Towards a Strategy for India’s Decarbonisation

Montek Singh Ahluwalia & Utkarsh Patel

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Outline of Presentation

This presentation is in five parts:

I. Background: The current picture on global warming.

II. Does reduction of emissions conflict with the development objective?

III. What is the evidence on scope for emission reduction in India?

IV. Problems in transiting to renewable energy.

V. Towards a strategy for CoP 26 in November.
I. The Current Picture on Global Warming

• The world is not on track to meet the Paris target of limiting global warming to ideally 1.5°C. Current policies imply >3°C warming by the end of the century.
• This will be disastrous, and India will be among the countries most affected.
• The IPCC has estimated that to achieve the 1.5°C target the world as a whole must reach net zero CO2 emissions by 2050.
• CoP 26 will focus on the need to “ratchet up” emission reduction commitments.
• Several countries – US, EU, Japan, Korea, and developing countries such as Brazil and South Africa – have adopted/proposed reaching net zero by 2050. China is aiming for 2060. The US and the EU have also announced near-term targets of cutting emissions to half by 2030.
• In this presentation we consider what India’s position should be.
India’s Traditional Position

• India’s per capita energy use is 1/3rd of the global average. We have traditionally argued that since development requires increased energy use, we cannot accept emissions reduction targets. These should be applied only to developed countries.

• This is logical but we have to recognise that as the 4th largest emitter, we will face pressure to accept some trajectory of emission reduction.

• This is especially so because technological development now makes it possible to switch to RE to meet energy needs while reducing emissions.

• In this presentation we examine the scope for adopting this approach
II. Can We Reduce Emissions and Still Grow?

An emissions reduction strategy requires action on three fronts:

a) **Raising energy efficiency** to reduce the total energy requirement of GDP: This will help emissions to some extent, but cannot eliminate them.

b) Switching from fossil fuels to electricity wherever possible **combined** with generating electricity from **renewable sources**. Electrification alone doesn’t help.

c) **Removing emissions from the atmosphere**. This can take care of unavoidable use of fossil fuel where electrification is not possible.

In the rest of the presentation, we explore how far this can take us towards net zero and in what time frame.
Scope for Emissions reduction in India

We reviewed several studies estimating the possibilities of decarbonisation in India

• TERI/Shell (2021): Looks at the energy sector only and concludes that it is “possible but highly challenging” for the sector to become net zero by 2050.

• IEA (2021): Shows that GDP growth of 5.4% plus a combination of efficiency gains and shift to RE can lead to net zero by around 2065.

• BP (2020): Models 6% growth rate of GDP, and net zero by 2070.

• CEEW study (Chaturvedi and Malyan, under review): Presents alternative scenarios that are “technically feasible”. Assumes GDP growth at 6.2% between 2020 and 2050 (slowing down thereafter). One of the simulations shows emissions peaking by 2040 and reaching net zero by 2070.
The simulation presents alternative scenarios: with and without the availability of H2 and CCS.

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<td>Electricity generation (TWh)</td>
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<td>7,000</td>
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<td>Share of solar in electricity generation (%)</td>
<td>4</td>
<td>43</td>
<td>65</td>
<td>53</td>
<td>69</td>
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<td>Share of electricity in final energy (%)</td>
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<td>Share of fossil fuels in primary energy (%)</td>
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<td>Gross emissions (Gt-CO2)</td>
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<td>Net emissions (Gt-CO2)</td>
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- Fossil fuels’ share in primary energy declines from 85% in 2020 to 20% in **High H2+CCS**. It has to fall to 6% in **Low H2, no CCS** because fossil fuels cannot be used without CCS.
- Some part of the demand from transport has to be met with biofuels.
- A much larger part of the energy requirement in the latter case has to be met with electricity.
- Share of nuclear energy rises from about 5% currently to 10% in **2070** in the **High H2 + CCS** scenario but has to be pushed up to 12% in **Low H2, no CCS** scenario.

Source: Chaturvedi and Malyan (under review). CEEW, New Delhi
III. Scope for Electrification in India

Since massive electrification is critical for emissions reduction, we present an assessment of the scope for electrification across sectors.

• **Transport:** Passenger vehicles and light duty road vehicles and all of railways can be electrified. However, long distance freight and passenger transport by road, heavy earth moving equipment, ships and airplanes cannot be electrified with the present technology. H2 has promising use here.

• **Industry:** Fossil fuels are hard to avoid where high-temperature heat and fossil feedstock is required viz. steel, cement and fertilisers. Electric furnaces and green H2 could help.

• **Buildings** (residential and commercial): Already electrified.

• **Cooking:** Currently moving from biomass/kerosene to LPG; electrification possible over time

• **Agriculture:** Farmers could be incentivised to switch to solar powered pumps for irrigation.

We conclude that some use of fossil fuels is likely to continue through 2050. The resulting emissions will have to be dealt with by natural sinks supplemented by afforestation and CCS.
Challenges of Transitioning to RE on the scale needed

1. **Intermittency** of RE poses a challenge for grid management. This affects competitiveness of RE.

2. Development of **effective electricity markets** adapted to high RE level will require more sophisticated regulatory structures.

3. **Financial position of India’s DISCOMs** has to be greatly improved to encourage private investment.

4. The shift to RE will also pose **other problems of structural change**. In making these changes the **centre, states and public sector entities** have to work in tandem.

Each of these issues is discussed in the subsequent slides.
IV. Managing Intermittency and impact on Cost of RE

The options to handle intermittency are the following:

• **Optimising the solar/wind ratio** can reduce the intermittency of the combined supply.

• **Hydropower could be used entirely for balancing.** However, its share is only 13% of the current capacity and will fall in the future. It’s also seasonal and constrained by irrigation requirements.

• **Battery storage is a feasible option but it will raise cost.** Costs are falling but possible shortages in key minerals create uncertainty about the pace of decline in costs in future.

• **Gas-based plants could be used to balance RE;** will add to cost due to low capacity utilisation.

• **Coal power plants under construction can be fitted with CCS.** This is feasible but very expensive.

• **Dedicated RE can be used to produce green H2 stored for later use.** Very costly and technology not yet commercialised.

• **Demand patterns can be adjusted** to match supply using time of day metering (agriculture, EV charging). Looking ahead there must be much finer calibration of time of day tariffs.
Studies estimate that storage amounting to 25% of solar capacity would be needed to deal with intermittency. (Abhyankar et al., forthcoming). **Graph shows that even allowing for this, solar costs would become competitive.**

A qualification: The estimates of battery costs are contentious and open to debate.

Source: IRENA 2021 for historical LCOE; Several sources for battery prices; Authors’ projections
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When can we phase out Coal-based Electricity?

- CEA is assuming that all thermal plants will operate for their normal life of 40 years. In that case coal would not be phased out for a long time.
- If RE is cost competitive, some of the existing plants could be phased out earlier than 40 years. Those approved but not under construction need not be taken up at all to avoid asset stranding.
- NTPC and Dept. of Atomic Energy could jointly examine the possibility of replacing some retired plants with small modular nuclear reactors which are coming into use. France, the US and Russia are making developments in this direction.

Source: Global Coal Plant Tracker (n.d.); Authors’ calculations
The recent G20 Finance Ministers meeting (where India participated) has endorsed carbon pricing.

An IMF staff paper has proposed a carbon price floor of $75/tonne-CO2 for the US and EU, $50 for China and $25 for India.

At $25/tonne-CO2, RE will be competitive with all coal-based power plants even today.

Introducing carbon pricing on coal will justify accelerated retirement of coal plants. Petrol and diesel already have a high tax incidence and need not require a carbon tax.

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Effect of Modest $15/tonne-CO2 Tax

- Carbon tax of $15/t-CO2 will raise the LCOE from coal-based plants by ₹1.05/kWh ($14.3/MWh).
- Assuming long term price elasticity of demand of -0.6, the demand for coal-based electricity will fall 30% (after 2030), implying shift in the merit order despatch of electricity.
- This would lead to complete elimination of all coal-based capacity by 2060.
- A contrary view is that we need to maintain a buffer of coal-based capacity in the medium term for flexibility and reliability (Tongia et al. forthcoming).
- States and the centre should deliberate jointly between new construction and retirement of existing plants.

Source: Global Coal Plant Tracker (n.d.); Authors' calculations
Structural Changes due to Phasing out Coal & Oil

The following structural changes have to be managed:

- **Employment**: Coal industry employs nearly a million workers directly or indirectly, mainly in Bihar, Jharkhand, Chhattisgarh and Odisha. The shift to RE will create new jobs, but these will be mostly in the Western and Southern states.

- **Royalty of coal producing states** will fall. These are poor states and the decline in revenue may need to be offset by more transfers from the centre via future Finance Commissions.

- **Indian Railway’s freight earnings from coal** will fall. These earnings subsidise passenger fares, and therefore railway passenger tariffs will have to rise.

- **Both the centre and states will lose revenue** from petrol and diesel sale in passenger transport.

- **Rural land acquisition for RE**: Solar expansion would require large tracts of land. It is unlikely that private developers will be able to acquire these themselves. State govts. would need to find ways to facilitate land acquisition.

- **Raising biofuels could impact food security**: We must focus on improving agricultural productivity so that availability of arable land does not fall short with rising biofuels demand.

- **There are positive aspects too**, which include improved air quality, energy security and foreign exchange savings (more so if manufacturing of PV, etc. can be efficiently localised).
Large investments required in T&D and storage capacity

• **Need for inter-state transmission**: Geographical concentration of solar and wind potential, imply that large power transfers from western and southern states to the rest of the country. Necessary transmission capacity would have to be built by central PSU Power grid.

• **Investment will also be needed in storage capacity**. RE producers could undertake half of this. Evening out the pattern of supply from the producer would reduce the need for evacuation capacity.

• **Transmitters and distributors** could provide about a third of the capacity. This will also help in improving the utilisation of existing transmission assets.

• **“Behind the meter storage”** (about 15%, mostly with commercial consumers) will help with storing decentralised generation and improve reliability. Pattern of time of day metering will help encourage such investment.
Financial Viability of DISCOMs: The Elephant in the Room

• Massive electrification will call for much larger investment not only in generation but also in transmission and distribution. This requires massive improvement in the financial state of DISCOMs and their management capability.

• The present state of the DISCOMs will not allow sufficient investment in generation because of high perceived risks.

• **State governments must:**
  - Create *genuinely independent regulators* with adequate expertise to fix viable tariffs, including creative use of time of day metering capable of dealing with the challenges of increasing RE.
  - **Avoid interfering with tariffs.** If subsidies have to be given, these must be given through the budget, preferably provided directly to target groups
  - Privatise DISCOMs where possible to reduce political interference and make efficiency gains
  - Avoid arbitrary cancellation of PPAs which has happened in some cases
Improving the DISCOMs (cont’d)

• At present, DISCOMs are obligated to purchase electricity from RE sources which are deemed to be “must run”. This forces DISCOMs to back down coal plants with which they have PPAs where they have to pay the fixed costs whether they buy the power or not. In this situation, DISCOMs would be unwilling to sign PPAs with solar generators.

• Low feed-in tariffs for rooftop installations are hindering expansion in this area.

• In addition to actions by state governments, Central Govt./PSUs will need to:
  ▪ Undertake investments needed in transmission to manage the large inter-state power transfers.
  ▪ Developing more mature wholesale markets suitable for RE (e.g. to create dynamic balancing capacity)

• DISCOMs would need to identify and tap the leakages in order to reduce the AT&C losses.
Realistic Timeframe for Electrifying Transport

• Indian manufacturers are currently engaged in shifting to EVs but the time frame will have to be more ambitious if significant reduction in emissions is expected.

• For the auto fleet to achieve zero emissions by a target date, EV sales must increase from 1% of the total at present to 100%, sufficiently before the zero emission target date so that older vehicles can be phased out.

• The EU plans to ban all sales of IC vehicles from 2035 i.e. 15 years before their net zero date. If we want the electrifiable vehicle fleet to be entirely electric by say 2060, Indian manufacturers must be told now that no IC vehicle can be sold after say 2040.

• The central government could announce that all existing IC cars owned or operated by them will be replaced by EVs starting in 2023, giving manufacturers time to start production. State governments could be encouraged to do the same.

• State governments could also be incentivised to phase out IC city-buses and induct EVs. Buses are also a good candidate for GST concession.
Challenges/Opportunities in Introducing EVs

Shifting to EVs will impact the automotive sector in several ways.

• Since EVs have far fewer engine components, much of the component production sector may disappear over the next two decades.

• Battery production will have to expand. This is a capital intensive sector. We need to plan to attract battery producers with state of the art technology to locate production in India.
  ▪ Standardising battery components will help achieve scale and competitiveness
  ▪ Battery recycling can be promoted.

• EV Charging Infrastructure needs to be developed. This needs standardisation which should be mandated.

• Charging EVs at home/office will reduce the need for so many fuel stations within the city. Some can be upgraded as battery swapping stations.

• Battery Swapping can reduce the upfront cost of EV ownership. China has innovated in this direction.
Implications for Climate Finance

• Projected additional energy investments for developing countries: $600 billion per year up to 2050

• India alone will require $150 billion per year additional investments (averaging to 1.8% of total GDP between 2020 and 2050).

• Further investments of comparable magnitude will be required in the areas of transportation and other infrastructure.

• Climate finance provided to developing countries so far is much lower, and estimates vary.

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<th>$ billion</th>
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<td>Biennial reports to UNFCCC</td>
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• Scale of financing needed going ahead has to be much larger than $100 billion.

• Need a clear signal to MDBs that they should expand financing of RE.

• Scale of requirement is such that private flows will have to have the major share.

1: McCollum et al. 2018
Suggested Strategy for India in CoP 26

• With technology allowing use of non-polluting sources of energy to fuel development, we should be willing to project a credible trajectory for emissions reduction.

• This trajectory should emerge from a “national energy planning exercise”.

• The India Energy Modelling Forum, presided over by the NITI Aayog, provides a basis for preparing a national trajectory building on various individual models that exist. NITI Aayog could come up with a proposed trajectory and the policy changes needed to bring it about.

• It is not necessary for all countries to get to net zero by 2050. Climate justice suggests that developed countries should get there earlier allowing developing countries more time.

• On this basis, we should come up with:
  ▪ a long-term emissions trajectory with a peaking date and a target to reach net zero which goes beyond 2050,
  ▪ a shorter-term target of reducing dependence on coal for generating electricity.
Key Elements of Strategy For India

- India could propose a **peaking target of 2040** and a long term target of **reaching net zero around 2070** (China has proposed 2060).

- We could also propose **peaking of thermal capacity before 2030** followed by reduction in thermal capacity to some fraction of the peak level by 2040, **indicating a clear transition away from coal**.

- These commitments should be conditional on **global commitments to provide long term finance** for covering a substantial portion of the $150 billion per year additional investment needed in the energy sector in India.

- The **funding capacity of the MDBs should be suitably increased**, along with elimination of country limits which restrict India’s eligibility to get funds.

- The EU may impose Border Adjustment Taxes on imports from countries that don’t have a CO2 price floor. If this happens we need to **consider whether we should impose an explicit tax on coal**. Tax on petrol and diesel is already very high and part of it could be seen as a CO2 tax.

- In parallel, we have to act on several fronts to facilitate the transition to green energy.
THANK YOU