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Indian leadership on climate change: Punching above its weight*

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Indian Prime Minister Narendra Modi and others at the highest political level have outlined in recent statements India's commitment to constructive engagement with the global effort to combat climate change. Taken at face value, these statements indicate that India wants to take a leadership role in addressing climate change. However, in the global discourse on climate change, India often gets singled out for resisting mitigation action and for its reliance on fossil fuels such as coal. In this paper we argue that in addition to the efforts directed toward coping with and adapting to climate impacts (e.g., recent floods in Kashmir and monsoon failure in 2014), India is also "punching above its weight" on mitigation.

India ratified the United Nations Framework Convention on Climate Change (UNFCCC) in November, 1993 and is a Non Annex 1 Party to the Convention. As a Non Annex 1 Party, India is not bound to mandatory commitments under the Convention. This is a central to the notion of "Common but Differentiated Responsibilities and Respective Capabilities" as enshrined in Article 3 of the Convention.[1]

Overall development of any nation is directly linked to its energy use and access: energy poverty is a good indicator of low levels of overall development. The United Nations Development Program's Human Development Reports have established that energy access and development are interlinked. Energy poverty is defined as a lack of adequate access to "modern energy services." Modern energy

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services include the access of households to electricity and clean cooking facilities—fuels and stoves that do not cause indoor air pollution. The poor in India are spending more than the rich in the developed countries on energy generally and clean energy specifically. Around 306.2 million people in India lack access to electricity (Table 1), perhaps the largest energy access challenge anywhere in the world. At around 705 million, India also has the highest number of people without access to non-solid fuels.[2]

Table 1: Access to Energy (Electricity and Non Solid Fuels)

	Access to Electricity (% of population)					Access to Non-Solid Fuel (% of population)				
Country	Total			Rural	Urban	Total			Rural	Urban
	1990	2000	2010	2010	2010	1990	2000	2010	2010	2010
Brazil	92	97	99	94	100	81	89	94	64	>95
China	94	98	100	98	100	36	47	54	19	70
Germany	100	100	100	100	100	>95	>95	>95	>95	>95
India	51	62	75	67	93	13	29	42	14	77
Japan	100	100	100	100	100	>95	>95	>95	>95	>95
U.S.A.	100	100	100	100	100	>95	>95	>95	>95	>95

Source: Global Tracking Framework, IEA

Carbon dioxide (CO2) emissions from energy use account for the majority of greenhouse gas emissions. According to the International Energy Agency (IEA), "meeting the emission goals pledged by countries under the United Nations Framework Convention on Climate Change (UNFCCC) would still leave the world 13.7 billion tons of CO2—or 60%—above the level needed to remain on track for just 2°C warming by 2035."[3] There are at least two ways to tackle this problem. The first is to scale up clean energy efforts, whether in the form of fuel switching from coal to gas or installation of renewable energy capacities. The second option is perhaps harder: lowering energy consumption dramatically by altering lifestyles in developed countries.

For India, the viable solution to address the global climate change challenge is clear. Given its low base, India's demand for energy will increase manifold in the decades ahead (energy consumption will increase by 128 percent by 2035 according to BP).[4] India will have to scale up efforts on the clean energy front: an enabling global agreement and domestic investment environment are critical for this.

Renewable Energy Framework

Development of renewable energy has been one of the pillars of the Indian Government's strategy to improve energy access to tackle energy poverty. India's Integrated Energy Policy, formulated in 2006, lays down a roadmap for harnessing renewable energy sources.[5] The extant policy framework for promoting renewable energy follows from this, with a target of adding 30 gigawatts (GW) by 2017 as per the 12th Five Year Plan. The sector specific developments are:

1. **Solar Energy:** The National Solar Mission, being implemented by the Ministry of New and Renewable Energy, increases utilization of solar energy for power generation and direct thermal energy applications. The long-term goal is to generate 20 gigawatts (GW) of grid connected solar power by 2022. The government has recently announced its intentions to increase the target for installed solar capacity to 100 GW.

2. **Wind Energy:** Wind energy is the largest source of renewable energy in the country. According to the meso-scale Wind Atlas (yet to be validated through field measurements), India has a potential of generating around 102 GW of wind power at 80 meters above sea level. Around 22 GW of wind power capacity had been installed by November 2014. Fiscal incentives in the form of a Generation Based Incentives (GBIs) on a per unit generated basis and Accelerated Depreciation (AD) that allow greater tax deductions early on in the project cycle have been reinstated recently. In the latest Union Budget, the Government has specified a 2022 target of 60,000 MW on wind energy capacity.

3. **Biomass:** The government has been supporting grid-interactive biomass power and bagasse co- generation in sugar mills in India, with a target of 400 megawatts (MW) between 2012 and 2017. Central financial assistance is provided for this. A 2022 target of 10,000 MW of installed biomass capacity has been announced recently.

4. **Waste to Energy:** The Indian government, through the "Swachh Bharat Mission," under the Ministry of Urban Development, has provided support for up to 20 percent of project costs linked 'Viability Gap Funding'[6] for waste processing technologies.

5. **Small Hydropower:** Hydropower units of less than 25 MW are classified as "Small Hydropower" projects by the government. As of December 2014, a total capacity of around 3,946 MW was available from such projects in India. Section 7 of the Electricity Act of 2003 stipulates that "any generating company may establish, operate and maintain a generating station without obtaining a license/permission if it complies with the technical standards relating to connectivity with the grid."[7] The government is targeting an installed capacity of 5000 MW by 2022.

At the end of the fiscal year in March 2014, the total cumulative installed capacity for renewable energy in India was around 13 percent of the total electricity share at 31,707 MW. The average per capita electricity consumption in India for the year 2013-14 was 957 kWh[8]: around seven per cent of the per capita consumption of the United States between 2010 and 2014 (13,246 KWh).[9] This is a stark reflection of India's energy poverty challenge. Despite a very low base of per capita electricity consumption, the scope and ambition of India's renewable energy initiatives is remarkable.

Assuming a solar energy capacity addition of 100 GW by 2022 as per the government's plan, India's per capita renewable energy installed capacity, not accounting for any capacity growth in wind, biomass, and waste to energy, will be around 92.6 watts per person, well over today's global average of around 80 watts per person.[10] This is a conservative estimate since currently wind power accounts for the largest share of renewable energy, at around 67 percent of total installed capacity, whereas solar accounts for only around 8 percent.

We should also note here that the large hydro (25 MW and above) potential and installed capacity is also significant and is not counted in the renewable energy estimates above. Large hydro potential in the country is around 145,320 MW of which 36,080 MW has been commissioned as of December 2014.[11] This is more than the entire renewable energy installed capacity in the country. Power from large hydro can also provide base load power to mitigate intermittency challenges of renewable energy.

Per Capita Spend on Renewable Energy

At the Conference of Parties (COP) to the UNFCCC in Paris (COP-21) in 2015, global leaders will decide if an international renewable energy and energy efficiency bond facility will be established.[12] Securing financing for mitigation and adaptation efforts is key to any meaningful attempts to address climate change. Promoting renewable energy offers a clear pathway for reducing greenhouse gas emission from the energy sector.

The key constraint to the development of renewable energy has been the historically higher costs associated with it. There are wide divergences in the Levelised Cost of Electricity (LCOE), as defined by the International Renewable Energy Agency (IRENA), depending on location. The cost of generation in non-OECD countries for both wind and solar power tends to be lower than for OECD countries owing to various structural factors such as cheap labor rates that lower project costs. For illustration purposes, the range of LCOE as assessed by IRENA in 2012 has been used.[13] In the case of Solar Photovoltaic systems without batteries the estimated LCOE is between 0.25 to 0.65 KWh. For onshore wind energy (projects larger than 5 MW), the costs are between 0.08 and 0.12 KWh.[14]

Assuming a weightage of 94 percent wind power and 6 percent solar power generation in India, the costs per KWh of electricity generated through renewable energy is between 0.09 and 0.135 (Table 2). Costs in USA, Germany, China, and Japan have also been estimated and summarized in the Table 2.

Table 2: Cost of Renewable Energy (USD) per KWh, 2012

Lower End	India	USA	Germany	China	Japan
Upper End	0.09	0.09	0.09	0.09	0.08
Weightage in	0.1356	0.1356	0.1356	0.1356	0.224
Renewables Mix	94% (W), 6% (S)	94% (W), 6% (S)	94% (W), 6% (S)	94% (W), 6% (S)	60% (W), 40% (S)

*Rough estimations (assuming that renewable energy is largely a combination of wind and solar, particularly given the relatively negligible growth in other sources over 2012-2040) following from electricity generation shares specified in the World Energy Outlook 2014, for countries (EU figures used as a proxy for Germany) in 2012

100 GW of installed solar energy capacity by 2022, run at a plant load factor of 13 percent,[15] will produce around 113,880 GWh or 113,880,000,000 KWh of electricity annually. Under this scenario India would be spending between USD 28.4 billion and USD 74billion on its LCOE for solar power based generation (using solar photovoltaics). The Indian government estimates that the additional overall investments required to facilitate this would be to the tune of USD 100 billion.[16] To further put this into perspective, 100 billion USD is around a third of the total budgeted expenditure of India's Union Government in 2015-16 (INR 17.77 lakh crores). Based on the lower end estimates in Table 2, the LCOE will be over a tenth of the total amount of 100 billion USD that the Green Climate Fund is to make available by 2020.

Given the fiscal challenges, India punches well above its weight in terms of its expenditure on renewable energy (Solar Photovoltaic and Wind Energy). Using verifiable approximations for 2012, the average Indian spent about one and a half times what the average Chinese spent, between 2.2 and 4.3 times what the average Japanese spent, and around 2 times what the average American spent. Indians spent between two thirds and half of what average Germans spent.

Table 3: Per Capita Income Spent on Renewable Energy (in % of Daily Income) in 2012*

Lower End	India	USA	Germany	China	Japan
Upper End	0.1080	1.95	4.146	0.3007	0.776
Weightage in	0.26	0.12	0.40	0.17	0.06
Renewables Mix	0.44	0.21	0.82	0.29	0.20

*Calculated on the basis of per capita incomes and country populations in 2012 as specified by the World Bank; renewable energy consumption as available in the BP Statistical Review of World Energy 2014 for the category 'other renewables' (2012) which is based on gross generation from renewable sources including, wind, geothermal, solar, biomass and waste, and not accounting for cross-border electricity supply and converted on the basis of thermal equivalence assuming 38 per cent conversion efficiency in a modern thermal power station; and the estimates in Table 2

*Calculated on the basis of per capita incomes and country populations in 2012 as specified by the World Bank; renewable energy consumption as available in the BP Statistical Review of World Energy 2014 for the category 'other renewables' (2012) which is based on gross generation from renewable sources including, wind, geothermal, solar, biomass and waste, and not accounting for cross-border electricity supply and converted on the basis of thermal equivalence assuming 38 per cent conversion efficiency in a modern thermal power station; and the estimates in Table 2

Over the next 7 years until 2022, India has a target of renewable energy capacity of 175 GW and most of this capacity addition is to come from solar and wind energy.[17] As India ramps up its solar

capacity to 100 GW and wind to 60 GW, which is close to the total wind and solar installed capacity in the EU in 2012,[18] the average Indian per capita spending on renewable energy as a percentage of daily income should positively compare with average EU levels.

Energy in the Paris Agreement

The future of global energy and the climate change challenge is contingent on a number of political and economic factors. This last year has been proof that even well-formed trends, such as in the case of the global price of oil, can change drastically. Current estimates suggest that coal, oil, and gas will contribute around 81 percent of primary energy consumption until 2035.[19] However, these estimates are based on benchmark prices of commodities and current technologies.

Changes in both prices and technologies associated with oil, coal, and gas are essentially unpredictable. However, the cost of renewable energy will certainly continue to decrease consistently in the coming years. The cost competitiveness of renewable energy in the form of onshore wind is already at par with fossil fuel based systems for generating electricity, and the LCOE for solar has halved between 2010 and 2014.[20] The costs of utility scale solar energy are likely to become competitive with fossil fuels in the future. Indeed this competitiveness narrative of renewable energy remains highly nuanced, and depends on a variety of factors such as existing grid infrastructure and labor costs. For instance, since the penetration of renewable energy in India is high, a substantial grid infrastructure cost will be involved in scaling up electricity generation through renewable energy.

As part of the domestic financing framework, recent measures have helped transition Indian policies from a carbon subsidization regime to a carbon taxation regime. From October 2014, a de facto carbon tax equivalent of USD 60 per ton of carbon dioxide equivalent in the case of unbranded petrol and around USD 42 per ton in the case of unbranded diesel has been introduced. In addition the clean energy cess[21] on coal has been doubled and is now equivalent to a carbon tax of around USD 1 per ton.[22]

However the fiscal space to maneuver is limited given that the proportionate per capita spend on renewable energy in India is already much higher than developed and developing countries and does divert resources from necessary social and infrastructure spending.

The main barrier for increasing renewable energy penetration will be a lack of financial and technological flows; India's achievements in renewable energy have occurred in spite of such flows. For instance, Clean Development Mechanism-linked flows, which could potentially subsidize renewable energy development dried up a few years ago owing to the oversupply of Carbon Emission Reduction certificates which are now trading at near zero levels.[23] Similarly, transfer of

cutting edge clean energy technologies has been limited by international trade law and protectionist policies of innovating countries. Capital flows can be unlocked by a new global agreement and robust bilateral cooperation on clean energy could potentially prove to be the most effective medium for government—government technology transfer.

In an important 1991 report on global warming, Anil Agarwal and Sunita Narain made a compelling case that "those who talk about global warming should concentrate on what ought to be done at home."[24] It seems that the conversation at the UNFCCC has inevitably evolved to reflect this discouraging reality. The centrality of the Intended Nationally Determined Contributions in the draft negotiating text of the Lima Call for Climate Action is indicative of the renewed focus on domestic action.[25]

Gauging by the renewable energy thrust alone, India's response at home has been more than commensurate with its economic weight. It must, at the very least, demand similar levels of per capita renewable energy spending by way of commitments from OECD countries. India is already among the countries leading the clean energy transition and must demand that much of the developed world catch up when the Conference of Parties meets at Paris.

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Endnotes:

1. https://unfcccint/files/essentiao_background/background_publications_htmlpdf/application/pdf/conveng.pdf
2. Common solid fuels used in India include dung cakes and firewood
3. http://www.iea.org/topics/climatechange/
4. http://www.bp.com/en/global/corporate/about-bp/energy-economics/energy-outlook/country-and-regional-insights/india-insights.html
5. http://planningcommission.nic.in/reports/genrep/rep_intengy.pdf
6. Viability Gap Funding is a grant to support infrastructure projects become financially viable
7. http://164.100.47.132/lssnew/psearch/QResult16.aspx?qref=7880
8. As per the provisional figures of the Central Electricity Authority: http://164.100.47.132/lssnew/psearch/QResult16.aspx?qref=8212
9. http://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC
10. Population in 2022 = 1.42 billion assuming a 17.64 per cent growth rate as seen in the decade 2001-2011 as per the Census of India
11. http://164.100.47.132/lssnew/psearch/QResult16.aspx?qref=8211
12. As per the draft negotiating text for COP 21: http://unfccc.int/resource/docs/2014/cop20/eng/10a01.pdf#page=2
13. http://costing.irena.org/media/2769/Overview_Renewable-Power-Generation-Costs-in-2012.pdf
14. Concentrated solar power systems generate solar power by using mirrors or lenses to concentrate a large area of sunlight, or solar thermal energy, onto a small area;
15. Considered by the IEA in the report: https://www.iea.org/publications/freepublications/publication/projected_costs.pdf
16. Economic Survey of India, 2014-15, Available at: http://indiabudget.nic.in/es2014-15/echapter-vol1.pdf
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