India's climate pledge and the global goal of limiting warming below 2°C

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In this note we have compared India's pledges (also called Intended Nationally Determined Contributions, INDC) to the United Nations Framework Convention on Climate Change with that of other major economies of the world. We find that despite being the most populous country in the world in 2030, India's greenhouse gas emissions under its INDC scenario will still be about a third compared to China. Further, we test India's INDC on the two well-regarded, but divergent approaches of emission reductions sharing between the nations and conclude it is consistent with more than 50% probability of limiting warming below 2°C under both the approaches, provided that other world regions adhere to their required emission reductions.

Representatives from around 194 countries will be converging in Paris in December this year to negotiate a new international climate agreement, with the aim of finding ways to limit the warming below 2°C. In December 2013, all Parties to the United Nations Framework Convention on Climate Change (UNFCCC) were invited to submit their Intended Nationally Determined Contributions (INDCs) in the run up to the Paris climate convention. A total of 147 countries accounting for 86% of the global emissions submitted their voluntary greenhouse gas (GHG) emission reduction pledges by 1 October 2015 (http://www4.unfccc.int/submissions/indc/Submission%20Pages/submissions.aspx). India is also one of these countries that took the voluntary pledge to reduce their GHG emissions. Table 1 summarizes the key features of the country-level INDCs.

As part of its INDC, India promised to reduce the GHG emission intensity of its economy by more than one-third. India's INDC implies that its emissions will not be peaking anytime soon, but a unit of GDP will be produced at least 33% more efficiently in terms of GHG emissions, compared to the 2005 levels. Different countries have selected different yardsticks and benchmarks to communicate their INDCs. China's goal may seem more ambitious than India's; however, considering that China's economy was 33% more GHG-intensive than India's in the year 2000 (ref. 1), India's pledges are largely comparable to that of China's. Russia, on the other hand, has pledged to reduce its emissions by 25–30% from the 1990 base, shortly before its emissions plunged dramatically in the wake of the collapse of the former Soviet Union. This pledge relative to 1990 base means that Russia will actually be increasing its emissions substantially all the way to 2030.

Figure 1 projects the annual GHG emissions of the major economies over the period 2000–30, as implied by their respective INDCs. The figure suggests

Table 1. Key features of the climate pledges from the major economies

Country	Intended Nationally Determined Contributions (INDC) from the major economies
China	– To achieve the peaking of carbon dioxide emissions around 2030 and making best efforts to peak early; – To lower carbon dioxide emissions per unit of GDP by 60% to 65% from the 2005 level; – To increase the share of non-fossil fuels in primary energy consumption to around 20%; and – To increase the forest stock volume by around 4.5 billion cubic metres on the 2005 level.
USA	To achieve an economy-wide target of reducing its greenhouse gas emissions by 26–28% below its 2005 level in 2025 and to make best efforts to reduce its emissions by 28%.
EU	At least 40% domestic reduction in greenhouse gas emissions by 2030 compared to 1990 base.
India	– To reduce the emissions intensity of its GDP by 33 to 35 percent by 2030 from 2005 level; – To achieve about 40 percent cumulative electric power installed capacity from non-fossil fuel based energy resources by 2030 with the help of transfer of technology and low cost international finance including from Green Climate Fund (GCF). – To create an additional carbon sink of 2.5 to 3 billion tonnes of CO_2 equivalent through additional forest and tree cover by 2030.
Russia	Limiting anthropogenic greenhouse gases in Russia to 70–75% (i.e. implied reduction of 25–30%) of 1990 levels by the year 2030
Brazil	To reduce greenhouse gas emissions by 37% below 2005 levels in 2025. Further, to reduce greenhouse gas emissions by 43% below 2005 levels in 2030.
Japan	To reduce greenhouse gas emissions by 26% by 2030 compared to 2013 (25.4% reduction compared to 2005).
Canada	An economy-wide target to reduce its greenhouse gas emissions by 30% below 2005 levels by 2030.
Australia	An economy-wide target to reduce greenhouse gas emissions by 26% to 28% below 2005 levels by 2030.

that despite being the most populous country in the world in 2030, India's GHG emission under its INDC scenario is projected to be comparable to that of USA and EU, whereas China's GHG emission is projected to increase to about three times compared to India. Under the INDC scenario, India's projected 2030 emissions will still be only about half of China's present emissions.

In addition to the emissions intensity-based goal, India has also pledged to increase its forest cover so that an additional carbon sink of 2.5–3 billion tonnes of CO_2 (1 billion tonne = 1 Giga tonne) is created by the year 2030. This goal implies that India will be adding up to 200 $MtCO_2$ per year in terms of forest carbon sinks. Indian forests currently sequester a little less than 200 $MtCO_2$ (ref. 2) per year. Given the challenges of shortage of land, high population pressure, high mortality rate of saplings, and low natural vegetation productivity rates in India, almost doubling of the rate of current carbon sink in this short period (2016–30) is a challenging task. However, the fact that India pledged to these very ambitious goals in the forest sector in the first place, knowing fully well about the underlying challenges and uncertainties, itself highlights the country's commitment to the international climate negotiations and its ambition to contribute to the global endeavor of limiting warming below 2°C. India will require financial and technical assistance to realize these ambitious goals in the forest sector.

UNFCCC recently published an assessment of the submitted INDCs for their adequacy in limiting the warming below 2°C (ref. 3). It has concluded that though these INDCs constitute an important advance in the global climate change mitigation efforts, they are clearly not enough to limit warming to below 2°C. This indicates that climate convention in Paris will have to find ways to scale up the GHG emission reduction commitments far higher than the current INDC pledges.

Global temperature change is estimated to be linearly related to cumulative carbon emissions[4,5]. India accounted for only 2.7% of the cumulative CO_2 emissions over the period 1850–2010, while the industrialized countries accounted for 70% of the historic cumulative emissions[6]. Hence the industrialized countries are largely responsible for most of the current GHG build up in our shared atmosphere. Cumulative carbon budget-based proposals[7–9] for allocating future emissions to different regions fairly account for this 'responsibility'. However, despite the widening scientific consensus about the usefulness of the carbon budget approaches, this perspective has witnessed considerable resistance from both the developed and developing countries; even the Executive Secretary of the UNFCCC, citing political difficulties, ruled out the possibility of using carbon budget-based perspectives in the emission reduction negotiations[8].

Currently, the literature related to the allocation of future emissions to different regions or geographies is generally being framed between the two extremes. At the one end lies the 'grandfathering' approach that allocates future emissions based on current shares of emissions[10,11]. The other end requires an abrupt transition to equal per capita emissions, in which all regions of the world are allocated a carbon budget that is equal to their share of the world population[10,11]. Between these two extremes lie different proposals that allocate future emissions in a manner that achieves a delicate balance of 'effectiveness, equity, national capacity, political feasibility, economic efficiency and technical requirements'[11,12].

One of the currently well-regarded equity-based frameworks for allocation of future emissions is the approach of 'contraction and convergence'[11,13]. Under this framework national or regional per capita emissions are first allowed to increase or decrease, depending on the baseline emissions and national circumstances, for some period of time until they converge to a point of equal per capita emissions across all regions in a given year. We apply this framework[11] for the allocation of emissions in 2030 among the major economies and the rest of the world. However, instead of using the stock value of the emissions over the period 2016–30, we use the flow value in 2030. Here we assume that global emissions converge to per capita equity by the year 2030. In order to have a >66% chance of limiting warming below 2°C, the projected model pathways indicate that global annual emissions in 2030 would need to be between 32 and 44 $GtCO_2eq$ (ref. 14). We consider a mean value of 38 $GtCO_2eq$ to represent these model pathways. Permissible emissions for each country in 2030 are obtained by dividing this 38 $GtCO_2eq$ global emissions allowance among different countries based on their population shares in 2030. Figure 2 compares the emission allowances for each country with their INDC-based projected emissions in 2030.

There are uncertainties in the emission projections in 2030, uncertainties are larger in case of 'others' however Figure 2 does not account for this uncertainty. It also suggests that India is one of the few countries, whose climate pledge is consistent with the goal of stabilizing the warming below 2°C.

Global climate conventions witnessed a tug of war on the various interpretations

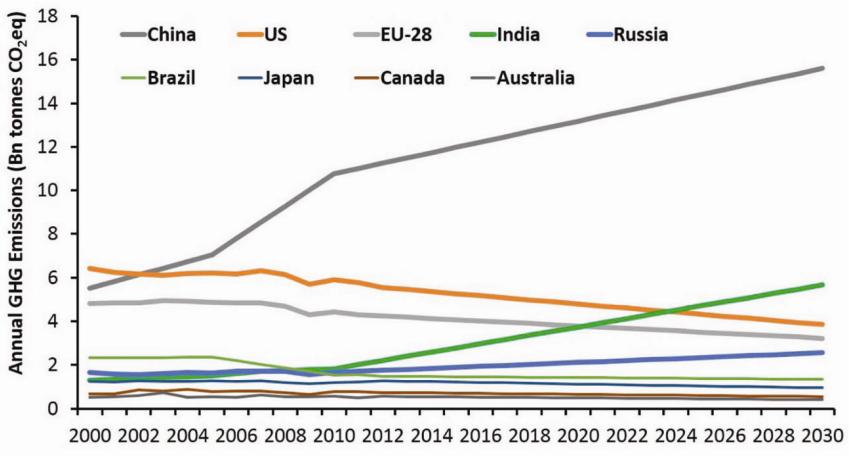

Figure 1. Greenhouse gas (GHG) emission projections for the major economies under their Intended Nationally Determined Contributions scenario. (For US 2030 emissions obtained based on 2025 and 2050 pledges; historic GHG emissions are obtained from UNFCCC; in case of China 2010 emissions obtained from EU database (http://edgar.jrc.ec.europa.eu/), and for India 2010 emissions computed from its INDC.)

of the issues of 'equity', 'responsibility' and 'capacity'. The criteria of 'equity in emissions' and of 'historical responsibilities' even though considered 'fair' for the allocation of the limited GHG space have been contested by the major emitters and the developed countries due to divergent interpretations of the concepts of 'responsibility' and 'capacity'. These disagreements have led to repeated failures of global climate agreements in the past 18 years since Kyoto (1997). Over this period global GHG emissions grew by about 26%. This prolonged disagreement meant that the world has already lost the opportunity to stabilize the warming below 1.5°C level and even the window to limiting warming below 2°C is fast closing[15]. IPCC in its fifth assessment report (WG3) published transformative emission reduction scenarios over the 21st century based on data from over 1000 new scenarios contributed by different integrated modelling research groups[16]. Based on these scenarios, IPCC provides regional emission reduction requirements for the 21st century, including the 2030 reductions relative to the baseline of 2010. Regional emission reduction requirements for the 430–530 ppm CO_2eq scenario are consistent with >50% chance of limiting warming below 2°C. These reductions are based on 'current emissions, regional mitigation potentials, and on the terms of trade effects' and are much more benign to the developed countries (compared to the criteria of emissions' equity, including its convergences at different dates) and imply that each region of the world more or less reduces its emission in 2030 compared to the 2010 levels. Developed countries are pledging emission reduction ambitions in line with these transformative scenarios (http://www.consilium.europa.eu/en/press/press-releases/2015/09/18-counclusions-un-climate-change-conference-paris-2015/; http://newclimate.org/2014/10/29/how-to-assess-the-level-of-ambition-of-an-intended-nationally-determined-contribution/), especially towards the second half of the century, which makes things a bit more flexible in the near-term, i.e. 2030. Under these scenarios developed countries, including Russia will reduce their emissions by 40% in 2030 compared to the 2010 levels, Latin America by 35%, while Asia could remain at the 2010 levels. These pathways do not provide any clarity on what individual countries should be doing within a region. Within Asia we assume that between China and India, China reduces its emissions, while giving vital space to countries like India to further grow their economies. Under these IPCC transformative emission reduction scenarios, we assess if India's INDC is consistent with limiting the warming below 2°C. Using the COP21 calculator (The COP21 calculator provides a simple and interactive description of how GHG emission reduction from countries over the period 2013–2100 impact the global temperatures. It allows the users to track and project GHG emissions from the major economies over the period 1870–2100. The calculator can be assessed here: http://ig.ft.com/sites/climate-change-calculator/, and the technical note describing the methodology can be obtained here: http://blogs.ft.com/ftdata/2015/10/20/how-we-built-the-cop-21-climate-change-calculator/; A copy of technical note can be requested from the authors), we estimate that if the other regions of the world adhere to their emission reduction requirements, then India's INDC scenario is consistent with a >50% probability of limiting warming below 2°C. In the event that developed countries are able to commit to more than 40% reduction (compared to the 2010 base), the chance for limiting warming below 2°C increases further.

This implies that India's projected emissions in 2030 are not large enough

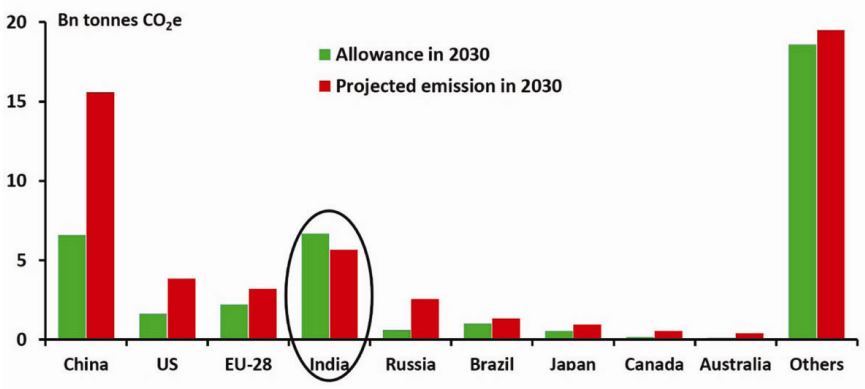

Figure 2. Comparison of emission allowance for each country based on the convergence of per capita equity in 2030 (for having >66% chance of limiting warming below 2°C) with the projected 2030 emissions from major economies of the world (Population data obtained from the UN (UNDESA, 2013) (http://www.un.org/en/development/desa/population/theme/trends/index.shtml; medium fertility scenario).

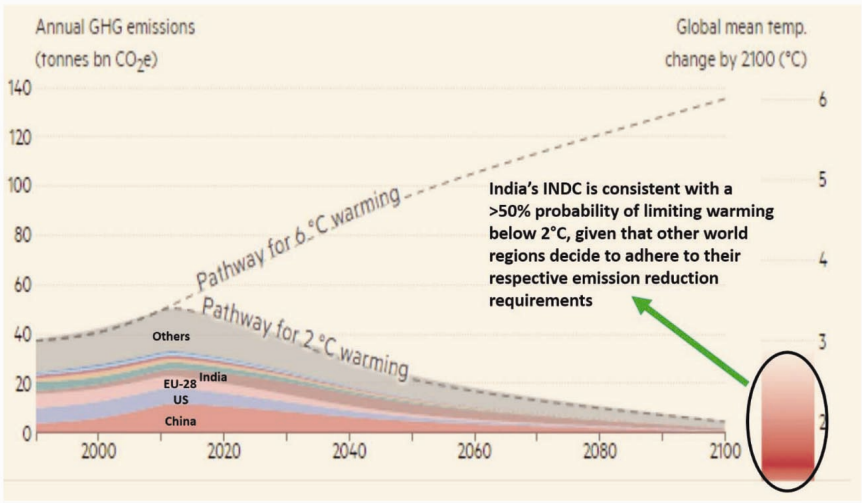

Figure 3. A possible global pathway for limiting warming below 2°C, with India's INDC, under the broad framework of IPCC's transformative scenarios (Figure shows the historic and projected emissions from China, US, EU, India, Russia, Brazil, Japan, Canada, Australia and Others in the order of bottom to top).

to jeopardize the 2°C target, given that other world regions decide to adhere to their respective emission reduction requirements. However, given the finite carbon space, there are risks to this scenario, especially if other regions or countries fail to meet their emission reduction requirements. Thus, while India's 2030 emissions will still be a little less than about one-third compared to China, the importance and benefits of further emission reductions could never be overstated. Our simulations further suggest that while till 2030 India continues to increase its emissions, it will have to take deep emission cuts post-2030 (Figure 3). Much of the infrastructure in India is still to be built and it is both an opportunity and a challenge that this upcoming infrastructure is built in a sustainable manner so that India does not lock herself into a GHG-intensive future. To avail these opportunities and to face these challenges, India needs support from the international community in terms of technology transfers and finances. A study[17] analysed the geographic distribution of inventions of a basket of 13 key climate mitigation technologies, and the trends in the international transfer (export) of these technologies based on the EPO/OECD World Patent Statistical Database (PATSTAT). The study concludes that at the global scale innovations are highly concentrated in three countries – Japan, Germany and USA – which account for 60% of the total innovations, with China and Korea accounting for another 15%. This indicates that most of the new technologies are being generated by the developed countries, plus China and Korea. Further, in terms of international transfer of these technologies, the study concludes that these mostly occur among developed countries, accounting for 73% of the total exported inventions and the technology transfer from developed countries to emerging economies is a meagre 22%, with China alone accounting for 75% of the same. The study further concludes that technology transfer from emerging countries such as China and Korea to other emerging economies such as India is almost non-existent. Given that climate change mitigation is largely a technology related issue[18], non-existent international technology transfers put emerging economies like India in a difficult situation. Under these uncooperative circumstances, it is hard for developing countries like India to find a balance between poverty alleviation goals and GHG emission reductions. Given limited international co-operation and India's huge reliance on coal for power production, one worries if India will be able to fulfill its developmental goals in the next 15 years, while still emitting only about one third of China's.

With the submission of the current INDCs, the world has taken an important first step towards a sustainable future. However, there still remains a large gap between current pledges and the emission reductions required to limit warming at safe levels. No single country can bridge this gap alone: it can be only achieved through genuine international cooperation, assistance, mutual trust and capacity building. India has already risen to this occasion and is doing its level best to limit the warming to sustainable levels. However, to achieve its full potential to contribute to emissions reduction India will need genuine cooperation, assistance and capacity building from developed countries and other advanced developing countries, which is currently not adequate.

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