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India's emissions in a climate constrained world

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ABSTRACT

Scientific studies have repeatedly shown the need to prevent the increase in global emissions so that the planet's average temperature does not exceed 2 °C over pre-industrial levels. While the divisions between Annex 1 and non-Annex nations continue to prevent the realization of a comprehensive global climate treaty, all members of the G-20 (incidentally also major emitters) have agreed to prevent the rise in global temperatures above 2 °C. This requires that nations consider budgeting their carbon emissions. India presents a unique case study to examine how a major emitter facing a desperate need to increase energy consumption will meet this challenge. The Greenhouse Development Rights (GDR) framework, perhaps considered the most favorable with respect to the responsibility and capacity of India to reduce emissions, was used to explore India's emissions trajectory. India's emissions have been pegged to the pathway required to meet the 2 °C target by non-Annex countries. The results have been compared to the expected emissions from 11 energy fuel mix scenarios up to the year 2031 forecasted by the Planning Commission of India. Results reveal that none of the 11 energy scenarios would help India meet its emissions target if it were to follow the 2 °C pathway. A thought experiment is followed to explore how India may meet this target. This includes a sensitivity analysis targeting coal consumption, the biggest contributor to India's emissions.

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1. Introduction

The lack of a comprehensive climate agreement at the United Nations Climate Conference in Copenhagen, Denmark has posed a challenge for genuine greenhouse gas mitigation efforts. In the lead up to Copenhagen there was much debate between maintaining global carbon emission levels such that they do not result in exceeding a mean over 2 or 1.5 °C from pre-industrial levels. While 2 °C has been politically agreed to be the upper limit, there are many studies revealing the need for the upper limit to be well below 2 °C (Hansen et al., 2008; Krause et al., 1989). As a result, many "Least Developed Countries" (LDCs) and small island states have demanded stricter cuts and an upper threashold of 1.5 °C or 350 ppm (parts per million) as the safe upper limit of carbon dioxide in the atmosphere (Hansen et al., 2008).

For many years the world allowed analysts with a "wait and see" attitude to govern policies on climate change (Krause et al., 1989). These were analysts who doubted the climate science and felt that the costs of mitigation were so high that they did not warrant immediate action, and instead funds would be better spent on further research on climate science. However science has repeatedly shown that to avoid a catastrophic change in the global climate system, we must control emissions so that they do not increase the global average temperature by more than 2 °C. One of the most plausible and practial ways to do this is by setting a maximum limit on the amount of carbon that countries are allowed to emit. This needs to be based on a maximum limit of the warming of the earth and a division of the carbon budget among countries. The idea of carbon budgets under a 2 °C limit of warming as first introduced by Krause et al. (1989) implied that a reduction of 20% below 1985 emission levels should be achieved by 2015, that 50% reduction should be achieved by 2030, and finally that 75% reduction below 1985 should be achieved by 2050.

Eighteen years have passed since the launch of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 and the world still grapples with the task of redefining our development paradigms in the context of a climate constrained world. The Kyoto Protocol called for global emissions to be reduced by 5.2% below 1990 levels but they have actually increased worldwide by 38% between 1992 and 2007. In the wake of such uncontrolled emissions growth, scientists of the United Nations Intergovernmental Panel on Climate Change (IPCC) have shown in their 4th Assesment Report that anthropogenic climate change could set off ecological tipping points, causing the collapse of countless unique ecosystems that sustain the livelihoods of billions across the globe (IPCC, 2007).

Specific areas of concern include the instability of the Greenland and West Antarctic ice sheets, the collapse of the amazonian forest, the weakening of the North Atlantic current, and the

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transformation of the Southwest Indian Subcontinent Monsoon (IPCC, 2007). The impacts of a run-away climate change scenario on agricultural productivity, water security, health, and human displacement is predicted to be devastating.

As a result the "2 °C guard rail", as it is now known, has been made the goal of the climate policies of 133 nations representing 80% of the global population and it includes G8 nations as well as rapidly emerging economies such as China, India, and Brazil (now a part of the larger G-20) (WBGU, 2009).

Limiting emissions while 1.6 billion people still do not have access to electricity and 2.4 billion people rely on traditional biomass for cooking fuel poses a great development challenge (UN, 2007). As development is directly related to having access to energy, it cannot be denied that the world's energy consumption will have to expand making the current total primary energy supply of approximately 12,029 Mtoe (million tons of oil equivalent) increase to 14,000–17,000 Mtoe (IEA, 2009). Thus we are left with no choice but to set a cap on our global carbon emission to ensure that this growth is through clean enegy sources.

A scientific study conducted by Meinshausen et al. suggests that "limiting cumulative CO_2 emissions over 2000–2050 to 1000 Gt CO_2 yields a 25% probability of warming exceeding 2 °C" (2009). Futhermore, it states that based on the emissions budget consumed by 2006 of 234 Gt CO_2, "less than half of the proven economically recoverable oil, gas, and coal reserves can still be emitted up to 2050 to achieve such a goal." Though this study claims that we may be on track toward not exceeding 2 °C warming, the "probability of exceeding 2 °C rises to 50–87% if global GHG emissions are still more than 25% above 2000 levels in 2020" (Meinshausen et al., 2009). Science is telling us that we must begin to take action to reduce the emissions immediately. Thus the questions include by when, for whom, and how much, in a way that ensures the right to development and the eradication of poverty?

India's role in this dilemma is key as providing access to electricity for India's approximately 400 million poor and meeting the goals of poverty eradication in a climate constrained world will be an indicator for how many nations can chart low-carbon pathways for development. As a result we must see whether scenarios of India's energy consumption fit within the required emission reductions as called for by the 2 °C warming limit.

Taking the example of the Greenhouse Development Rights (GDR) Framework established by Baer et al. (2008), under the 2 °C "emergency pathway," we may peg India to the larger "South's dilemma". In this model (see Fig. 1), peaking global emissions by 2013 reduces the possibility of passing the 2 °C limit from 54% (should we peak in 2017) to 32%. This requires Annex 1 countries to peak in 2010 and reduce emissions to 90% below 1990 levels by 2050. For the purposes of this study we will assume that this may have happened by the end of 2010. However it still does not leave much room for emissions in the non-Annex 1 nations to grow, requiring them to peak latest by 2015–2020 and then decline by 6% annually through 2050.

This paper seeks to project into 2030 India's current emissions (440 million tons of carbon annually) to the 2 °C pathway proposed by the GDR Framework to see how the various scenarios of its energy future compare. Using the results we will be able to conduct some thought experiments on what is required for India to meet this challenge, which will have global implications.

2. Methodology and data

Taking the budgets as depicted by the Greenhouse Development Rights Framework in Fig. 1, indexing was done to map India's current emissions and project its growth into the future based on the tragectory required of the non-Annex 1 countries under the 2 °C emergency pathway. This meant starting India's CO_2 emissions expressed as approximately 0.44 Gt carbon annually (IEA estimate as of 2007) and making them increase and peak at 2020 before beginning the incremental decline (IEA, 2007). The point of this exercise is simply to show the emissions India would be required to have at the 2020 peak year under this budget scenario. This can then be compared with the emission scenarios given by various different agencies under the same time period.

The Indian government approved the Integrated Energy Policy in 2006 after many public consultations. This report outlines the challenges and prospects India faces in the energy sector up to 2031–2032 while attempting to maintain 7–8% economic growth in order to achieve poverty alleviation. Under an 8% growth rate, 11 scenarios are outlined in the report depicting what the energy fuel mix could be in the year 2031–2032 (see Fig. 2). The statistics given in the report were used to create graphs and visualize the percentage difference in fuel-type between the scenarios (see Table 1 for exact figures).

Scenario 1 is coal dominant as this is the most economical option for India. India is the 3rd largest producer and consumer of coal and has the 3rd largest reserves of coal in the world after the United States and China (IEA, 2007).

Scenario 5 sees a maximization of hydro to the full potential of 150 GW by 2031, assumes nuclear to provide 63 GW of power by 2030 on account of 8 GW worth of imports of Light Water Reactors with fuel over the next ten years. The latter assumes that the 8 GW capacity worth of imports could be coupled with

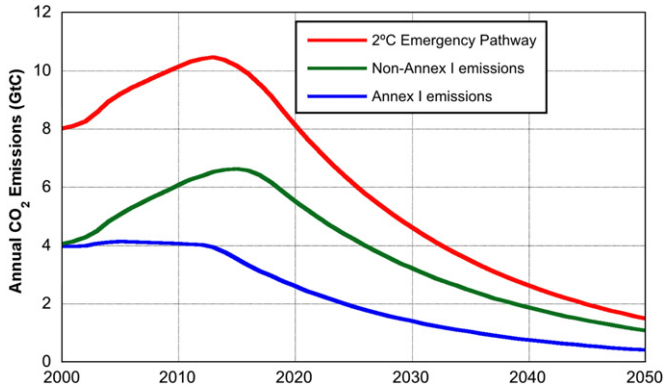

Fig. 1. South's Dilemma, GDR Framework. Green line shows the pathway/budget for the non-Annex countries in order to meet the global 2 °C target (Baer et al., 2008). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

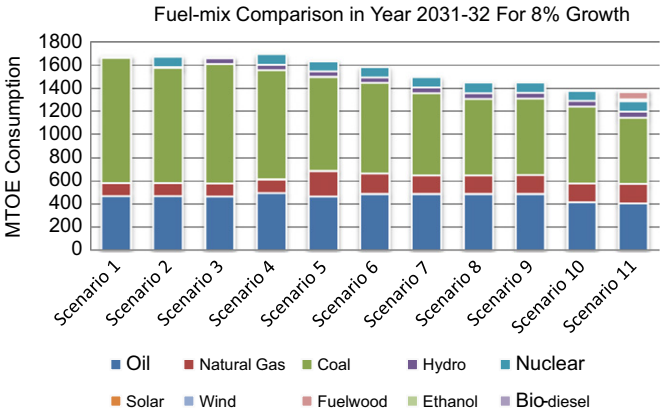

Fig. 2. Energy mix scenarios as outlined in the Integrated Energy Policy Report. *Source*: Planning Commission, Government of India.

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