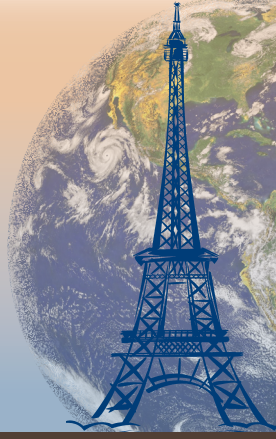

India:
Potential for Even Greater Emissions Reductions

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In 2013, India emitted 2.4 billion metric tons (GT) of carbon dioxide, making it the third-largest emitter in the world. India ranks in emissions behind only China (10.0 GT) and the United States (5.2 GT). Along with the European Union, these three countries emitted almost 60 percent of the worldwide CO2 emissions in 2013. Thus, India's October submission of its Intended Nationally Determined Contribution (INDC) to the United Nations was widely anticipated.

In its Intended Nationally Determined Contribution, India expressed its intent by 2030 to:

1. Reduce the emissions intensity of GDP by 33-35 percent from the 2005 levels.
2. Increase the percentage of non-fossil-fuel electricity to about 40 percent of total electric power capacity.
3. Create an additional carbon sink of 2.5-3.0 billion tons of CO2-equivalent through additional forest and tree cover.

Here I discuss the ambition of India's INDC, how it compares to the emissions goals of China, why there's significant potential to increase India's contribution to emissions reduction, and how that could be done.

India's emissions goals are less ambitious than they look

The goal to reduce India's emission intensity by 33-35 percent by 2030 seems ambitious, but if one examines the target more closely it does not seem very difficult to achieve. India's emissions intensity in 2005 was 0.47 metric tons of carbon dioxide per $1,000 of GDP; it would be reduced to about 0.31 metric tons in 2030 if India's emissions intensity goal is reached. If the Indian economy grows at 7 percent between now and 2030 it will reach about $18 trillion in terms of purchasing power parity, based on 2005 prices. If India's emissions intensity is then 0.31, then CO2 emissions in 2030 would be about 5.6 GT.

In April 2014, an expert group convened by the Indian Planning Commission issued a report that called for a major increase in investment in nuclear, hydroelectric, wind, solar, and biomass capacity compared to a baseline or business-as-usual projection. The report projected 2030 emissions would be about 5.3 GT in a business-as-usual scenario, not much different than the expected 5.6 GT using the government's INDC goal for emissions intensity. If the report's proposal for a low-carbon growth strategy were to be accepted, the projected emissions in 2030 would be only 3.8 GT—that's 1.8 GT less than the INDC's 33-35 percent reduction in emission intensity.

India's intent to achieve 40 percent of total electric power installed capacity from non-fossil-fuel based energy sources by 2030 can also be achieved relatively easily. Current production capacity is already about 27 percent non-fossil-fueled. Total non-fossil-fuel capacity in the proposed expert group low-carbon strategy is projected to be 52 percent by 2030, much above the current Indian goal of 40 percent.

Some media outlets have reported incorrectly that India intended to produce 40 percent of its electricity from renewable sources rather than have 40 percent of its capacity be non-fossil-fuel-fired (see here and here). India's 40 percent target for non-fossil-fuel capacity includes nuclear energy, which is not a renewable source, as well as renewable sources such as hydro, wind, solar, and biomass power plants. Furthermore, hydroelectric, wind, and solar plants can operate on average at only a fraction of their nameplate capacity. As a result, non-fossil-fuel production is normally a significantly smaller percentage of *production* than it is as a percentage of *capacity*. Typically, hydroelectric plants operate on average at 45 percent, and wind and solar around 30 percent of full capacity because they are limited by the volume of water, wind, and sunshine available. Fossil-fuel-fired thermal plants can operate in excess of 80 percent of full capacity. For example, although the expert group projected that non-fossil-fuel *capacity* could be 52.0 percent with the strategy that they propose, non-fossil-fuel electricity output in 2030 would be only 24.2 percent of the total electricity *produced*.

Yet India's emissions goals are more ambitious than China's

As of November 2015, it seems clear that the INDCs submitted thus far are not sufficient to achieve the internationally agreed-upon target of limiting the growth of the average global temperature to less than 2.0 degrees Celsius by the end of this century. Climate Action Tracker, a consortium of four research institutions, estimates that by the end of this century the INDCs can limit global warming to 2.7 C—more than the 2.0 C target.

According to Climate Action Tracker, the range of uncertainty around their projection of 2.7 C is between 2.2-3.4 degrees Celsius. This seems to be a rather more narrow range than could be inferred from the uncertainties around the INDCs of both China and India, the first- and third-largest emitters of carbon dioxide in the world.

The reduction in CO2 emissions implied by China's goal of achieving peak emissions by 2030 is very uncertain, because there is no limit on the growth of China's emissions between now and then. Over the last decade, greenhouse gas emissions by China have been growing at nearly 10 percent a year. If they grow half as fast between now and 2030, China's CO2 emissions will more than double—from 10 GT in 2013 to 24 GT in 2030—and the per capita emissions of China would then be 70 percent more than in the United States before China even begins to reduce emissions.

India chose not to declare when their carbon dioxide emissions will peak. However, if India's emissions were to peak when India reached the same per capita income (on a purchasing power parity basis) as China is expected to have in 2030, we estimate that the peak will not occur until about 2043. An Indian commitment to a year of peak emissions would add little to reducing the uncertainty about future emissions growth.

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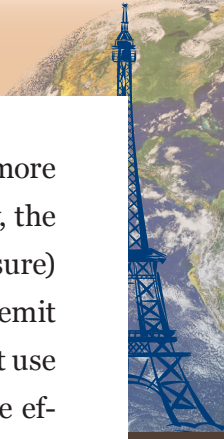
China's announced intent to reduce the emissions intensity of GDP by 60-65 percent compared to 2005 is a more meaningful constraint on emissions than its pledge to begin to reduce emissions in 2030. However, China's proposed reduction in emissions intensity also seems more ambitious than it is. In 2005 China's emissions intensity was 0.941 metric tons per $1,000 of GDP, roughly twice that of India. If China reduces its emissions intensity from this level by 62.5 percent between 2005 and 2030, it will be 0.353 metric tons per $1,000 of GDP in 2030, still well above the Indian 2030 target of about 0.310 tons per $1,000 of GDP.

Furthermore, if China's GDP grows at 7 percent a year between now and 2030, and its emission intensity is 0.353 metric tons in 2030, its total emissions in that year will be approximately 15.5 GT, 50 percent more than in 2013 and almost three times the total emissions of 5.6 GT projected for India in 2030. China's emissions per capita in 2030 will be approximately 10.35 metric tons, almost three times the per capita emissions of India of 3.73 metric tons in 2030.

China has also announced its intent to increase the share of non-fossil fuels in its primary energy consumption to around 20 percent, a more meaningful target than India's for non-fossil-fuel sources to reach 40 percent of total electricity capacity. However, the impact on both Chinese and Indian emis-



sions has relatively little to do with how much non-fossil-fuel energy resources are used and a lot more to do with the energy efficiency of its new coal-based power plants, and, even more significantly, the importance of natural gas relative to that of coal for power production. Supercritical (high-pressure) coal plants can be almost one-third more efficient than subcritical (low-pressure) coal plants and emit proportionately lower amounts of carbon dioxide. Modern natural gas combined cycle plants (that use waste heat from gas turbines to produce additional electricity from steam turbines) can achieve efficiencies almost twice that of subcritical coal plants and produce two-thirds less CO2.

There is significant potential to improve India's emission goals at Paris

As noted, the INDCs introduced for the COP21 negotiations are insufficient to achieve the goal of limiting a global temperature increase to 2.0 C. Thus, participants in Paris may explore how to improve the current crop of INDCs before the next round of negotiations. India has a lot of potential for improvement.

The level of emissions in 2030 implied by India's goal of reducing the emissions intensity of GDP by 33-35 percent is about the same as that in the business-as-usual case documented by the Planning Commission's expert group. Thus, India can achieve its current INDC emission goals by undertaking very few, if any, new initiatives.

The expert group proposed a low-carbon growth strategy that could result in 3.8 GT of carbon dioxide emissions in 2030, a reduction of 1.5 GT from the 5.3 GT of emissions projected in the business-as-usual case. The implied reduction in emissions intensity would be 55 percent.

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The problem with the expert group low-carbon growth strategy is that it would require additional investment of approximately $834 billion, or about $650 per capita, over the 20-year period from 2011 to 2030, a very large investment for a lower-middle-income country like India. Most of the additional investments would be made in developing and building additional supercritical coal plants, hydroelectric and nuclear plants, and utility-scale wind and solar power plants compared to the business-as-usual case, which relies much more heavily on subcritical coal plants to meet the future growth in demand for electricity.

The expert group did not include as part of its low-carbon growth strategy any additional investment in highly efficient natural gas combined cycle plants, which are far less capital intensive than coal, hydro, nuclear, and renewable electric power and emit far less carbon dioxide than coal plants. Natural gas combined cycle plants can only achieve maximize fuel efficiency if a supply of natural gas can be assured to run the plants at close to full capacity—for example, by entering into long-term contracts for imported liquid natural gas. There also needs to be a tax on, or price for, CO2 emissions such that it makes natural gas preferable to coal in the so-called dispatch order. Natural gas will also become more attractive if the administered price for local natural gas is abolished or linked to import prices for liquid natural gas. Currently, the linkage of administered local prices to domestic prices in Russia, Canada, the United Kingdom, and the United States makes very little sense for India and has discouraged exploration and development of local natural gas resources.

The energy policy reforms required to take more advantage of natural gas will be difficult to achieve but can generate significant benefits at a lower cost. In order to estimate the net benefits of including natural gas combined cycle as an alternative in a low-carbon growth strategy, I cut the expert group's reliance on supercritical coal plants by one-half, increased investments in wind power, and reduced investments in very high capital cost solar plants, many of which are not likely to be built because of transmission constraints. With this new low-carbon strategy:

1. Carbon dioxide emissions would be further reduced by about 400 million tons to 3.4 GT in 2030, 1.9 GT lower than the business as usual projection.

2. Additional investment requirements would be reduced by $415 billion, cutting the total required additional investments in the expert group report by almost half, from $834 billion to $429 billion.

3. Non-fossil-fuel electric power capacity could be 52 percent of total electric power capacity in 2030, significantly higher than the 40 percent goal in India's INDC.

India's INDC is a good first step in defining its contributions to emission reductions and compares favorably with China's emissions goals, but the potential for even greater contributions by India clearly exists.