) on the basis of specific interventions that are already under consideration such as improved operation and maintenance, coal washing and use of better coal, and employing energy

efficient conversion technologies such as boilers, integrated gasification combined cycle (IGCC) and pulverised fluidised bed combustion (PFBC). [See TERI 2001 for details on these technologies and their CDM potential]. The umbrella project then in turn could be implemented by instituting emissions trading or some other flexibility mechanism domestically across the power plants. At the plant level, actual reductions in GHG emissions could comprise a combination of specific interventions mentioned above. However, there would be flexibility in using specific technologies across plants and over time. Better information on costs and technology could alter the mix of measures that plants instituted. Further, as with all market-based instruments this approach would not require knowledge of plant specific marginal abatement costs – each unit would on its own adopt the most cost-effective combination of technologies. Thus, an umbrella approach would offer several advantages over a 'project by project' approach where each project at each plant is scrutinised and approved individually. For one, it would save time and lower transaction costs. Second, depending on the scale of the umbrella project the CDM funds acquired could also be substantial.

A second possibility would be for the plants (or an entity acting on their behalf) to collectively and ex post present an aggregate amount of emission reduction as a CDM project. In other words, projects undertaken in consonance with CDM procedures could be aggregated and collectively put up for consideration for CDM funding. While less flexible than the ex ante approach, this would still reduce transaction costs associated with case-by-case approvals and funding.

Another advantage of an umbrella approach both in the ex ante and ex post variants, would be that it would facilitate collective bargaining, and prevent individual project proponents from undercutting each other. While it may not be easy to achieve all these objectives, this suggestion is worth examining in greater detail. An important issue here would be the agency that would play the role of a coordinator or facilitator. Likely candidates could be the designated national authority (DNA) under CDM guidelines, industry associations or financial institutions. For instance, depending on the scale of the

umbrella project financial institutions could implement such CDM projects unilaterally and get them funded later. This would be particularly useful for a collection of small projects that may be too small in themselves and may not have the resources to go through the CDM approval process.

Likely CDM scenarios with respect to the number of buyers and sellers may be summarised in a stylised manner below (Table). While there may be a continuum of buyers and sellers we simplify this into two categories – 'many' and 'few'. Collective bargaining may be particularly relevant if there were many firms offering CDM projects within India but a few international funders, that is, the monopsonist market outcome. A situation with many 'buyers' and 'sellers' would be somewhat similar to emissions trading where CERs could be traded in something resembling a tradable permits market.

Finally, an umbrella approach would avoid an ad hoc and eclectic portfolio of CDM projects that could result if these were taken up on a case by case basis. In the latter, the DNA would simply be in a reactive rather than a proactive mode. Whereas in the former it (or other agencies such as industry associations working under its guidance) could guide the process such that India maximised its share of CDM projects.

Thus, in the short-run (first commitment period) too there may be convergence of a different kind, namely, combining CDM internationally with emissions trading domestically. The experience with the phaseout of ozone depleting substances (ODS) under the Montreal Protocol may be instructive in this regard. Both India and China were major producers of ODS and thus eligible for funding of ODS phaseout projects under the Multilateral Fund (MF). The typical approach would be for individual projects to be screened by national steering committees on and forwarded to the MF secretariat for funding on a case-by-case basis. In the case of China, however, for some sectors such as halon producers a sectoral approach was adopted and funding for an umbrella project was obtained. In turn, a tradable permit scheme was initiated domestically for phasing out production of halons. (See 'Sector Plan for Halon Phaseout in China' at <http://www-esd.worldbank.org/mp/whatsnew/fin-ap97.shtml> for details.) It is likely that a




Table 1: Likely CDM Scenarios

CERs	Many sellers	Few sellers
Many buyers	'emissions trading'?	Monopolist market
Few buyers	Monopsonist market	Bilateral bargaining

more comprehensive approach rather than forwarding projects on a case-by-case basis enabled China to garner more funds from MF than India.

With regard to monitoring, enforcement and verification, both CDM and emissions trading throw up their own challenges. The nature of the problem would be quite different for CDM projects approved and implemented on a case-by-case basis, than for sectoral or umbrella CDM projects. For the former, elaborate guidelines and procedures have been specified. In the latter case, the nature of monitoring and enforcement would be similar to market-based instruments (MBIs) in general. (For a detailed examination of these issues see Gupta 2003).

V Conclusions

Despite near-term uncertainty about the size of the CDM market and the price of CERs, it is very likely that India will be a major player. This is also true in the long run where India along with other developing countries may take on some commitments and where emissions trading may be an important component of the GHG abatement architecture. While there are several issues of concern such as the impact of technical progress in abatement technologies on the gains from emissions trading for India, on the whole it may stand to benefit from participating in such trading. Further, there are good prospects of convergence across CDM and emissions trading both in a short-run and in the long-run. It is, however, important that we understand and address the problems in using a market-based approach to environmental management in India on the whole, particularly with respect to monitoring and enforcement. 

Notes

- 1 "All the documents are ready for ratification, they are currently with the government," Osokina told reporters. "The Duma has to conduct three readings, and I cannot say how this will go as I am not a member of parliament, but I do not think that the Duma will reject it." (News agency reports, September 5, 2003.)
- 2 For a detailed discussion on India's emission inventory see Garg and Shukla (2002).
- 3 Some modelling exercises, however, treat the flexibility mechanisms as fungible and assume CERs will be traded in a perfect international market along with other carbon emission credits such that there is a single global price [Jotzo and Michaelowa 2002]. While this assumption may be useful in estimating likely prices under different model scenarios, until the Kyoto Protocol comes into force and CDM projects

start getting implemented widely, it is not clear what will exactly happen. We come back to this issue later in the paper.

- 4 It is a moot point whether additional 'low fruit' opportunities would keep arising. This would happen only if convergence of technologies between North and South did not occur. This (lack of convergence) seems unlikely especially with deregulation and globalisation taking place in several economies in the South particularly India and China. Most of the old technologies in the energy intensive sectors in the South (power and transport for example) are being replaced by state of art technologies. Therefore, it seems more plausible to view the 'low fruit' as a one time opportunity.
- 5 As stated earlier, in this study the international price is same across the flexibility mechanisms due to fungibility of credits.
- 6 This is an approach to developing country emissions commitments that would not cap emissions in absolute terms but would require countries to increase their GHGs emissions at a slower rate than their economies [Hargrave and Helme 1997]. In other words, *emission intensity* (the ratio of GHG emissions to gross domestic product) would decline – very much like the Clear Skies Initiative announced by president Bush in February 2002.
- 7 Some writers refer to this as 'tropical hot air' since it originates in developing countries [Philibert 2000]. In general, hot air implies giving allowances for emissions that could be reduced at no cost.
- 8 In calculating per capita entitlement in year *t*, population is not pegged at some reference year but is taken at the actual level that prevails in year *t*. Thus, India with an increasing population gains disproportionately as compared to countries such as China that have stabilised their population. The "hot air" that India would acquire would be less if the reference population level were fixed at year 1990 or 2000.
- 9 In this context, it should also be noted that China's emissions are projected to roughly double (from 833 Mton in 1990 to about 1800 Mton in 2010). However, under the per capita criterion it can increase its emissions by 162 per cent over the same period (Gupta and Bhandari op cit, Table 6). Thus, it does not stand to gain as much by creation of "hot air" and may therefore be a less enthusiastic supporter of allocations on a per capita basis.
- 10 It can be easily verified that an alternate allocation rule such as OSS to the South (in effect covering the South's baseline emissions) would lead to less loss in revenue to the South from technical progress.
- 11 "...with an exogenously set global budget allocated by the per capita rule with a consequent large redistribution of global permanent income towards the South, inhabitants of the South would lose from technical progress *wherever in the world it takes place*." (Bertram op cit, p 480, emphasis added) It is important to note that as a permit exporter the South would also be a net loser from technical progress in the North alone or from uniformly diffused technical progress. Thus, given the possibility of technical progress it would be better for the South to opt for a more conservative quota allocation rule such as one that covers its business-as-usual emissions – that is, a NRFTS (no-regrets for-the-South) rule.

References

- ADB (Asian Development Bank) (1998): *Asia Least-Cost Greenhouse Gases Abatement Strategy*, Asian Development Bank, Manila and United Nations Development Programme.
- Babiker, Mustafa, J M Reilly and H D Jacoby (2000): 'The Kyoto Protocol and Developing Countries', *Energy Policy*, 28, 525-36.
- Babu, P G, K S Kavi Kumar and B Saha (2003): 'Clean Development Mechanism: Issues and Options' in M Toman, U Chakravorty and S Gupta (eds) *India and Global Climate Change: Perspectives on Economics and Policy from A Developing Country*, Resources for the Future Press, Washington DC.
- Bertram, I Geoffrey (1996): 'Tradable Emission Quotas, Technical Progress and Climate Change', *Environment and Development Economics*, 1(4), 465-87.
- Cazorla, Marina and M Toman (2000): 'International Equity and Climate Change Policy', *Climate Issues Brief No 27*, Washington DC: Resources for the Future.
- Chander, Parkash (2003): 'The Kyoto Protocol and Developing Countries: Strategy and Equity Issues' in M Toman, U Chakravorty and S Gupta (eds) *India and Global Climate Change: Perspectives on Economics and Policy from A Developing Country*, Resources for the Future Press, Washington DC.
- Chen, Wenying (2003): 'Carbon Quota Price and CDM Potentials after Marrakesh', *Energy Policy*, 31, 709-19.
- CRISIL (1999): 'Investment potential for the Clean Development Mechanism in India': Confederation of Indian Industry, New Delhi.
- Halsnaes, Kirsten (2002): 'Market Potential for Kyoto Mechanisms – Estimation of Global Market Potential for Cooperative Greenhouse Gas Emission Reduction Policies', *Energy Policy*, 30, 13-32.
- Hargrave, T and N Helme (1997): 'Growth Baselines: Reducing Emissions and Increasing Investment in Developing Countries': Centre for Clean Air Policy, Washington DC, October (re-issued January 1998).
- Garg, Amit and P R Shukla (2002): *Emissions Inventory of India*, Tata McGraw-Hill Publishing Company, New Delhi.
- Gupta, Shreekant (2003): 'Incentive-Based Approaches for Mitigating Greenhouse Gas Emissions: Issues and Prospects for India' in M Toman, U Chakravorty and S Gupta (eds) *India and Global Climate Change: Perspectives on Economics and Policy from A Developing Country*, Resources for the Future Press, Washington DC.
- Gupta, Sujata and P M Bhandari (1999): 'An Effective Allocation Criterion for CO₂ Emissions', *Energy Policy*, 27, 727-36.
- Jotzo, Frank and Axel Michaelowa (2002): 'Estimating the CDM Market under the Marrakech Accords' *Climate Policy*, 2, Issue 2/3, 179-96.
- Karp, Larry S, and Xuemei Liu (2000): 'The Clean Development Mechanism and its Controversies' Working Paper No 903, Department of Agricultural and Resource Economics and Policy, University of California at Berkeley.
- Leimbach, Marian (2003): 'Equity and Carbon Emissions Trading: A Model Analysis', *Energy Policy*, 31, 1033-44.
- Manne, A and R Richels (1995): 'The Greenhouse Debate: Economic Efficiency, Burden Sharing

- and Hedging Strategies', *Energy Journal*, 16, Issue 4, 1-37.
- Philibert, Cedric (2000): 'How Could Emissions Trading Benefit Developing Countries' *Energy Policy*, 28, 947-56.
- RFI (Resources Futures International) (2003): 'The CDM: Risks and Issues for Indian Industry' (Draft, January 2003) Submitted to Department of Foreign Affairs and International Trade, Government of Canada.
- Sagar, Ambuj (2002): 'India's Energy R and D Landscape: A Critical Assessment', *Economic and Political Weekly*, September 21, 3925-34.
- Springer, Urs and M Varilek (Forthcoming): 'Estimating the Price of Tradable Permits for Greenhouse Gas Emissions in 2008-12', *Energy Policy*.
- TERI (Tata Energy Research Institute) (2001): 'Clean Development Mechanism Project Opportunities in India', TERI, New Delhi.
- Toman, Michael A (2000): 'Establishing and Operating the Clean Development Mechanism', Climate Issues Brief No 22, Resources for the Future, Washington DC. Accessed at http://www.rff.org/issue_briefs/PDF_files/ccbrf22_Toman.pdf