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COMMENTARY

Elements and Possible Constraints for a Smooth Energy Transition in India

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Abstract: The Prime Minister of India laid down a target for India at COP 26—to achieve net zero emissions by 2070. Realizing this target depends upon a transition away from fossil fuels towards non-fossil-fuel alternatives. This Commentary highlights the main constraints in this attempt at transitioning to an energy mix that has a greater share of renewables. It is noted that while the share of solar and wind in installed capacity has increased significantly, there has been no corresponding decrease in the share of coal. In absolute terms, coal-based capacity has also shown significant increase. The Nationally Determined Contribution (NDC) of India as communicated to the UNFCC was revised in August 2022 in view of the progress made and now includes a target of increasing the share of non-fossil-fuel sources to 50% of installed capacity. In addition, in the recently released Draft National Electricity Plan (DNEP), a target of 413 GW of new installed capacity has been set for the decade 2022–32. This is against the 54 GW achieved in 2017–22.

The major concern is that this sharp increase in renewable energy capacity is not supported by any corresponding policy measures. If these targets are not met, fossil fuel capacity will increase more than anticipated- as per the DNEP, coal-based capacity could increase by about 50 GW in the next decade. Another concern pertains to the problems associated with energy storage systems, which are necessary with high level of penetration of renewable energy. Finally, the other concerns are the issues connected with a just transition—ensuring support to those whose livelihoods could be lost in this transition of the energy system to one where fossil fuels, mainly coal in India, could see a decline.

Keywords: Emissions, fossil fuels, renewable energy, climate change, electricity

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At the 26th Conference of Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) held in 2021, the Prime Minister of India announced that the country will achieve net zero emissions by 2070. The journey to net zero emissions builds on near-term energy transition goals that are dominated by the decarbonization of the electricity sector. Targets to move from a fossil-dependent energy system to a non-fossil-based energy system have been announced and periodically revised. This commentary reviews India's energy transition trajectory and highlights the main constraints that the country faces in the realization of its renewable energy (RE) goals. It argues that the energy transition goals set forth by India are ambitious and the progress made in integrating RE has been admirable. However, a detailed analysis of India's targets and achievements reveals that the transition to low carbon energy will face many hurdles, which can be overcome through concerted planning and action at multiple levels.

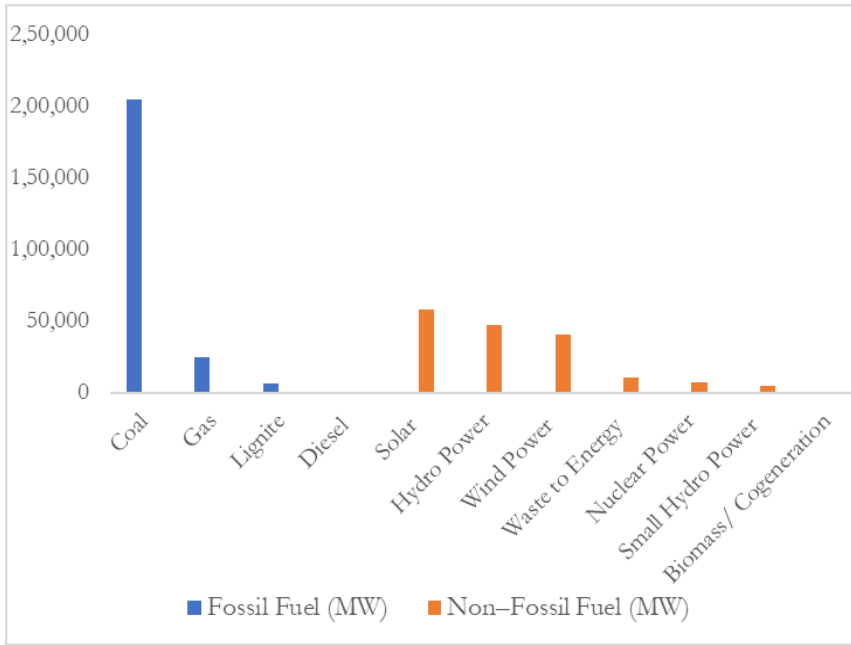
1. STATE OF ENERGY TRANSITION IN INDIA

India has made considerable progress in setting goals and achieving targets to realize its energy transition in the recent past. As on 31 July 2022, India has a total installed power generation capacity of 404,132.95 MW, of which 58% was from fossil and 42% from non-fossil sources (CEA 2022b). As shown in Figure 1, the highest share of installed capacity is contributed by coal (50%), followed by solar (14%), hydro (12%), and wind (10%) power.

The grid-connected RE capacity, especially from solar, wind, and other RE sources, has increased manifold in the past decade, from 5% of the total installed capacity in 2006 to 28% in 2022,[1] demonstrating that there has been an energy transition in the country. However, although the share of solar and wind power has increased, the share of coal has not decreased correspondingly. In fact, the share of coal in the installed capacity for the above-mentioned period has remained nearly the same. In absolute terms, the installed capacity of coal-based power plants has tripled since 2006.

[1] Authors' estimate based on various sources (Central Electricity Authority 2020a; 2020b; 2022a).

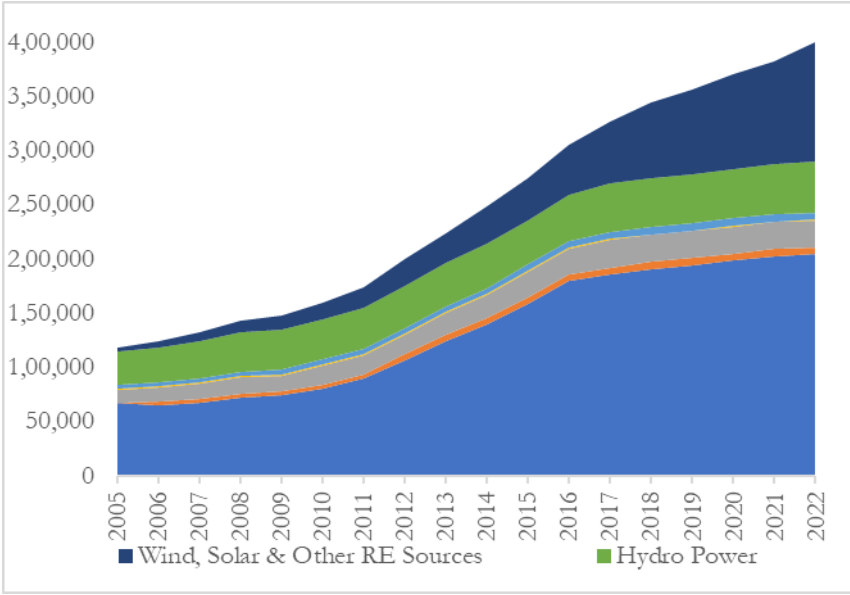
Figure 1: Installed Capacity on 31 July 2022 (in MW)



Source: CEA (2022b)

Figure 2 illustrates how coal-based capacity and RE capacity have grown almost in tandem. There has been a consistent increase in both fossil- as well as non-fossil-based installed capacity. Although the RE share has increased at a higher rate in recent years, coal-based installed capacity has also increased, and coal continues to constitute the largest share. Nevertheless, renewables will play an increasingly important role in India's energy mix. According to Central Electricity Authority (CEA) estimates, the demand for electricity in 2029–2030 is expected to reach 2,518 billion units (BU), of which 1,393 BU will be met by coal, lignite, and gas and 914 BU by non-fossil sources (CEA 2020b). More recent estimates by the CEA, included in the Draft National Electricity Plan, suggest that the total installed capacity in the country is likely to be 622 GW by financial year (FY) 2026–2027 and 865 GW by FY 2031–2032 (CEA 2022a). Much of this capacity addition would be from RE sources, as suggested by various climate and energy targets and projections. The percentage of installed capacity of electricity generation from non-fossil sources already crossed 40% on 31 March 2022. In view of this progress, the Nationally Determined Contribution (NDC) had to be updated this year, as explained in the next section.

Figure 2: Growth of Installed Capacity for Different Sources in India



Source: Authors' estimate based on various sources (Central Electricity Authority 2020a; 2020b; 2022a)

2. SYNERGIZING ENERGY AND CLIMATE GOALS

India ratified the Paris Agreement on 2 October 2016 and has communicated its NDC to the UNFCCC for the 2021–2030 period. The NDC lists eight goals, of which an important one is to increase the installed capacity for energy resources from non–fossil fuels by 2030 (Government of India 2015). The quantifiable targets with respect to the energy transition in the NDC, as revised and approved by the Union Cabinet, include (i) 50% of cumulative electric power installed capacity from non-fossil sources and (ii) a 45% reduction of the emissions intensity of the GDP in comparison to 2005 levels (Government of India 2022; Press Information Bureau 2022).

Besides the NDC, India has been setting ambitious RE generation targets over the years. India had initially set a goal of achieving an installed capacity of 175 GW from renewable power by 2022, which has not been achieved yet. In 2021, at Glasgow, the prime minister announced a revised target of 500 GW to be achieved by 2030. These targets are ambitious but necessary for India's transition to a low carbon pathway. However, realization of these goals is fraught with challenges and calls for a holistic approach to addressing the three dimensions of the energy trilemma—energy security,

energy equity, and environmental sustainability (World Energy Council 2019).

3. CHALLENGES IN TRANSITIONING TO A LOW CARBON PATHWAY

Remarkable progress has been made in RE integration in the past decade, but the position of coal in the overall energy mix has not reduced: it is at 51% for installed capacity and at an even higher 69% for total generation. The shift towards renewables, although urgently needed, will be gradual. Even as RE integration into the grid increases, coal-based power will continue to be added to the grid as multiple sources are needed to meet the rapidly growing energy demand. RE-based installed capacity addition would only help address part of this demand. Coal-based plants will continue to produce electricity, and newer plants will also come up, albeit on a smaller scale as compared to RE, to meet energy demands in the near future. The draft National Electricity Plan (DNEP) has highlighted the need for additional coal-based capacity of at least 17 GW, which would rise to 28 GW by 2031–2032. This would be in addition to the capacity of 25 GW already under construction. Therefore, around 50 GW of coal-based capacity is planned within the next decade for energy security. Considering that coal-based power will continue to be used, it is imperative to lay emphasis on, firstly, reducing supply disruptions, and, secondly, enhancing efficiency and performance with respect to environmental parameters.

Although the RE goals are clear, ambitious, and laudable, there is little discussion on how these targets will be achieved. The target capacity addition from RE sources, according to the DNEP, is about 188 GW in 2022–2027 and about 225 GW in 2027–2032. This compares with about 54 GW achieved in 2017–2022. These high targets are not matched by any corresponding policy measures to lift the RE capacity addition to the desired levels.

An enabling ecosystem for the energy transition would be based on technology, finance, and government support. Although the overall goals have been consistent and clear in terms of direction, the specific policy support has been inadequate. A recent study mapping government support for RE technologies in India found that government subsidies for renewables reduced by 59% between 2017 and 2021 (Aggarwal *et al.* 2022). In the absence of adequate regulatory and policy support at both the national and state levels, along with prescriptions for how the aforementioned targets will be met in a time-bound manner, the high RE

targets may not be achieved. If the share of renewables, especially solar power, is lower than envisaged, the gap would have to be filled by other sources, most likely fossils and mainly coal, either domestic or imported. This raises concerns about preparedness in the event of a deviation from the planned transition towards environmentally sustainable energy systems.

One of the common challenges in using variable RE for power generation is that it may not coincide with peak demand. Energy storage systems are of vital importance in overcoming problems of demand–supply mismatch, grid balancing, and ensuring the success of RE installations. The electricity demand projections and installed capacity targets require 6.81 GW of pump storage by 2026–2027 and 18.82 GW by 2031–2032. This would be supplemented by 51.56 GW of a battery energy storage system (BESS; CEA 2022a). Pump storage, a form of hydroelectric storage, is the most common mode of energy storage worldwide (REN21 2022). However, its use in India has been limited due to challenges such as high upfront costs and longer gestation periods (Ernst & Young and FICCI 2022). The use of BESSs, which are mostly dominated by lithium-ion batteries, has grown in recent years and will continue to grow. As the demand for BESSs grows, challenges related to upfront costs, raw material availability, safety and liability, waste disposal, and so on will multiply. Governments at all levels must provide the necessary support for utility-scale energy storage systems to reduce dependence on coal and meet India's energy transition goals.

Finally, a smooth energy transition has to be sustainable as well as equitable. One of the frameworks to take equity into account is that of "just transition", which includes principles and policies that make all stakeholders beneficiaries of the transition to a low carbon economy (IPCC 2022). A just transition towards a low carbon economy contributes to the "goals of decent work for all, social inclusion and the eradication of poverty" (ILO 2015). As India reduces the output from coal-based power plants and moves towards closing coal mines, a large number of formal workers as well as informal workers, such as those engaged in coal washeries, loading/unloading, and transportation (Bhushan, Banerjee, and Agarwal 2021), will lose their livelihoods. Concerted efforts need to be taken to minimize the negative impact on those people dependent on coal-related activities. Decarbonization of the energy sector should be treated as an opportunity to distribute the benefits of a sustainable economy equitably.

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