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Considering the practical application of India's COP21 INDC

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India's officially stated INDCs

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1. To put forward and further propagate a healthy and **sustainable way of living** based on traditions and **values of conservation and moderation**.

2. To adopt a **climate friendly and a cleaner path** than the one followed hitherto by others at corresponding level of economic development.

3. To **reduce the emissions intensity of its GDP** by **33 to 35% by 2030** from **2005 level**.

4. To achieve about **40% 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).

5. To **create an additional carbon sink of 2.5 to 3 billion tonnes of CO2 equivalent** through additional forest and tree cover by **2030**.

6. To **better adapt** to climate change by enhancing investments in development programmes in sectors vulnerable to climate change, particularly agriculture, water resources, Himalayan region, coastal regions, health and disaster management.

7. To mobilize **domestic and new & additional funds** from developed countries to implement the above mitigation and adaptation actions in view of the resource required and the resource gap.

8. To **build capacities**, create domestic framework and international architecture for quick diffusion of cutting edge climate technology in India and for joint collaborative R&D for such future technologies.

Questions India's INDC had to have answered

- What are India's interests and what could India pledge? This requires an understanding of climate-development synergies, costs of action, and costs to India of climate impacts.

- In an international context, what is in India's strategic interest to place on the negotiating table? Larger foreign policy considerations also play a role.

- What is the financial support available for adapting to and mitigating the effects of climate change?

What does the INDC do?

It rehearses, as it should, long-standing elements of the Indian negotiating position: that an agreement should address all components—adaptation, finance, technology, capacity—and not just mitigation; that considerations of equitable access to carbon space are most significant; and that the Paris outcome must be based on the principle of equity and "common but differentiated responsibility and respective capabilities."[1]

[1] http://www.epw.in/system/files/pdf/2015_50/42/Neither_Brake_Nor_Accelerator.pdf

Current and projected emissions in India

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Carbon Dioxide Emissions in India						
Year	2005	2007	2008	2009	2013	2014
Carbon Dioxide Emissions mn Tonnes	1,160	1,357	1,431	1,585	1,745	1,954
Percent increase from previous period		16.9	5.4	10.8	10.0	11.9

Source: www.indiastat.com

Projection of GHG emission by 2030

	NCAER CGE Model	TERI MoEF Model	IRADe AA Model	TERI Poznan Model	McKinsey India Model
GHG emissions in 2030-31 (CO_2 or CO_2e) (billion tons)	❑ 4.00 billion tons of CO_2e	❑ 4.9 billion tons (in 2031-32)	❑ 4.23 billion tons	❑ 7.3 billion tons in 2031-32	❑ 5.7 billion tons (including methane emissions from agriculture); ranges from 5.0 to 6.5 billion tons if GDP growth rate ranges from 6 to 9 per cent

Source: www.moef.nic.in

Note to slide 5

Models used for projection:

- NCAER (National Council of Applied Economic Research with Jadavpur University): National Computable General Equilibrium (CGE) Model (NCAER-CGE)

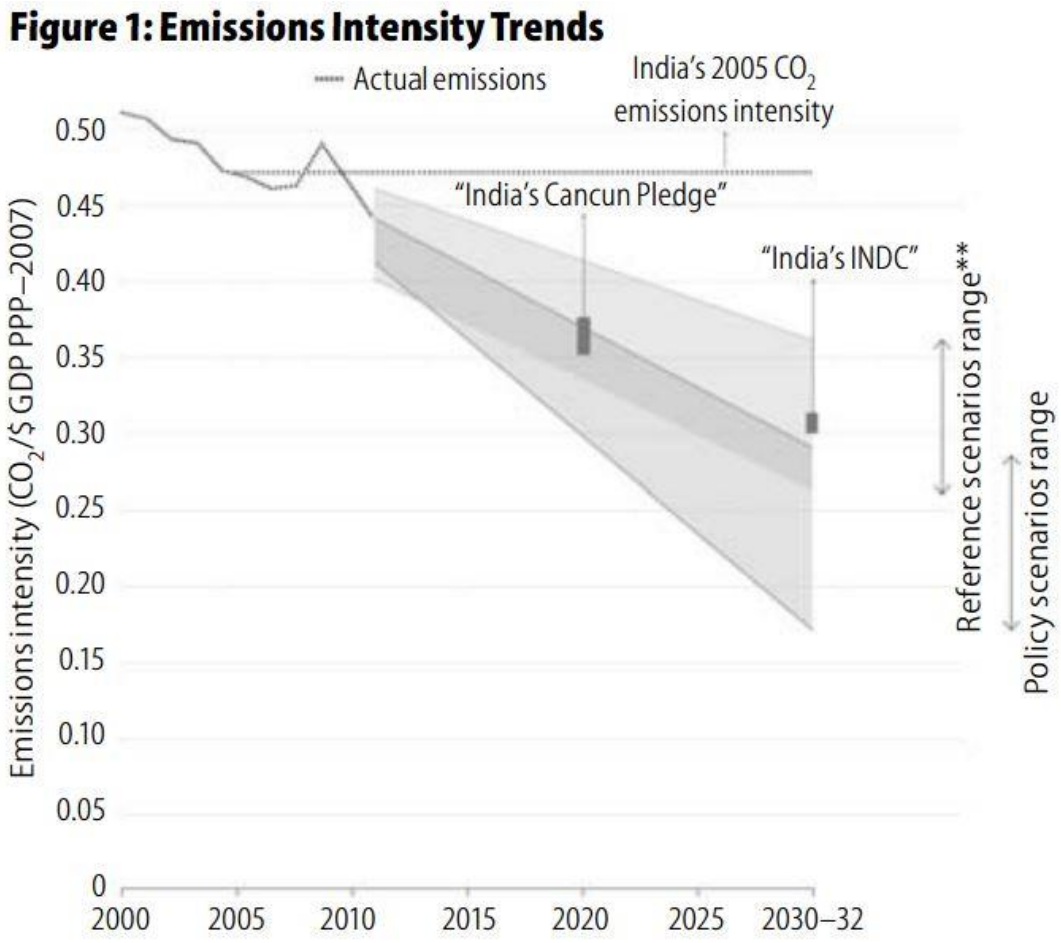
- TERI: India MARKAL model (TERI-MoEF) : TERI-MoEF, a market allocation (MARKAL) modelling study by the Energy & Resources Institute (TERI); MARKAL is a generic model tailored by the input data to represent the evolution over a period of usually 30 to 50 years of a specific energy system at the global, national, regional, or state level.

  The MARKAL model is a bottom-up cost-minimization energy sector model with a potential to internalize environmental considerations and study the effects thereof. It involves a Linear Programming Model set up with an objective function of cost-minimization of the overall energy system over a 30 year modelling timeframe extending from 2001-2031. While minimizing total discounted cost, the MARKAL model must obey a large number of constraints, which express the physical and logical relationships that must be satisfied to properly depict the associated energy system.

- Teri Poznan Model – Idencial TERI-MoEF except that it assumes a lower GDP growth rate than the TERI-MoEF study

- IRADe(Integrated Research for Action and Development): Activity Analysis Model (IRADe-AA)

INDC#3: Emissions Intensity (EI)



The **33-35% EI target** is at the conservative end of the spectrum. Dubash et al (2015) show that the pledge falls at the low end of the reference scenarios and high end of the policy scenarios – **this is not brave enough**.

With existing policies, **India can reduce EI by 41.5%** by 2030 (acc. to Climate Action Tracker). Also, if INDC #4 is met, then absolute emissions will fall, resulting in higher EI reduction than the target.

The EI is calculated with an average growth rate of 8.6%, which is at the very high end of historical averages, and probably unrealistic over 15 years.

NOT WELL THOUGHT THROUGH.

INDC#4: Fossil Fuel Free (FFF) Energy

INDC Objective: RE should form 40% of total energy production by 2030.

Domestic Objective: 175GW of renewable energy (RE) by 2022.

If India achieves 175GW by 2022, it will overachieve the 2030 FFF target.

However, despite these additions to capacity, the share of RE might not actually increase if there is little divestment from FF energy sources.

Note to slide 8

Jawaharlal Nehru National Solar Mission: Year-wise Targets (in MW)

Category	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	Total
Total	2,000	12,000	15,000	16,000	17,000	17,500	17,500	97,000

Source: http://pib.nic.in/newsite/PrintRelease.aspx?relid=123607

The Minister also stated that in order to achieve the proposed capacity of 100 GW target by 2022, the investment required would be around INR 6,00,000 crores (@ Rs.6 crores per MW at present rate) (approx. USD 90 billion) out of which about INR 4,20,000 Crores (approx. USD 63 billion) is proposed to be debt sourced from both domestic and international financial institutions including multilateral and bilateral organisations

Current status :

- 3,743 MW commissioned up to 31.03.2015
- As on 30th June 2015, the cumulative installed grid-interactive solar power generation capacity in the country is 4061.64 MW.

FFF Energy Projections (as per INDC)

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Energy Source	Current Capacity (GW)	2022 Capacity (GW)
Solar	4	100
Wind	24	60
Biomass	4.5	10
Hydro	46 (LH = 42 | SH = 4)	N/A (potential = 100)
Nuclear	6	63 (by **2032**)

The CAGR of Solar over the last 10 years has been 101%, from .0037GW to 4GW. For the next 15 years, solar requires a CAGR of 23.8% to get to 100GW.

In late 2010, GOI reiterated the ambition of 63GW from nuclear by 2032, but in 2011 it was noted that this was unrealistic. Revised expectations: 14.6GW by 2021 and 27.5GW by 2032. NPCIL scaled this down even further to 14.5GW by 2024.

How can we be sure that such issues won't plague the "Solar Mission"?

INDC #5: Carbon Sequestration

India's INDC intends to create an additional carbon sink of 2.5 to 3 billion tonnes of CO2 through additional forest and tree cover

This would require average annual carbon sequestration to increase by at least 14 percent over the next 15 years relative to the 2008-2013 period.

With the Green India Mission expected to deliver 50-60 percent of the required total, India needs to provide further detail on how it plans to achieve the rest. The INDC notes the importance of financing to address implementation challenges

INDC #5: Carbon Sequestration

Particulars	Units	Amount
Lower limit of carbon sink target	tCO2	2,500,000,000
Lower limit of the carbon sink target	tC	681,198,910
Average tC/ha in India's forest	tC	36.6
Therefore to achieve the lower limit of carbon sink target		
Area of additional forest cover needed	Ha	18,611,992
Area of additional forest cover needed	Km2	186,120
Average increase in forest between 1997-2007	Km2	3,130
If growth continues along the same path – between 2015-2030, increase in forest cover	Km2	Approx. 50,000

Source: Gundimeda et.al 2005, moef.nic.in

Note to slide 12

According to 'Indian state of forest report 2013,' Recorder Forest cover – **771,821 km^2**, which is approximately 23.5 % of the geographical area of India.

Increasing forest cover by 186,120 km^2 would mean increasing forest cover from the current 23.5% to approximately 30%.

How to bridge the difference?

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Agro-forestry:

Agroforestry may not match up to the environmental benefits provided by natural forests, however it is a practical solution as it does provide a certain degree of environmental benefits along with a number social as well as economic benefits.

Benefits	Examples
Social Benefits	Employment opportunities
	Increases resilience
Economic Benefits	Increased Productivity and Income
	Bridges demand and supply gap of wood products
Environmental Benefits	Provides various ecosystem services such as - Carbon sequestration - Ground water augmentation - Biodiversity preservation
Investment required	**INR 25,323/ha per day in 2011 (GIST Advisory, 2012).**

Note to slide 14

Benefits of Agroforestry

- **Increased employment opportunities** – According to study conducted by GIST Advisory, on the vital role of Indian coffee towards ecosystem services and livelihoods in Karnataka, Coffee agroforestry employees about 64 worker/ha out of which 60% are women (GIST Advisory, 2012). If we assume that of the 18,611,992 ha of forest cover increase needed, if 75% is undertaken under agroforestry, approximately **12 million job opportunities** can be created.

- **Increases resilience-** The diverse component of agroforestry provides multiple harvests at different times of the year. It increases food production, improves supply of fodder for fish and livestock, increases supply of fuelwood, improves soil fertility and water supply, habitats, etc. Thus it reduces the risk of crop failure and ensures alternate income for the farmers

Note to slide 14

- **Increases productivity and Income** - Studies show that forest influenced soils give higher yields than ordinary soils. Indian Grassland and Fodder Research Institute, Jhansi conducted experiments that indicated increased yield of fodder when fodder grasses were intercropped with fodder trees as compared to mono cropping of fodder grass. In South India, and states like Punjab, Haryana, Uttar Pradesh and Gujarat, intercropping agroforestry food crops was found to be more productive.

  A farmer on an average earns **INR 8-10 lakh** per acre in agroforestry in five years in Punjab by having growing poplar alongside wheat and maize.

  Farms in Costa Rica which have forests close by or practice agroforestry have shown to have increased yields by **20 %**, reduced the incidence of pea-berries by 27 per cent and **increased farm incomes by up to 7 %**; bringing in an extra USD 60,000 annually for the coffee plantation (Ricketts T. H et al., 2004).

- **Bridges demand and supply gap of wood products**- Demand for timber is projected to be 153 million cubic meters by 2020, whereas the supply of wood from forests are projected only at 60 million cubic meters by 2020. Agroforestry will help not only bridge this gap but also reduce pressure of deforestation. However care needs to be taken so that native species are given preference and wood is harvested sustainably.

Note to slide 14

- **Carbon sequestration** - The average carbon sequestered by these practices has been estimated to be 9, 21, 50, and 63 tC/ha in semiarid, sub-humid, humid, and temperate regions respectively. According to a study conducted by GIST Advisory, coffee agroforestry practices followed in the Western Ghats approx. 20.7 tC/ha – 81.3 tC/ha is stored.

  Average carbon storage in different land use

Land-use Class	Plantation	Dry land Agriculture	Mixed Dry land Agriculture	Grassland	Rice Field
Carbon stock per hectare (tC/ha)	63	8	10	4.5	5

Source: (Suryadi, 2012)

- **Ground water augmentation**- Studies in Costa Rica show that **runoff** as a percentage of total rainfall was lower in agroforestry system (5.4 %) than monoculture (8.4 %) (P. Cannavo et al., 2011)

- **Investment required**: According to study by GIST Advisory, Investment required for a hector of coffee agroforests is **INR 25,323 per day** in 2011. This includes the fixed as well as the variable costs, which includes labour cost, expenditure incurred on diesel (required for tractors, irrigation and processing) cost of maintenance of equipment and machinery etc.

Financing the INDC

The INDC signals at achieving its stated targets contingent on international climate financing, but there are inconsistencies. The 40% FFF target is conditional on receiving finance from the GCF – which, of its stated ambition of distributing $100bn annually, has raised only $10.2bn as of Nov 2015.

	USD (Billions | '14/15 prices)
Adaptation	206
Mitigation	1,136
Total	1,342

The INDC specifies the amounts needed for adaptation and mitigation purposes, but states that at least $2.5 trillion (14/15 prices) will be required for meeting India's climate change actions between now and 2030.

The sum of the two (adaptation + mitigation) is about $1.2 trillion short of the total. No explanation for this in the INDC. Not carefully thought through?

Thank you!

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