How Much ‘Carbon Space’ Do We Have? Physical Constraints on India’s Climate Policy and Its Implications

It is necessary to determine the role of various nations, including India, China and the other major developing countries in keeping the total atmospheric stock of greenhouse gases below 450 ppm (carbon dioxide equivalent) which, in turn, would provide a 50% probability of keeping the global temperature increase below 2°C.

An analysis of future emissions of CO₂ in Annex I countries, large developing nations and other nations is done using a GAMS-based emission model. This analysis underlines sharply the historical responsibility of the developed nations for global warming and their duty to cut emissions drastically to mitigate climate change. Also large developing nations like China and India also need to contribute strongly to mitigation. It is argued that this necessity makes evident that carbon offsets will act as “double burden” on developing nations, as also a major disincentive to innovation in critical migration technologies in the industrialised world. The analysis implies that India needs an alternative climate policy that recognises proactive action for climate change mitigation while ensuring that the developed nations do not pass on their burden to the global South, which would otherwise seriously restrict its development options in the process.

1 Introduction

We take the attitude in this study that considerations of climate change policy must begin with the essential facts related to tolerable emission limits for greenhouse gases (GHGs), most particularly carbon dioxide (CO₂). This is above all a consideration founded on social and ethical grounds, recognising that within the parameters of our current state of scientific knowledge, unchecked emissions would lead to levels of global rise of temperatures and other effects that would have profoundly negative social, economic and political consequences.

The majority of uncertainties regarding the science of climate change are related to the relative importance of various effects that would accelerate climate change to a greater or lesser degree. Over two decades no results have emerged that point to any natural effects that could have the net effect of decelerating the currently observed rate of global warming that is primarily driven by GHG emissions originating from human activity. There is of course greater uncertainty regarding the extent to which nature and human society could adapt to climate change but all evidence suggests that adaptation is not unlimited and that global warming would have serious negative consequences.

The second pertinent fact is that the current stock of GHG in the atmosphere, particularly CO₂, has already set global temperatures rising. The current concentration of CO₂ in the atmosphere is approximately 379 parts per million (ppm) as of 2005. For 2008, the global average is about 385 ppm (Carbon Dioxide Information Analysis Center 2009). The concentration of GHG including CO₂ and other gases (measured in terms of CO₂ equivalence) that would lead to a temperature rise of 2°C (with 50% probability) is of the order of 450 ppm (with approximately 400 ppm due to CO₂).

It is uncontested that the bulk of the GHGs have been put there in the atmosphere by the industrial production and consumption patterns of the developed countries and that the first move towards reducing global emissions significantly must come from the developed nations (United Nations Framework Convention on Climate Change 1992). Even if this has not yet been translated into definite and binding quantum of emissions reductions by the governments of the developed nations, the European Union’s climate policy proposals1 for instance have clearly recognised this necessity.

However, the crux of the issue is whether the developing countries also need to cut their emissions, over and above the cuts by the developed countries in order to keep GHG concentrations below the 450 ppm threshold. If indeed the answer to the first...
question is yes, we also need to know the extent of these cuts, whether there need to be absolute cuts in emissions or a deceleration of the rate of growth of emissions. We also need to know over what timescales these emissions cuts or declines of rates of growth should become operational.

The urgent need to find answers to these questions is obvious. The first is that with current levels and forms of technology and with the urgent requirements of development and growth in developing countries, emissions from developing countries will inevitably rise. Second, there is currently little evidence that new technologies are immediately available for large-scale deployment such that developing countries can access a development pathway that can be significantly different from the ones that advanced countries took to reach their current levels of economic and social well-being. Thus emissions-intensive current technologies continue to remain relevant in the short and even the medium term. Third, even with existing technologies, there are a number of economic and political factors that limit access to the “best” currently available technologies that have lower emission characteristics. To create the conditions for successful and widespread deployment or the diffusion of these “best” available technologies will itself need sufficient length of time. Since development obviously cannot be slowed down in the interim, emissions will continue to rise on this count also. It is clear therefore that developing countries need to know the extent of “carbon space” that is available to them without accelerating the approach to some “tipping point” for serious climate change impacts that would have the most negative consequences primarily for the developing nations.

It is relevant to emphasise here that despite the per capita emissions from developed countries being much, much lower than the per capita emissions of developed countries, global warming is driven by the total stock of GHGs in the atmosphere, particularly CO₂. Nor is it possible to scrub the bulk of the existing CO₂ in the atmosphere for the prescribed scenario. The first reservoir is the quantity of interest to us. The parameters being factored in at a later stage by somewhat different techniques. In order to compare with emission limits based on all GHGs expressed in CO₂ equivalent terms, we will later indicate the extra contribution expected from non-CO₂ emissions. But we will not model them explicitly in the results described here.

We now briefly sketch some aspects of the GAMS model. The model consists of two parts. The first part describes a simple carbon cycle that describes how emissions of CO₂ are distributed as stock over time between three reservoirs that we will call Atmosphere, Upper Ocean and Lower Ocean. The stock of CO₂ in the first reservoir is the quantity of interest to us. The parameters in this carbon cycle model are closely related to the ones used by W H Nordhaus in the Dynamic Integrated model of Climate and the Economy or DICE model (Nordhaus 2007). Using this carbon cycle we can determine the increase of CO₂ concentration in the atmosphere due to the emissions. In the second part we begin with the emissions in the year 2008 and allow it to evolve using the prescribed scenario. The GAMS linear programming solver then optimises an objective function that sums the deviation of the concentration for every year from the target value of CO₂ concentration (in ppm) that we have set over the entire 100-year period. The corresponding values of the emissions and concentrations for every year that we obtain with the emissions trajectory are distributed over a time period of 50 years.

2 The Model
We now describe the overall strategy for a GAMS-based emissions model that would enable us to determine the “carbon space” available to developing countries over a time period of 50 years. In this model we begin with the current data on emissions and rate of growth of emissions. These are restricted to CO₂ for reasons that we will discuss shortly. The rates of decline of emissions for Annex I countries are then prescribed for the period between 2008 and 2050. In various scenarios we prescribe the general behaviour of the growth and subsequent decline of the emissions of the developing countries. For a target value of the concentration of CO₂ we allow GAMS to determine the emissions and concentrations over a period of 100 years using a linear programming algorithm. The final output determines the concentration of CO₂ over the 100-year period with the scenario of cuts that we have prescribed. This allows us to determine the trajectory of concentration of CO₂ that we obtain with the emissions trajectory of the Annex I and developing countries that we have prescribed.

In the model itself we focus only on CO₂. This is in keeping with the Intergovernmental Panel on Climate Change (IPCC) strategy of determining stabilisation pathways based on CO₂ with other GHGs being factored in at a later stage by somewhat different techniques. In order to compare with emission limits based on all GHGs expressed in CO₂ equivalent terms, we will later indicate the extra contribution expected from non-CO₂ emissions. But we will not model them explicitly in the results described here.
As a matter of detail in the actual GAMS runs we handle the Land Use Change and Forestry (LUCF) and non-LUCF sectors separately and implement separate emission contributions and cuts in each of these sectors for various regions. However, for ease of presentation we do not, in what follows, present the non-LUCF and LUCF sectors separately. Therefore the numbers that we will present for emissions cuts and reductions in growth rates of emissions below will always refer to the combined effect of reductions and cuts in both sectors.

Initial country-wise data for emissions from both non-LUCF and LUCF sectors is taken from the Climate Analysis Indicators Tool (CAIT) (CAIT 2005) tool of the World Resources Institute, which is based on emissions data from the Carbon Dioxide Information Analysis Center’s database. It may be noted that, in general, the LUCF data do not have the same level of accuracy as non-LUCF data. But the relatively low weight of LUCF emissions in the overall picture mitigates the effects of this uncertainty. To determine the evolution of per capita emissions based on total emissions we use the population projections up to 2050 provided by the United Nations Population Database (United Nations Population Database 2008).

Given the general acceptance of the need for deep cuts by Annex 1 countries we focus on scenarios where this is implemented. For concreteness we consider the cuts in the EU proposals and the cuts provided for in the Waxman-Markey bill that has been recently passed by the US House of Representatives. While the first clearly represents a certain consensus amongst an important section of Annex I countries, the second is indicative of what the United States’ Congress is likely to approve in the short term. Indeed it is not essential that we consider the EU proposal per se and we could easily consider various scenarios wherein the Annex 1 countries invariably implement serious emissions cuts. However since the EU proposal offers a ready and well-known scenario it is convenient to phrase the discussion in those terms.

In the absence of any international agreement apart from the Kyoto Protocol that quantifies the cuts we also run pessimistic scenarios where the Annex 1 countries delay drastic reductions in emissions. We then run various scenarios with different patterns of growth or cuts for the various regions other than the US and the Annex 1 countries.

3 The Results

3-Region Model Results: We begin with some illustrative results from optimising with respect to a 450 ppm CO₂ target for a 3-region model. In view of the conclusions of the IPCC Fourth Assessment Report, this would translate approximately into GHG concentration of 500 ppm CO₂-equivalent (Fourth Assessment Report 2007).

We have chosen this target for two reasons. The main reason is that this illustrates more sharply some of the issues that we wish to emphasise. The second is that given the current difficult state of climate change negotiations and the low levels of preparedness for drastic mitigation efforts, this target seems a more realistic option to explore. In what follows, the cuts in annual emissions (to be achieved by specified years) of the Annex 1 countries are prescribed in terms of their percentage with respect to annual emissions in 1990. This of course would imply steeper reductions with respect to current annual emissions. For the Emerging Economies and the Rest of the World, we will prescribe the reduction in the growth rate of their emissions as a percentage reduction from the current growth rate of emissions. We refer to this current growth rate as business-as-usual (BAU), without assuming BAU to imply any further increase in the growth rate of emissions.

We present here three illustrative scenarios.

Scenario I: Annex 1 countries implement the lower end of the EU proposals while the Emerging Economies also implement the lower end of the EU proposals, implementing a 15% cut in rate of growth of emissions by 2020. However their emissions peak only after 2035 (shown in Tables 1 and 2).

The appearance of figure greater than 100% in Table 2 may be surprising, but merely reflects the fact that absolute reductions are taking place rather than a mere reduction in growth rate. An elementary algebraic exercise will show that absolute reductions signify greater than 100% reductions in the growth rate. Such numbers will appear regularly in the following tables.

Scenario II: The Annex 1 countries implement the higher end of EU proposals while the Emerging Economies also implement the higher end of the EU proposals cutting their rate of growth of emissions back by 30% by 2020. Their emissions in this scenario peak between 2030 and 2035 and absolute emissions reductions set in by 2040 (Tables 3 and 4).

Scenario III: The Annex 1 countries implement the higher end of the EU proposals while the Emerging Economies do not play ball. They cut the rate of growth of emissions by only 20% by 2030. In this scenario their emissions peak by 2045 (Table 5).

Scenario IV: The Annex 1 as a whole follows the Waxman-Markey proposal for emissions cuts. The cuts for the Annex 1 in this are significantly less
than the EU proposal. In this scenario we expect that the Emerging Economies will also not undertake substantial cuts and will only undertake absolute cuts after 2040 (Table 6, p 37).

The GAMS runs give the following results:

Scenario I leads to 485 ppm by 2100 with an overshoot beyond 500 after 2040 as shown by the XL ppm actual curve in Figure 1. Thus it is well off the 450 ppm CO\textsubscript{2} stabilisation pathway. The other lines in Figure 1 are the 350 ppm and 450 ppm CO\textsubscript{2} stabilisation pathways of the IPCC.

Figure 1: The Actual Concentration for Scenario-I Overshoots Beyond 500 ppm

Following the IPCC’s Fourth Assessment Report (Fourth Assessment Report 2007), discussions on stabilisation of the non-CO\textsubscript{2} contribution in such a scenario is likely to be higher than the 50 ppm that is true for the 450 ppm range.

Scenario II is much closer to the 450 ppm stabilisation pathway, approaching 491 ppm at its peak and approaching 465 ppm by 2100.

Figure 2: The Actual Concentration for Scenario-II Closely Approximates 450 ppm Stabilisation Pathway

Scenario III, where the Annex 1 countries cut emissions significantly (following the higher end of the EU proposals) but the Emerging Economies do not cooperate, diverges significantly from the 450 ppm pathway remaining above 500 ppm by 2100. This illustrates clearly the critical role of the Emerging Economies as a whole in curtailing the growth rate of their emissions if concentrations are to be maintained at 450 ppm. Of course this role becomes even more important if the target concentration of carbon dioxide were to be lowered further.

Scenario IV also produces greater concentrations of CO\textsubscript{2} with figures around 520 ppm in the year 2100.

Figure 4: The Actual Concentration for Scenario-IV (CO\textsubscript{2} concentration, in ppm)

Of course, significant reductions by the Emerging Economies much earlier would lead to lower concentrations. But there is likely to be little incentive for Emerging Economies to do so in view of the fact that the Waxman-Markey proposals represent a considerable retreat even from the EU proposals.

The conclusions from these scenarios are clear:

(i) Even if the higher end cuts of the EU proposal are implemented by the entire Annex 1 group of countries, the long-term concentration levels depend significantly on the behaviour of the Emerging Economies. Even the generous target of 450 ppm of CO\textsubscript{2} requires absolute reductions in emissions beginning between 2030 and 2040 by the Emerging Economies. The emission trajectories needed from both the Annex 1 and the Emerging Economies to achieve a close approximation of the 450 ppm stabilisation pathway are shown in Figure 5. The fact that the Annex 1 emissions go negative is a consequence of including the negative emissions from LUCF, though the effect is not very significant.

(ii) For total global emissions to decrease early on, early reduction in the growth rate of emissions from the Emerging Economies appears necessary. Later reduction in the growth rate as in Scenario I lead to total global emissions peaking at a much later period and as a consequence the final concentrations rise.

(iii) The per capita emissions from the Emerging Economies as a whole will surpass the per capita emissions of the Annex 1 countries somewhere between 2019 and 2030 in the range of scenarios that we have considered here based on the EU proposal. Shown in
Figures 6 and 7 are the annual per capita emissions for the 3 regions if the upper limit of the EU cuts and the cuts proposed by the Waxman Markey bill are implemented.

**Figure 6: Annual Per Capita Emissions for the Higher Cuts Proposed by EU (Tonnes of CO₂/person)**

**Figure 7: Annual Per Capita Emissions for the Cuts Proposed by the Waxman-Markey Bill (Tonnes of CO₂/person)**

It is clear that this is a fairly robust result. Thus the Manmohan Singh convergence principle (referring to Prime Minister Manmohan Singh’s assurance that India’s per capita emissions would never cross that of the developed countries) will lose force quickly for the Emerging Economies as a whole. However the definition of regions that we have used here masks various serious inter-regional disparities that need to be clarified. We shall do this when we examine the 6-region model.

(iv) It is clear that even in optimistic scenarios of reductions in emissions growth (with early reductions in absolute emissions by the Emerging Economies) 50% or more of the total stock of GHGs due to CO₂ in the atmosphere even in the year 2100 continues to be on account of Annex 1 emissions as shown in Figure 8.

This is particularly significant in view of the question of historical responsibility that is a critical aspect of climate change negotiations including financing. The need for action by the major developing countries does not in any way take away from the responsibility of the developed nations. However, it is also clear that this fact does not provide room for the Emerging Economies to persist with a BAU policy as this would drive CO₂ concentration well beyond even the generous threshold that we have set in our model runs. Indeed this point sharpens the question as we discuss again later on.

**6-Region Results:** In this set of scenarios we explicitly focus on the United States, China and India together with the other Annex 1 countries, the other Emerging Economies and the Rest of the World. We continue to optimise with a 450 ppm CO₂ target.

We begin again with a set of scenarios set up with reference to the EU proposals.

However, we are able to specify independently the emission cuts of more regions. This enables us to determine independently the significance of both the highest per capita emitter, the United States and the highest emitter of total emissions, currently China. We will also be able to independently examine the flexibility that India possesses at the level of physical constraints. Of course in practice this flexibility is somewhat circumscribed as India’s position cannot diverge drastically from that of the other developing countries.

What is immediately evident in the 6-region model is the significant weight of China in the overall global emissions scenario. We will use this fact in the construction of the various scenarios here for the 6-region model.

In this part of the paper for Emerging Economies, China and India we have assumed that emissions steadily decline in the LUCF sector at a constant rate (taken to be the current rate of decline) till 2050. There are varying rates of emission growth in the model only in the non-LUCF sector. This assumption is valid completely for India and China but may be somewhat optimistic in the context of other Emerging Economies. However for Annex 1 and US we have varying rates of emissions cuts in both non-LUCF and LUCF sectors.

We examine the following scenarios in the 6-region model:

**Scenario I:** The Annex 1 countries and the US cut emissions on the lines of the lower end of the EU proposal. China cuts more sharply, roughly 40% from BAU (viz, the original rate of growth in 2008), while India and the Emerging Economies cut around 15% from BAU (the original rate of growth) by 2020. China, India and the other Emerging Economies reduce absolute emissions after 2040 (shown in Tables 7 and 8).

**Scenario II:** The Annex 1 countries and the US apply cuts in emissions on the lines of the higher end cuts of the EU proposal as shown in Table 9.

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**Table 7: Emission Cuts by Annex 1 Countries and USA (as % below emissions in 1990, implementation of lower limit of EU proposal)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Annex 1</th>
<th>US</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>2030</td>
<td>55</td>
<td>63</td>
</tr>
<tr>
<td>2050</td>
<td>80</td>
<td>80</td>
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</table>

**Table 8: Reduction in Growth Rate of Emissions (as % reductions from BAU, for India, China, Emerging Economies and the Rest of the World – only in non-LUCF sector, implementation of lower limit of EU proposal)**

<table>
<thead>
<tr>
<th>Year</th>
<th>EE</th>
<th>China</th>
<th>India</th>
<th>RotW</th>
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<tbody>
<tr>
<td>2020</td>
<td>15</td>
<td>10</td>
<td>95</td>
<td>12</td>
</tr>
<tr>
<td>2030</td>
<td>40</td>
<td>20</td>
<td>70</td>
<td>20</td>
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<tr>
<td>2050</td>
<td>80</td>
<td>40</td>
<td>80</td>
<td>40</td>
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</tbody>
</table>

**Table 9: Emissions Cuts by Annex 1 Countries and USA (as % below emissions in 1990, implementation of upper limit of EU proposal)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Annex 1</th>
<th>US</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>2030</td>
<td>77</td>
<td>81</td>
</tr>
<tr>
<td>2050</td>
<td>95</td>
<td>95</td>
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</tbody>
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China implements even steeper reductions in the rate of growth, India and the remaining Emerging Economies cut to about 30% of BAU in 2020 and begin absolute reduction in emissions after 2030 as shown in Table 10.

**Scenario III:** In this scenario the Annex I countries follow the higher end of the EU proposal while the US follows the pattern of cuts of the Waxman-Markey bill. China, India and the Emerging Economies follow the pattern of cuts in Scenario II (shown in Tables 11 and 12).

**Scenario IV:** In this the Annex I and the US follow the higher end of the EU proposal cuts and all of China, India and the other Emerging Economies follow the same trajectory of emissions cuts till 2030. This is in contrast to Scenario II where China reduces the growth rate of emissions faster than other developing countries (shown in Table 13).

The GAMS runs give the following results:

**Scenario I:** The concentration of CO$_2$ goes over 500 ppm and comes down only till 490 ppm even at 2100 (shown in Figure 9).

**Scenario II:** The trajectory of CO$_2$ concentration stabilises around 460 ppm by 2100 with a mild overshoot (shown in Figure 11).

**Scenario III:** The cross over in per capita emissions for China and the other Emerging Economies with respect to the US and the Annex I occurs a little earlier compared to Scenario I. For India, its per capita emissions cross the Annex I and the US figures by 2036 itself as shown in Figure 13.

**China’s per capita emissions cross both the US and the non-Annex I between 2015 and 2020. The Emerging Economies (excluding China and India) per capita emissions also cross the Annex I and US figures between 2015 and 2020 (this is due to high increase in the emissions due to LUCF). However India’s per capita emissions do not converge to the US and Annex I figures until 2050 (shown in Figure 10). In this scenario the extent of LUCF reductions in the Emerging Economies ensures that their total emissions decline slowly, but steadily.
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This has obvious implications for India's stand that it's per capita emissions will not cross the Annex I countries' levels at any point in time.

Scenario III appears very similar to Scenario II primarily because with other countries being held to the higher end of possible cuts the weight of one single country is not very significant. However as the US is the highest per capita emitter, the crossover of the per capita emissions trajectory of China, India and Emerging Economies will be delayed further from the years shown for Scenario II as shown in Figure 14.

Figure 14: Per Capita Emissions for Various Regions/Countries (Scenario-III) (Tonnes of CO₂/person)

The results of Scenario IV are instructive. In contrast to Scenario II the concentration is over the 450 mark at 480 ppm (approx) in 2100 with an overshoot in the years prior to it as shown in Figure 15.

Figure 15: Concentration for Scenario-IV of the 6-Region Model (CO₂ concentration, ppm)

It is clear that China has a special role to play in limiting global warming by reducing the growth rate of emissions. However we must emphasise that a significant section of China’s manufacturing is also directly related to exports, with one estimate placing it as high as 33% of China’s total emissions in 2005, driven most likely by developed world consumption patterns (Weber et al 2008). Given China’s status as the “manufacturing hub of the world” (in contrast to the domination of India’s growth by the service sector), its emissions clearly cannot be considered the responsibility of China alone.

It must also be emphasised that after China, India is the next largest source of emissions among the Emerging Economies. Thus any action by the Emerging Economies on emissions is very likely to follow the lead set by India. As the 3-region model demonstrates combined action by the Emerging Economies has a critical role to play in keeping total GHG emissions below tolerable limits. We will comment on this further in the concluding section below. However for all other countries, while no single country alone with a different pattern of cuts would make a difference to the final result, nevertheless their collective responsibility is clear from the results of the 3-region model.

4 Further Policy Implications

What are the implications of the results that we have discussed here for the making of climate policy, particularly for India?

Equity Issues

It is clear that the Emerging Economies as a whole have a significant role to play in limiting global emissions even to the generous targets that we discussed in this paper, namely 450 ppm of CO₂. In GHG carbon equivalent terms this amounts to a GHG concentration of approximately 500 ppm. At this concentration the probability of exceeding a 2°C rise in temperature lies between 48% and 96% and that of exceeding 3°C lies between 11 and 61% (Meinshausen 2006). In many of the more moderate scenarios we have seen concentrations of CO₂ rise as high as 500 ppm. Translating this to 550 ppm of GHG in CO₂ equivalent terms, the expected temperature rise is 2°C with 63-99% probability, and 3°C rise with a probability of 21-69% (ibid).

In the simplified carbon-cycle model that we have used in our analysis, future climate change feedback effects have not been incorporated appropriately (Nordhaus's analysis referred to earlier suggests that some past climate feedback effects have however been incorporated). In view of this, the concentration levels that we report here represent a lower bound on the likely trajectory of concentrations in the future.

At the same time, these results underline even more sharply the responsibility of the developed industrial nations in bringing global society to this pass. Indeed the situation is far more serious than that implied by the recitation of relative per capita emissions alone. All the scenarios studied indicate that in terms of total stock of CO₂ in the atmosphere, at least 50% would have originatd in the Annex I countries even by the year 2100. If stock contribution is measured in per capita terms then the continued occupation of carbon space by the developed world becomes even more dramatic.

The early occupation of the “carbon space” by the developed world has also sharply restricted the room for manoeuvre by the developing countries as a whole. Among the developing countries, China needs to implement reductions from BAU emissions at an earlier date than other developing economies. India’s offer of maintaining per capita emissions always below developed country levels will itself require significant efforts for deviation from BAU no later than two decades from now. Developing countries will thus be forced to move along conceptually ill-understood, untested and expensive (at least in the initial stages) low-carbon pathways of development in the short and medium-term. For many of them this will constitute a deliberate turning away from the utilisation of their most readily accessible natural resources, like coal in the case of India.

While these arguments do not take away from the pressing need for action by the developing countries as a whole and the Emerging Economies in particular, they also have sharp implications for the substance and conduct of international climate change negotiations. While we will not discuss these implications here in any comprehensive manner we will highlight some of them in the context of the proposal for a new climate policy for India that has been outlined in the concept note for this meeting.
New Technologies and IPR

It is clear that new technology has a critical role to play in the future, notwithstanding the many uncertainties that surround issues of technology development and innovation pathways, diffusion of innovations and deployment of new technologies and so on. However rent-seeking behaviour by the developed countries and their industrial enterprises by the imposition of a stringent intellectual property rights regime covering technologies relevant to low-carbon pathways will amount to the imposition of a double burden on developing countries. Apart from being forced to low-carbon development pathways that are in any case expensive (in the short term at least) they will also have to pay for the needed technology and in due course for the deployment of these technologies in the third world by first world enterprises. The history of technology transfer to the third world would offer little room for confidence that the cost of this new technology would be substantially lowered by large-scale deployment in the presence of a stringent Intellectual Property Rights (IPR) regime. Much room for manoeuvre has already been curtailed on this count by World Trade Organisation and Trade Related Aspects of Intellectual Property Rights (TRIPs) negotiations. Access to all new technologies relevant emissions reduction needs therefore to be placed outside the purview of IPR restrictions in the public domain.

Carbon Offsets

The second issue is the role of carbon offsets in assisting developing countries to move along low-carbon pathways in future, whether in the form provided by the Kyoto Protocol or in some revamped or refurbished version. Carbon offsets as a means of global emissions reduction are problematic on three different, though related, counts.

In the first instance, it is again another instance of increasing the burden of global emissions reductions that falls on developing countries. The UK Low Carbon Transition Plan (United Kingdom Low Carbon Plan 2009) reveals the contours of this problem clearly. While new technology has been considered seriously as part of the mitigation proposals in most sectors of industry, fully 100% of the mitigation in the energy industry (which is the largest source of emissions) is expected to come from carbon credits purchased under the European Union Greenhouse Gas Emission Trading System (EU-ETS) carbon trading scheme. However, it is clear that this is something of a specious strategy. As the most advanced of European nations in the matter of climate change mitigation, the lead provided by the UK is likely to be followed by other nations. In this event, it is clear that the carbon credits for energy mitigation (which is no mitigation at all in terms of actual emissions reduction) has to come from outside the EU-ETS scheme or indeed the rest of the Annex I countries but from some form of carbon offsets purchased from developing countries. This would amount to the developing countries not only having to reduce their own growth of emissions and later reducing them absolutely, but also having to bear the burden of emissions reduction of some of the most polluting sectors of Annex I industry. The implications on the per capita emissions and the total stock in such a situation are shown in Figures 16 and 17.

It can be seen that in such a case the per capita emissions never converge and the developed industrial nations occupy more than 60% of the carbon space even by 2100.

The second problem with offsets is that it is odds with the need for the global development of new low-emissions technologies. Carbon offsets are unlikely to act as an incentive to the development of new technologies in the advanced industrial nations since they precisely blunt the demand from Annex I countries for innovations in energy technologies. There is little reason to hope that third world demand will act as a spur for first world innovation. There is much evidence against this as in the case of the production of essential drugs and pharmaceuticals for the third world. In cases where innovation has been driven partly by potential demand in the third world, as in the case of genetically modified food technologies, the results have had several other problematic features. In the case of energy technologies, nuclear energy is a pertinent example where technology that has been deemed unsafe in the first world is marketed as the solution to third world energy issues.

It is evident that the denial of carbon offsets for mitigation in Annex I countries can equally act as a powerful mechanism to spur innovation, but this is an option that of course has been ignored. The G-8 countries, that account for the world’s highest per capita emitters, continue to insist on the self-defeating logic of having both carbon offsets and promoting energy innovation almost entirely through the private sector and market mechanisms.

Third, in essence carbon offsets act as a bribe to the elite of the third world, to undertake the burden of emissions reduction for the advanced industrial nations. In the event the third world elite can fulfil this role only by passing the costs on to the poor while locking them into patterns of production and consumption that, while being low-carbon, are also likely to leave them stranded at
low levels of material well-being. Many third world countries are already characterised by very large disparities in energy use and emissions responsibility between the elite and the bulk of the population. Carbon offsets are likely to perpetuate and exacerbate these trends. From a comparison of the statement of the G-8 leaders at the L'Aquila summit titled ‘Responsible Leadership for a Sustainable Future’ with the joint statement titled “Declaration of the Leaders of the Major Economies Forum on Energy and Climate” it is clear that both offsets and IPR policy are central to the advanced industrial nations’ attempt to mitigate climate change costs while attempting to pass the burden on to the developing world.

Finally, the argument from the computation of historic responsibility for GHG stock in the atmosphere made in this paper should clearly underlie any international negotiations on the question of international financing for climate change mitigation and adaptation. As this paper has repeatedly emphasised above, even after considerable cuts by the Annex I countries, the current situation is such that they will continue to occupy a strongly disproportionate amount of carbon space. This consideration needs to be at the centre of all discussions on financing arrangements in the future.

5 Concluding Remarks

The final argument of this paper is that India’s climate change policy, at least till recently, has been characterised by two equally unsustainable tendencies. On the one hand, while insisting, quite correctly, on the historic and contemporary responsibility of the advanced industrial nations in mitigating the effects of climate change, Indian policy has been tardy in recognising the role, at least officially, in addressing their role, as part of the Emerging Economies, in keeping global concentrations of GHGs within limits that would limit the impacts on global society and particularly on the most vulnerable of the world, many of whom are Indians.

On the other hand, in a series of encounters with the leaders of the advanced industrial nations, the Indian political leadership has gradually acceded to the demands of the G-8 on the means to deal with climate change. From the acceptance of global emissions trading and offsets, in particular, in the final accession to the Kyoto Protocol to the acceptance of strong IPR regimes in the climate change context at Heilingdamm, Indian policy has accepted the core propositions that have the effect of doubling the burden on developing countries in dealing with climate change.

The divergences between the G-8 and the Major Economies Forum statements at L'Aquila indicate that the G-8 will demand more from the developing countries in the run-up to Copenhagen. While India moves forward in recognising the need for the large developing nations in particular to contribute strongly to climate change mitigation, it must also ensure that Annex I countries do not pass on their burden to the global south and seriously restrict its development options in the process. 

NOTES
1 On 17 December 2008, the EU committed itself to reduce its GHG emissions by 20% below 1990 levels by 2020. It also committed to cut its emissions by 30% 1990 levels by 2020 if other developed countries made comparable emission reductions under an ambitious international climate agreement, Copenhagen, 2009, See European Union Climate and Energy Package (2008).
2 For a critique from the perspective of mainstream economics, see, for instance, Stephen De Canio (2003). For more radical critiques, see also the work of Larry Kohlmann or George Monbiot.
3 General Algebraic Modelling System or GAMS is a modelling system for mathematical programming and optimisation.
4 The Annex I countries are those listed under the United Nations Framework Convention on Climate Change, namely, Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Iceland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom and United States of America.
5 The countries of the Emerging Economies region are Argentina, Brazil, Chile, China, Egypt, India, Indonesia, Iran, Israel, Korea (South), Malaysia, Mexico, Saudi Arabia, Singapore, South Africa, Taiwan, Thailand, Uzbekistan and Venezuela.
6 In its 30 March 2009 submission to the United Nations Framework Convention on Climate Change, the EU proposed that developed countries collectively reduce their GHG emissions by 25-40% by 2020 and by 80-95% by 2050 relative to 1990 levels. The EU further added that developed countries’ emission reduction efforts were solely not enough to achieve the 2°C objective, and that developing countries had to participate through nationally appropriate actions. In this context, the EU cited recent studies which indicated developing countries limit growth in emissions to 15-30% below business-as-usual by 2020. See European Union proposal (2009).
7 The Waxman-Markey Bill proposes to reduce US GHG emissions by 17% below 2005 levels by 2020. Further, the Bill proposes to reduce emissions by 83% below 2005 levels by 2050. See Waxman-Markey Bill (2009).
8 We will take the figure of 3.32% to represent India’s growth rate of emissions as business-as-usual even though it originates as the growth rate in 2008 from the CIBDA data. However this is closely related to the compounded annual growth rate for the period 2000-2005 provided by Garg et al (2003). We make the similar assumption, that the 2008 growth rate is extrapolated across all years as BAU, for China and the other Emerging Economies too.
9 For an elegant quantitative statement of this argument see Monbiot (2009).
10 See for instance the text of the G-8 statement from the recent L’Aquila summit (G-8 Statement 2009).

REFERENCES