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India And Climate Change In The Context Of Rapid Global Emissions Growth

Ross Garnaut, Stephen Howes, Frank Jotzo1

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[1] Australian National University; formerly of the Garnaut Review of Climate Change. This paper draws extensively on the Review, and the authors would like to thank colleagues who worked on the Review. Contact: Stephen.howes@anu.edu.au

India and climate change in the context of rapid global emissions growth

Abstract

Global greenhouse gas emissions are growing rapidly and are projected to continue to do so. Existing projections already show that India will be hard hit by climate change. In the absence of policy action, global emissions growth is likely to be faster than previously assumed, so the expected global temperature increases and the expected damages from climate change to India this century become even larger. The probability distribution of possible outcomes includes some that would be considered to be catastrophic. India is a significant contributor to the rapid growth in global emissions, but to a much lesser extent than China. Its greenhouse gas emissions are less than a quarter of China's, and not growing as fast. Nevertheless, India's relative contribution to global warming will increase over time. Its share in global carbon dioxide emissions from the combustion of fossil fuels increase from 4 per cent in 2005 to 8 per cent by 2030 under a business-as-usual scenario developed by the recent Garnaut Review on Climate Change. India's recently released national climate change policy includes both a number of immediate measures and a long-term vision, but the likely extent of its overall impact is unclear. The prospect of the severe domestic impact of climate change on India and of intensifying international action will over time increase the pressure on the Indian government to do more to contain emission growth. India and the world need a fair basis for allocating a more ambitious global mitigation effort between countries, having at its core convergence towards equal per capita entitlements, a principle strongly supported by India. Success will require a large increase in public funding for the research, development and commercialisation of low-emissions technologies by high-income countries, with substantial amounts of the associated expenditure incurred in developing countries.

1. Rapid global emissions growth

Global warming has been a major issue in international discussions since the early nineties. So far, there has been only slight progress in reducing emissions below what they would have been if there had been no policy interest in reducing them. A number of structural factors have caused the global rate of increase in emissions to in fact increase since the turn of the twenty first century, after the international community formally embarked on a climate change mitigation strategy in the 1990s. This is the result of an otherwise greatly welcome acceleration of economic growth in much of the developing world and accompanying changes in the structural composition of that growth.

Carbon dioxide is the main greenhouse gas. CO_2 released from the combustion of fossil fuels make up close to about 60 percent of annual greenhouse gas emissions. This is the fastest-growing source of greenhouse gases, and the one about which data is most available.

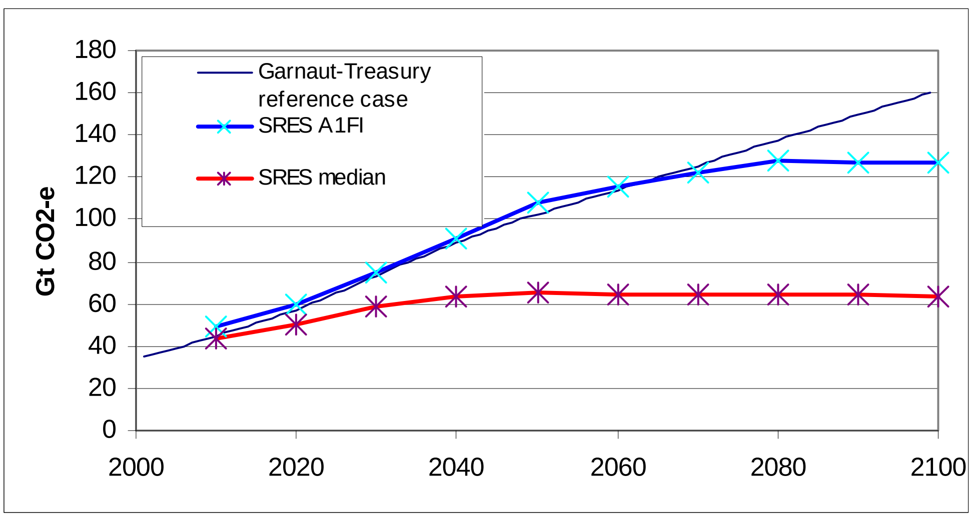
In the 1970s and 1980s, CO_2 from fossil fuels worldwide grew at about 2 per cent a year. In the 1990s, this fell to 1 per cent a year, as energy efficiency improved in China, and formerly-Communist economies contracted as they made the transition from central planning to the market. In the first five years of this decade, the annual average growth rate of global CO_2 emissions increased to 2.9% (IEA, 2007a). More recent data for 2006 and 2007 show continued high global emissions growth. The Netherlands Environmental Agency (2008) reports that global emissions of carbon dioxide from fossil fuel use and cement production increased by 3.5 per cent in 2006 and 3.1 per cent in 2007. The acceleration in emissions growth this decade reflects rapid, energy-dependent – and in particular coal-dependent – economic growth in the developing world in what has been labelled the 'Platinum Age' (Garnaut and Huang, 2007) since it reflects growth rates higher than those in the 'Golden Age' of the 1950s and 1960s.

Most emissions projections do not reflect this recent rapid growth in emissions. The most influential projections are still the SRES scenarios, developed by the International Panel on Climate Change in the 1990s (Nakiçenovic and Swart 2000). These show a wide range of possible emissions paths. The median SRES scenario projects annual average CO_2 emissions growth of 2% to 2030. The most rapid projection, A1FI, shows growth of 2.5%. More recent official forecasts project global emissions growth of about 2% a year (for example, those of the International Energy Agency, 2007b).

Recent projections developed for the Garnaut Review suggest a very different future, with a continuation of post-2000 trends out to 2030. Garnaut et al (2008a) project annual average CO_2 emissions growth to 2030 of 3.1% under "business as usual" assumptions, that is, in the absence of strong policy action to mitigate climate change. 90 per cent of this growth in emissions will take place in developing countries, whose share in global emissions between 2005 and 2030 is projected to increase from 40 to 63 per cent of total CO_2 emissions.

These projections were extended to incorporate other major greenhouse gases and to 2100 in a joint exercise carried out by the Garnaut Review with the Australian Treasury, under what is called the Garnaut-Treasury reference case (see Garnaut, 2008 for details). Figure 1 projects annual emissions to 2100 under the Garnaut-Treasury emissions and in comparison to the A1FI emissions and to the SRES median emissions. Emissions show no sign of flattening out by the end of the century as they do under both the SRES median scenario and the scenario with the most rapid emissions growth, AIF1. Emissions over the century according to the Garnaut-Treasury projections are comparable with or above the AIF1 emissions.

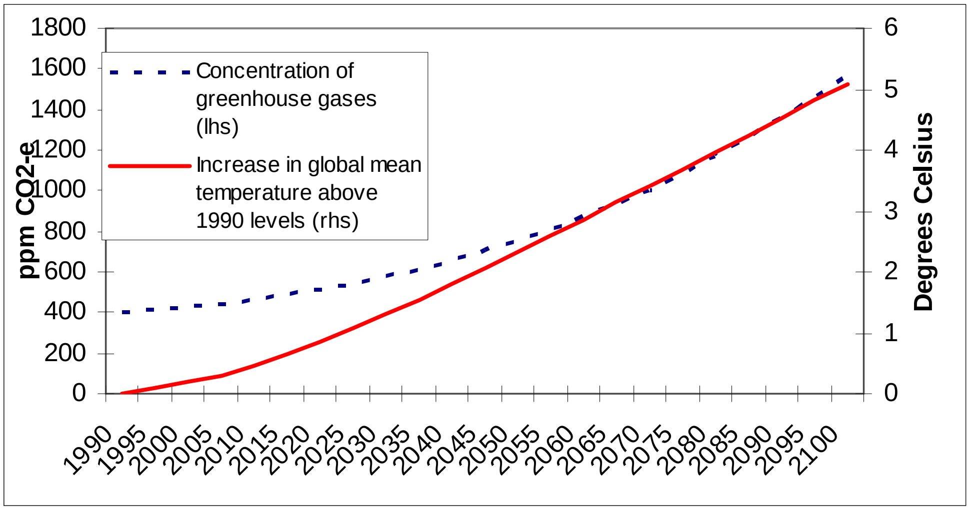
Figure 1 Total greenhouse gas emissions over the 21st century, projected by the Garnaut-Treasury reference case and the median and highest-emissions-growth SRES scenario



Source: Garnaut (2008) Figure 3.10

Figure 2 shows the expected rise in atmospheric concentrations and temperatures over the century associated with the Garnaut-Treasury projections, under median assumptions for the sensitivity of temperature to greenhouse gas concentrations.

Figure 2 The expected atmospheric concentrations of greenhouse gases and global temperature increases associated with the emissions profile of the Garnaut-Treasury reference case.



Notes: Concentrations and temperatures are derived using the MAGICC climate model (Wigley 2003). Temperatures are projected using a best estimate climate sensitivity of 3^{o}C, as per the IPCC Fourth Assessment Report.

Source: See Garnaut (2008) Figures 4.4 and 4.5

By the end of the century, applying the Garnaut-Treasury projections to the mainstream science embodied in the IPCC reports, temperatures are expected to increase by 5.1^{o}C. By contrast, the 2007 Fourth Assessment Report of the IPCC presented a range of best-estimate temperature increases based on the six main SRES scenarios from 1.8 ^{o}C to 4 ^{o}C, with the highest estimate derived from the pessimistic A1FI scenario. The difference between the IPCC projections and those of the Garnaut Review are caused by different assumptions not about the relationship between temperatures and emissions, but about underlying emissions projections.

2. Climate change impacts on India: the case of agriculture.

Rapid emissions growth means that global warming looms as a much more urgent problem than it had been anticipated in the analysis of the IPCC – based on the SRES scenarios – and in analysis based on IPCC assumptions, like that of Stern (2007). An increase in average global temperatures of 5^{o}C over the course of the century would be equivalent to the amount of warming that has occurred between the last ice age and today. The effects 'could be catastrophic, but are currently very hard to capture with current models as temperatures would be so far outside of human experience.' (Stern, 2007, p. 67)

The science suggests that India could be one of the world's main victims of global warming, as a result of the warming of a country that is already hot having a large effect on agriculture, with risks of disruption of flows of water in the great rivers of North India, Pakistan and Bangladesh, with the possibility of disruption of the monsoon, with millions at risk of sea-level rise, and with the possibility of these same influences destabilising Bangladesh and Pakistan in ways that have large economic, social and strategic implications for India.

A full treatment of the likely impact of climate change on India is beyond the scope of this paper. The aim is simply to establish that India is positioned to be adversely and severely affected by climate change, using the example of agriculture.

Cline (2007) provides climate change impacts on agriculture for individual countries. India emerges as one of the countries most susceptible to climate change. Cline finds that global agricultural productivity would decline in a range of 3-16 per cent from today's levels on account of climate change projected to be realized by 2080.[2] Developing countries would suffer by more, with an estimated decline in agricultural productivity in the range of 8-20 per cent. India would be one of countries most at risk of a substantial decline in agricultural output. Cline's preferred estimates show an expected decline in the range of 29-38 percent. India's neighbours would suffer losses of similar proportions. The region is vulnerable to climate change because it is already hot to begin with, so the additional warming is particularly damaging to agricultural productivity. Rainfall is expected to increase, but only marginally.

Cline's results are driven solely by increases in temperatures, expected associated changes in precipitation, and by possible carbon fertilization benefits for plants. They take no account of the Himalayan deglaciation which global climate change will likely lead to, and which could produce first flooding, and then water shortages (Stern, 2007) or the possible climate-change induced disruption of the Indian monsoon (Challinor et al, 2006). Such outcomes are difficult to assign probabilities to, but could be catastrophic.

[2] Cline estimates losses in agricultural productivity relative to 2003 levels. He argues that by the end of the century, while technological advance will have boosted agricultural productivity, demand-supply agricultural imbalances will have, if anything increased, due for example to a shift to meat.

Cline bases his projections on the A2 SRES scenario, which gives an expected global warming by 2080 of 3^{o}C. Land warms faster than the ocean, and this global expected increase corresponds to an expected land warming at 4.4^{o}C (weighted by farm area) (Cline, p. 41). Under the Garnaut-Treasury projections above (Figure 2), the expected global temperature increase alone by 2080 is 4.5^{o}C. This would correspond to a significantly higher expected land warming than assumed by Cline.

The higher temperatures associated with the Garnaut-Treasury projections might be offset somewhat by greater precipitation and carbon fertilization. In general, however, the net effect of a further increase in temperatures at levels that are already high is strongly negative. The Stern Review notes that for a temperature increase over the century of about 5 ^{o}C 'Agricultural collapse across large parts of the world is possible … though clear empirical evidence is still limited' (2007, p. 81).

3. India's contribution to global emissions: current and projected.

Over the last few years, India and China have come to be increasingly mentioned in the same breath, coupled together as Asia's, indeed the world's, emerging economic giants. In the area of climate change, the two countries are both seen as critical to controlling emissions in the coming years, and as essential participants in any future climate agreement. For example, an adviser to Presidential Candidate Obama on climate change was recently quoted as saying that the US Congress would not support a post-Kyoto international agreement "…unless we engage the developing world, China and India in particular." (Carbon Finance, 2008).

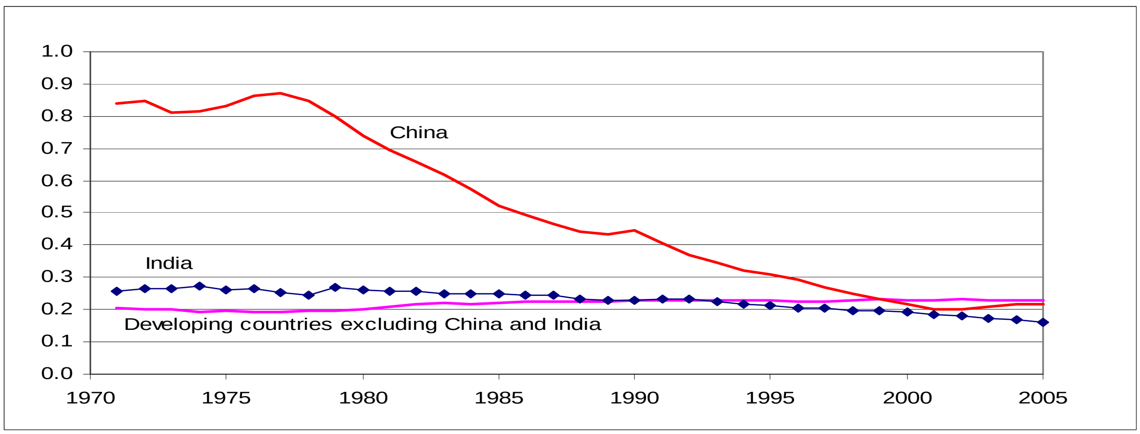
In fact, China and India's emissions are of a very different order. Using 2005 data from the IEA (2007a), China's $C0_2$ emissions from the combustion of fossil fuels (5.1 Gt CO_2-e) are about 4.5 times as big as India's (1.1 Gt CO_2-e). Whereas in 2005 China is responsible for 19 per cent of global CO_2 emissions from fossil fuel, India was responsible for only 4.3 per cent.

India's total emissions in 2004 were 1.7 Gt CO_2-e, compared to China's 6.6 Gt (Garnaut, 2008, Figure 3.1). This certainly puts India among the world's largest emitters. It is the seventh largest, when the EU is treated as a single emitter, and all greenhouse gases from all sources are accounted for. However, in per capita terms, whereas China is today at around the world average (6-7 tonnes), and developed countries are more than twice this average, India's total emissions are just 1.6 tonne per person.

China’s emissions are much larger than India’s for three reasons. Its economy is almost 1.5 times bigger than India’s. The Chinese economy is about one-third more energy intensive than the Indian economy. And the energy than China uses is about one-third more carbon intensive than India’s.

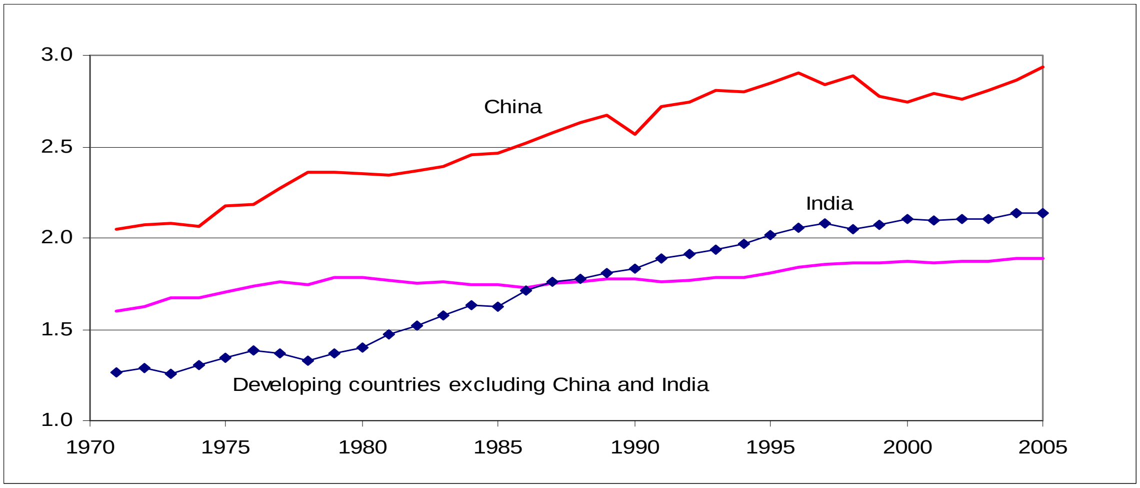
India’s energy intensity of GDP is now below that of the average for developing countries (Figure 3), but its carbon intensity is above the average for developing countries and rising (Figure 4). This reflects the growing dependence in India on coal. Between 1980 and 2005, coal demand rose in India on average by 5.6 per cent annually, compared to annual average growth in total energy demand of 3.8 per cent. In 2005, coal provided 39 per cent of India’s energy, compared to 63 per cent of China, and only 17 per cent of the rest of the world (IEA 2007b).

Figure 3 Energy intensity of GDP for India, China, and other developing countries



Note: The ratio is of energy (total primary energy supply measured in millions of tones of oil equivalent) over GDP (in 2000 USD purchasing power parities).
Source: IEA (2007a).

Figure 4 Carbon intensity of energy for India, China and other developing countries



Note: The ratio is of CO_2 emissions (millions of tonnes) to energy (total primary energy supply measured in millions of tones of oil equivalent).

Source: IEA (2007a).

So far India has been a much lesser player in the acceleration of global greenhouse gas emissions than China. China accounted for 55 per cent of the global absolute increase in CO_2 emissions from fuel combustion from 2000 to 2005, and India for 5 per cent – still the second highest for any individual country, but far behind China. The growth rate of emissions in India actually slowed down in the first five years of this decade, even as economic growth accelerated (Table 1). This reflected rapidly declining energy intensity of GDP, so that energy use grew only half as fast as GDP. CO_2 emissions grew slightly faster than energy. India's absolute annual average CO_2 emissions increment in the 1990s slightly exceeded that of this decade to 2005.

Table 1 Annual average emissions, GDP, energy, energy intensity and carbon intensity growth, and energy/GDP and emissions/energy elasticities for India, 1971-2005.

	1971-1990	1990-2000	2000-2005
Emissions growth	5.9%	5.1%	3.5%
GDP growth	4.5%	5.5%	7.0%
Energy growth	3.8%	3.7%	3.2%
Energy/GDP growth	-0.7%	-1.7%	-3.5%
CO2/energy growth	2.0%	1.4%	0.3%
Energy/GDP elasticity	0.84	0.67	0.46
Emissions/energy elasticity	1.53	1.39	1.09

Source: IEA (2007a)

Most developing countries show an energy to GDP elasticity of around one or more (Sheehan, 2008). Why has India's energy intensity fallen so much in recent years? First, economic growth in the first five years of this decade in India was led by the service sector. It is only in the last couple of years that industrial growth has picked up. Second, India is beset by serious power shortages, which give households little opportunity to increase their electricity consumption, and gives industry strong incentives to improve energy efficiency. Industrial growth has picked up more recently, and there are signs that energy consumption has grown with it. Though comprehensive data on energy demand is not available, electricity production data shows faster growth between 2004/05 and 2007/08 (6.2 per cent annually on average) than between 1999/00 and 2004/05 (4.1 per cent) (Indiastat.com, 2008).

The national and international "business as usual" projections discussed below show energy intensity in India continuing to decline, though not at the rates seen in recent years.

The International Energy Agency (2007b) projects annual average emissions growth of about 4.5 per cent on average per annum for India out to 2030. The Garnaut et al (2008a) projections adjust this upwards to about 5.5 per cent solely on the basis of adjusting projected GDP growth to 2030 from 6.4 to 7.5 per cent, in line with recent performance. This is a conservative projection. The average elasticity of energy growth to GDP used in these projections is around 0.6, whereas the official Parikh Report (of the Expert Committee on Integrated Energy Policy, Government of India Planning Commission 2006) projects energy elasticities of 0.75 this decade, 0.7 the next decade, and 0.67 the following decade. If India does at last succeed in finding a solution to its chronic power sector shortage problems, then its emissions will increase faster.

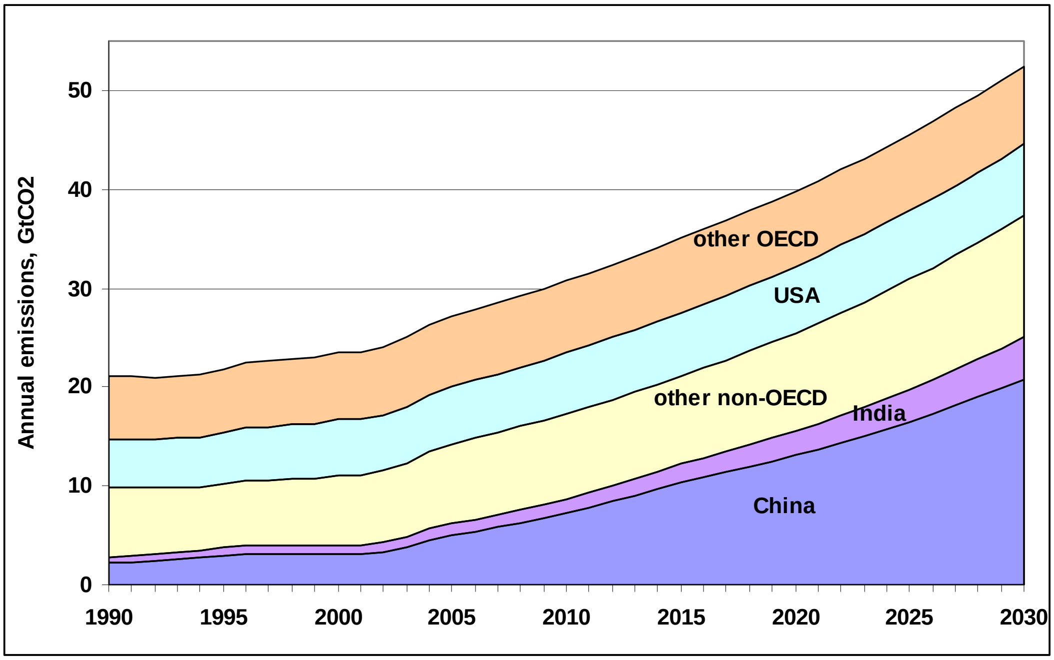
The Parikh report projects CO_2 emissions from the energy sector to be in the range of 3.9 to 5.5 billion tonnes by 2030, depending on the energy mix, and assumptions on energy efficiency. The top end of this range is a coal dependent scenario, in which the fuel mix for electricity generation is determined purely on economic grounds. The Garnaut et al (2008a) projections sit within this range at 4.4 Gt CO2.[3]

Under the Garnaut et al (2008a) projections, India's CO_2 emissions from fossil fuels rise by 2030 to 8 per cent of the world total. But China's emissions rise even more quickly, and by 2030 reach an astonishing 37 per cent of the global total. India's emissions under business as usual are projected by 2030 to match those of Europe in aggregate terms, but remain below those of the United States (Figure 5).

After 2030, China's economic growth is projected to slow, in part because population growth becomes negative. The longer-term Garnaut-Treasury projections show India's economy catching up in absolute size with China's by 2080, and suggest that, under business as usual, both economies will contribute about 20 per cent to total CO_2 combustion emissions by the end of the century.

[3] IEA (2007b) projections of CO_2 emissions in 2030 are lower at 3.3 Gt. Even under the IEA's "rapid growth" scenario its 2030 CO_2 emissions are only 3.9 Gt.

Figure 5: Historical and projected CO_2 emissions levels



Note: 1990 to 2005 from IEA (2007b), Platinum Age projections from Garnaut et al (2008a).
Source: Garnaut et al (2008b)

While the focus of this section is on emissions from carbon dioxide, non-CO_2 emissions are unusually important for India. They account for about 35-45 per cent of India's total greenhouse gas emissions. Agriculture dominates emissions of other greenhouse gases, primarily due to India's large and growing livestock population and the cultivation of paddy (World Bank, 2007). India's forest cover has stabilized and so emissions from deforestation are not significant. Since CO_2 emissions from the combustion of fossil fuels are the fastest growing source of India's emissions, their share in emissions will rise over time, and trends using all greenhouse gases look similar to trends analyzing only CO_2 combustion emissions, though the growth rates of the latter will obviously be faster.

4. India's climate change mitigation policies: current and prospective

In 2008, India released a National Action Plan on Climate Change (Government of India 2008), which starts out by noting that "India may face a major threat because of projected changes to climate" (p.1). The Action Plan put forward a number of measures to adapt to climate change, and to reduce emissions below business-as-usual levels through encouragement to low-emissions energy and energy efficiency, and through afforestation initiatives. Eight government “missions” are created, for solar power, energy efficiency, sustainable habitat, water, the Himalayan ecosystem, Green India, to promote carbon sinks, sustainable agriculture, and for strategic knowledge for climate change. In general, the plan avoids quantitative targets, which makes it difficult to evaluate what it “adds up” to. (An exception is the noting of existing policy to increase forest cover from 23 to 33 per cent.) The Action Plan is underwritten by a commitment that India will not exceed developed country average per capita emissions.

This approach is quite different to that taken by China, which, on the one hand, has avoided making any long-term commitment but on the other has articulated more comprehensive domestic policy energy objectives, for example to quadruple GDP from 2000 to 2020, while only doubling energy consumption, and to reduce the energy intensity of GDP by 20 per cent from 2005 to 2010 (Garnaut et al 2008b). The different approaches taken by India and China reflects the different recent development experiences of the two countries. China has recently experienced the rapid development of energy intensive industries and has seen energy intensities stay constant or grow since 2000. India has seen much less industrial development, and Indian policy makers see faster energy growth as critical for sustaining rapid economic growth.

What does India’s per capita emissions commitment mean? One extreme interpretation would be that India will not do anything about controlling emissions until it has reached developed country per capita averages. Using the global mitigation pathways developed by the Garnaut Review, this would mean, depending on the stringency of the underlying pathway, India would not take any action until the mid-2030s or early 2040s.

This is an extreme and unrealistic interpretation since India already has the policies articulated in its National Climate Change Action Plan in place to reduce emissions. But the impact of these policies is in many cases uncertain, and to what extent India is prepared to control emissions is unclear, as indeed it is for developing countries in general.

India has been an active participant in the Clean Development Mechanism which provides credits from project-level emission reductions below a counter-factual baseline. India has been one of the most significant sources of CDM projects.[4] However, emission reductions claimed under the CDM cannot be proven and only offset emission reductions in developed countries. Given that 90 per cent of emissions growth in the future will come from developing countries, emissions reductions in developing countries below business as usual will be required in addition to reductions in developed country. This implies an approach which goes well beyond offset mechanisms.

An obvious alternative is a system of national emissions entitlements, which are tradable among countries, allowing comprehensive coverage as well as differentiation between countries. For such a system, the crucial question is how to divide up the global emissions budget, or what principle to use to determine the allocation of emissions rights between countries. For any system to be widely acceptable, it will need to be perceived as both simple and fair.

Indian policymakers and think tanks have long advocated that emissions rights should be the same for each person (Agrawal and Narain, 1991), and that national allocations should reflect this. This idea has recently been reiterated by the Indian Prime Minister, [5] and is obviously consistent with the India's commitment made recently in its Climate Change Action Plan.

The Garnaut Review develops an allocation system for countries for tradeable emissions entitlements, which is intended to be both practicable and fair. The basic principle underlying the proposed allocation system is that each country should have the same per capita entitlement to emit greenhouse gases by 2050, and that countries should converge to this goal in a linear manner, or faster if possible (if converging from below) or necessary (if converging from above).

Importantly, under the Garnaut Review proposal, developing countries are given a transitional period to adjust up to 2020. All developing countries are allowed to grow their emissions at

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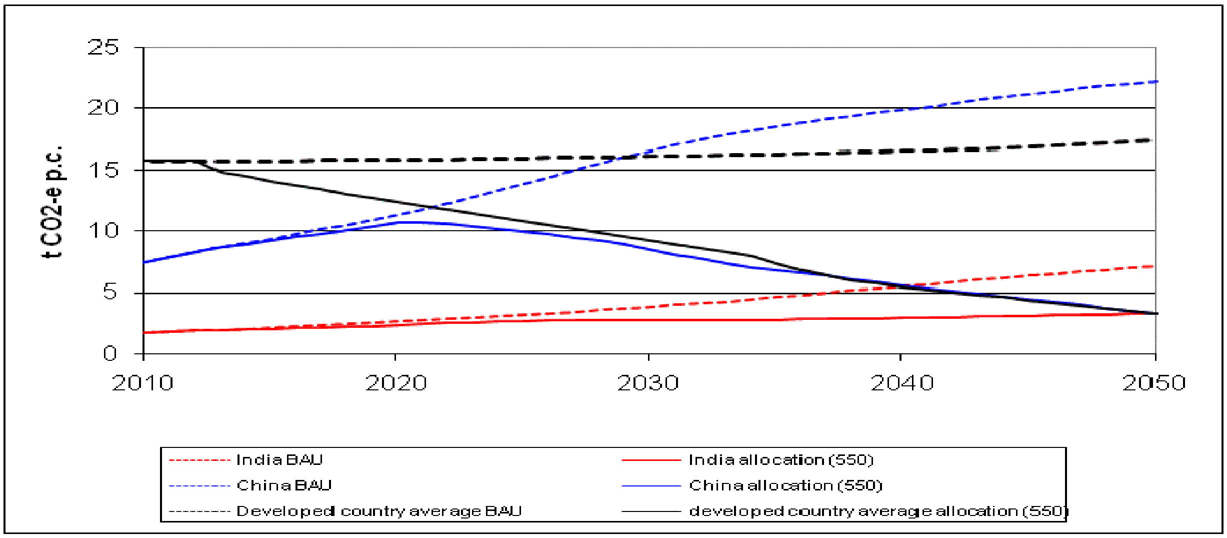
[4] Claimed emissions reductions under CDM projects expected in India amount to about 70-80 Mt CO2-e per year over the Kyoto period 2008-12, or about 4 per cent of India's total annual emissions. India accounts for 15 per cent of the global expected CDM supply, the second largest country behind China (UNEP 2008).

[5] In his speech launching the National Action Plan on Climate Change, the Prime Minister of India stated: "Every citizen of this planet must have an equal share of the planetary atmospheric space. Long term convergence of per capita emissions is, therefore, the only equitable basis for a global compact on climate change." (Singh, 2008)

half of their anticipated rate of GDP growth. High-income countries and China would be required to accept binding targets based on the allocations derived from these principles. All other developing countries, except the least developed, would be required, up to 2020, only to accept one-sided targets which gives them the opportunity to sell permits should they exceed their target, but no requirement to buy permits internationally should they under-achieve.

The resulting allocations for India under one of the global mitigation strategies analysed by the Garnaut Review are plotted in Figure 6 in per capita terms. Business as usual emissions for India are also shown, as are developed country average and China's emissions, both under business as usual and under the global mitigation strategy.

Figure 6 India, China and developed country per capita (a) emissions under business as usual and (b) emission entitlement allocations under the Garnaut Review 550 ppm CO_2-e stabilization global mitigation strategy



Note: Based on modelling undertaken for the Garnaut Review. See Chapters 3 and 9 of Garnaut (2008). The "550 ppm" strategy is one in which the world agrees to stabilize the atmospheric concentration of greenhouse gases at 550 parts per million CO2-equivalent, and divides up the resulting global emissions trajectory among nations in terms of tradeable emissions entitlements starting in 2013, based on the principles outlined in the text.

Several features stand out from this graph. First, the transitional period means that by 2020, emissions entitlements for India are only about 10 per cent below their business as usual level.

Second, India's per capita emissions allocations continue to grow over the convergence period. Third, developed country average emissions allocations fall rapidly and continually over the period. Fourth, because of its low starting point, and lower underlying growth in emissions India has less of an adjustment task than China. China's emissions entitlements in 2050 are 15 per cent of business as usual levels, but India's are almost 50 per cent.

Under the principle of gradual convergence to equal per capita emissions entitlements, India has a lot more room to grow emissions than China. Because of the lesser extent of adjustment required in India than in countries with higher initial per capita emissions, it is likely that with international trading in emissions rights, India would end up as a net seller of entitlements. This would partially or even fully offset the domestic costs of mitigation (Ojha, 2008).

The international sale of emission permits is one mechanism to help developing countries fund mitigation costs. The other is through international public funding of mitigation and adaptation costs. This has been very limited to date. The Garnaut Review proposes a Low Emissions Technology Commitment which high-income countries would subscribe to, and which would provide funding – in areas and using modalities at the discretion of contributing countries – for low-emissions technology research and development, and to support mitigation policies in developing countries, for example through technology transfer. The Garnaut Review argues that this Commitment should be funded to the extent of $100 billion annually, of which up to half could be committed for expenditure in developing countries. As argued by the economist Jagdish Bhagwati (2006), such a commitment (to, in his words, a "global warming superfund … to researching a variety of CO2-saving technologies … and to subsidizing the purchase of environmentally-friendly technology by the developing countries") would rightly fall only on developed countries on account of not only their affluence but also their historical responsibility for global warming. An agreement around a Low Emissions Technology Commitment is critical for reasons of both efficiency and equity, and for building developing country support for a global agreement.

5. Obstacles to progress

What stands in the way of India doing more on climate change mitigation?

The lack of international progress is a fundamental deterrent. India's perspective is dominated by the fact that developed countries are mainly responsible for the rise in greenhouse gas concentrations to date. India also perceives developed countries as not having delivered on their Kyoto commitments.[6] In such a context, India will resist calls for it to commit to a greater role in global mitigation efforts as hypocritical and inequitable. India also insists that developed countries honour earlier commitments to finance mitigation costs in developing countries (Government of India, 2008, p. 46).

Another barrier is that, as in many countries, India's energy sector is deeply politicized. Retail petrol and diesel prices are set by government, and often highly subsidized. Electricity supply is largely the responsibility of government-owned utilities, often loss-making and inefficient. Technical loss and theft levels are high. Supply is often rationed. Electricity to industry is expensive, but electricity to farmers is highly subsidized, and in some states free. Attempts to introduce reforms into the energy sector to put it on a more market-oriented footing have met with at best mixed success.

In such a context , putting a price on carbon emissions by way of a tax or an emissions trading system could change long-term investment decisions, but may have limited short- to medium-term effect on emissions. In the face of political pressure, a tax applied to petrol and diesel might be offset by greater subsidies. A tax applied to fuels used in electricity generation might not be passed through to users. Carbon pricing would change incentives for investment in electricity generation and industry, favouring accelerated phase-out of old, inefficient installations and investment in lower-carbon technologies and more efficient plants. However in the context of supply shortages and rationing, the change in the generation mix, and thus carbon intensity of electricity, would occur more slowly than would otherwise be the case.

Finally, India is still a very poor country, with a large number of immediate needs relating to both security and development. Giving adequate attention to problems, even those that are very serious, that are long-term in nature will always be challenging in such a context.

6. The way forward

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[6] The Prime Minister of India Dr Manmohan Singh was quoted at the 2008 G8 Summit in Japan on climate change as criticizing "the world's most industrialized countries for not showing any 'demonstrable progress on even the low levels of agreed greenhouse gas reduction,' even as the prognosis is that emissions from the developed nations will continue to rise even further in the years to come." (Rediff, 2008)

The rapid growth in global emissions lends urgency to the issue of climate change as prospective damages once thought remote are brought forward in time, and as the probabilities of catastrophic damage increase. The calls on developing countries to contain emissions growth will also increase as they become responsible for an ever-increasing share of global emissions.

As global concerns about climate change intensify and broaden, and as India recognizes the serious domestic impact of climate change, there will be increasing pressure, domestic and international, on the Indian government to build on current efforts and contribute more to the global mitigation effort. India's extreme vulnerability to climate change, its long-standing commitment to an international allocation of emissions on the basis of population, its various existing policies to contain emissions growth, and its very low current per capita emissions, as well as the country's rapidly rising international standing, all position India as a potential leader on climate change among developing countries

However, for India to take on this role it will be essential first of all that the developed world take on the leadership role which it agreed to first in 1992 under the United Nations Framework Convention on Climate Change in 1992 and then under the Kyoto Protocol in 1997. Unless developed countries meet their Kyoto targets – thereby demonstrating both a credible commitment, and the possibility of decarbonisation without the sacrifice of prosperity - and start providing large-scale funding to support developing country mitigation efforts, developing countries including India will continue to resist constraints on their own growth in emissions. Developed countries also need to agree on a framework for that allocation of global emissions responsibilities which recognizes the right of developing countries to continue to increase their emissions for some time.

The Garnaut Review has detailed one possible international package which builds on the existing Kyoto Protocol, and which may provide a way forward through the current impasse. It involves differentiated commitments across countries, a gradual start for developing countries, and financing to developing countries both through international emissions trading, and through large public funding from developed countries.

Even if India becomes part of a new global effort to mitigate climate change, it will face serious domestic challenges to implementation of mitigation measures, including from the politicized nature of India’s energy sector. It is important in this regard that expectations be kept realistic, the project be recognized as a long-term one, and that India and other developing countries be given time to develop and implement effective mitigation policies.

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