COMMITTED POLICY BRIEF

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India

Status of Coal in India – Current trends, barriers and opportunities

- India has indicated a strong commitment towards greenhouse gas (GHG) emissions mitigation not only through its Nationally Determined Contribution (NDC) but also by raising its climate ambitions with the Net Zero (NZ) commitment.
- Due to increasing energy demand and emphasis on energy accessibility, affordability and security, India must have a balanced portfolio of non-fossil sources.
- Challenges include costs of storage, grid flexibility, availability of critical minerals, repurposing stranded assets, reskilling manpower, managing regional inequity and low-cost finance for transition.

Just energy transition policies must go beyond the inclusion of socio-economic and political impacts, but also account for value chain challenges, resource availability, and affordable finance — at both national and sub-national levels.

COMMITTED: Climate pOlicy assessment and Mitigation Modeling to Integrate national and global TransiTion pathways for Environmental-friendly Development

The goal is to reinforce global climate change mitigation efforts by supporting the work of researchers and experts from Asia on national and sectoral greenhouse gas emissions modelling. This is done by strengthening capacity building for GHG emissions modelling and exchanging best practices and know-how between leading modellers from the EU and Asia working closely with the government.

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Creating Innovative Solutions for a Sustainable Future

Current trends

Many of the major developed, emerging and developing economies around the world are still heavily dependent on fossil fuel (coal, oil and natural gas). India, China, the US, Russia, and Japan exhibited significant fossil fuel dependencies (in 2024) in their respective primary energy mix ranging from 83.0% to 93.9%. In 2024, the two most coal-dependent countries were India (59.2%) and China (58%), while coal dependency of Japan, Russia and the USA was 27.6%, 11.8% and 8.6%, respectively [1].

Globally, India is the second largest producer, importer and consumer of coal, and third largest producer and consumer of electricity. However, its per capita electricity consumption (2023) was low compared to the global average (above one- third) and other emerging economies [2]. India has the ambitious vision to become a developed country by 2047, however for achieving Net Zero[1] (NZ) carbon emissions target by 2070, it faces many challenges.

In 2022-23, the coal consumption (as final energy) in the power (utilities and captive) sector was approx. 878 Mt, industry and other sectors consumed around 330 Mt. Total projected coal demand in power sector with enhanced plant load factor and addition of new capacity is expected to touch more than 1-1.5 Gt by 2025-2030 [3, 4]. In recent years, renewables-based captive generation technologies have been installed but coal is still dominant and expected to remain in near future.

As of 30th June 2025, 50.1% of India's total 484 gigawatts (GW) of installed power capacity (out of which 221 GW of coal) and ~32% of annual generation was powered by non-fossil sources (except coal, oil and gas), as indicated in fig.1 [5, 6]. Increased fossil-fuel dependency brings in negative externalities such as local air pollution [7, 8] and water stress [9, 10, 11] in addition to managing emissions.

This brief summarizes the results and examines the coal dependency in power sector under five different scenarios proposed by two Indian research institutes[2] and comparative results in terms of cumulative emission for the energy sector, power sector emission and power sector installed capacity. Furthermore, it discusses the challenges at national and sub-national levels for transition towards non-fossil dependent power sector.

Results and analysis

Under advanced NDC and NZ scenarios, India would surpass its emission intensity of GDP target (reduce by 45% from 2005 levels) by 2030. While India has already achieved 50% of cumulative non-fossil installed electric power capacity in 2025 [15]. Further, cumulative emissions between 2020 to 2070 are projected to be around 180-245 $GtCO_2$ under BAU and NDC scenarios and 120-145 $GtCO_2$ under NZ scenarios [11]. The carbon emission intensity of GDP sees a substantial decline (approx. 45%-56%) across advanced NDC and NZ scenarios by 2030 from 2005 level.

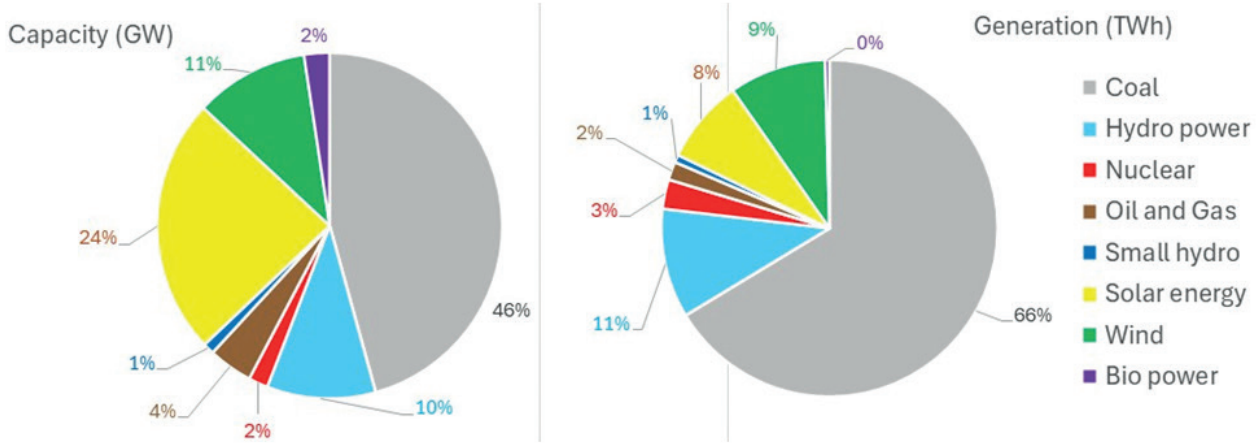

Figure 1: Power mix: Installed capacity and generation by source as on 30th June 2025

1 While India's aspiration for achieving net zero emission target does not explicitly clarify if this is in CO_2 or GHG terms, we assume (in this study) that the Net Zero is based on CO_2.

2 IIM Ahmedabad has analyzed three scenarios in this study: (a) Advanced NDC scenario, (b) NDC Net-Zero Scenario with coal continuance (NZ-CCUS) and (c) Net-Zero scenario without coal continuance (NZ-Renewables) using AIM/Enduse-India Water-Energy-Land model [11, 12, 13, 14]. TERI has explored two scenarios (d) Business as Usual (BAU) and (e) Net Zero (NZ) from TERI-MARKAL model (Ver. 23).

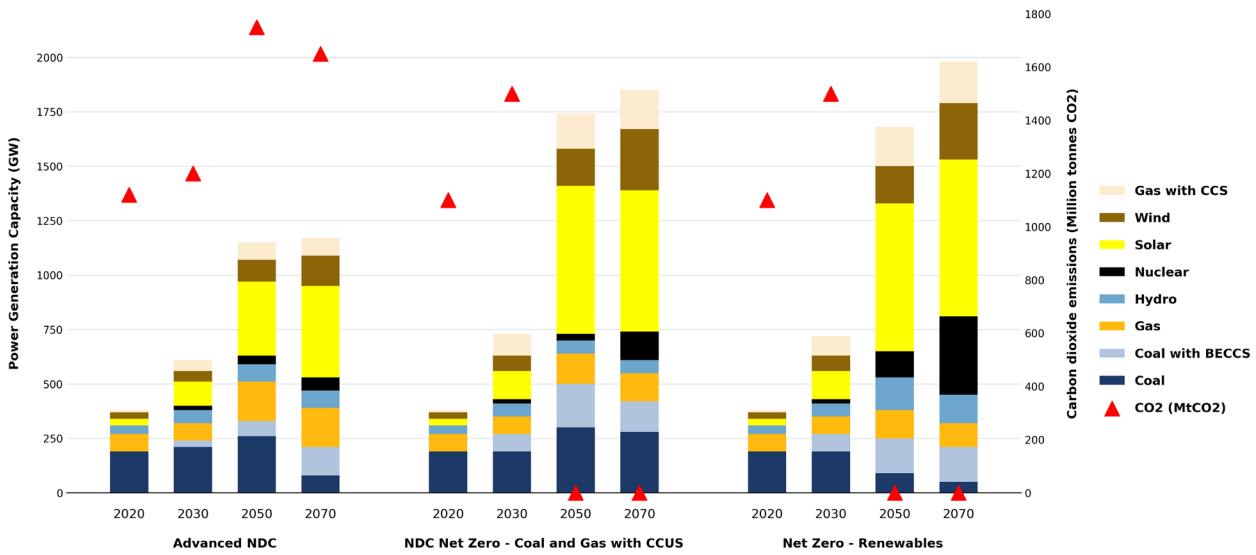

Figure 2: Power generation capacity and emission trends under advanced NDC, NZ-CCUS, and NZ-Renewables scenarios from IIMA-AIM model. *Note:* Red triangle is the power sector emissions across the scenarios

The share of power sector emissions in the energy sector is projected to decrease from 53% [16] in 2020 to nearly 0% in the NZ scenarios by 2050, according to the IIMA-AIM model, and by 2066, as per the TERI-MARKAL model. This decline would be attributed to the growth of renewable energy technologies and the increasing affordability of storage technologies.

The decline in power sector emissions would be attributed to several key factors. These include, (a) significant increase in the share of renewables, (b) decrease in transmission and distribution losses, (c) improvements in the efficiency of thermal power plants and (d) shift towards non-fossil sources facilitated by cost-effective energy storage solutions. The cost of storage technology has dropped by 85% over the past decade and is expected to decline further, enhancing the viability of renewable energy integration.

Discussion

Projections for power-mix differ significantly across models and scenarios, showing that multiple pathways exist to phase out power sector emissions. Trajectories are influenced by diverse assumptions about electrification rates, economic growth, technology improvement costs, and resulting power demand. Feasibility of reducing coal dependence would depend on several factors such as technology transfer, investment cost, capacity building, socio-economic consequences and political economy of Indian states and low-cost financing for transition [17]. Moreover, the nature and pace of policy implementation in the power and associated sectors will play a significant role.

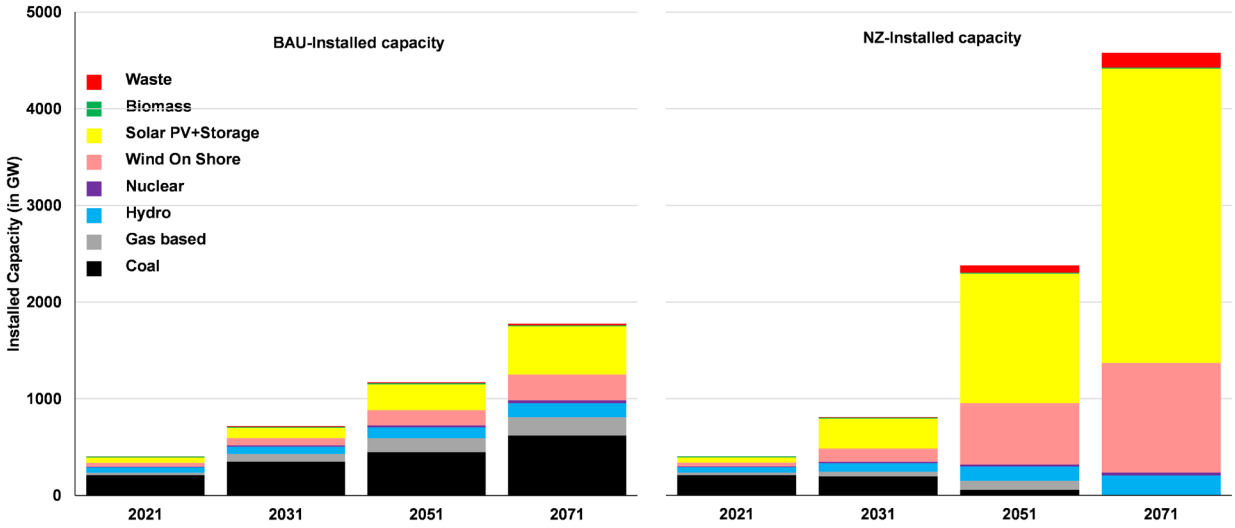

Figure 3: Power generation installed capacity under BAU and NZ scenarios from TERI-MARKAL (v23) model

Power sector

Renewable energy (RE) sources (solar and wind) are inherently intermittent, making it challenging to ensure a reliable supply to meet India's massive electricity demand without storage integration and demand flexibilization. Although recent hybrid RE bids have shown tariff reductions, achieving 24/7 supply with RE remains more expensive than traditional thermal power.

India's significant dependence on coal imports implies that achieving net-zero scenarios would enhance energy security by reducing coal use and imports. However, this transition may lead to increased reliance on imports of critical minerals, particularly rare earth elements essential for renewable energy technologies. The concentrated market for these minerals, largely controlled by China [18], and strained Indo-China relations pose a potential energy security risk for India's green transition due to import dependency on these materials.

Moving away from coal in India will depend on various factors i.e. presence and alternative utilization of stranded assets, availability, reliability and affordability (storage inclusive) of alternative energy sources including RE sources, adequate and affordable finance, policy and regulatory support, etc. [19, 20]. The shift depends on possibility of early actions, shifting base load from coal to low carbon options, and non-fossil based installed capacity.

Industry sector

Energy intensive industry (especially steel and cement) sector remains a hard to abate sector in terms of mitigation options. Shift to electrification would become important driver to reduce industrial emissions. This can be further be reduced by installing carbon capture, utilization, and storage (CCUS) technologies at selected sub-sector/locations. While CCS has issues of uncertainty, CCU is more promising in sub-sectors like Iron & Steel, Cement, etc. However, financing of these technologies will play very important role in determining actual dependence on coal. A key component of low-cost finance especially for CCUS would be outcome-based sustainability loans or sustainability linked loans along with green bonds [21].

Employment

The phasing down of coal use impacts both formal and informal employment in coal and power sector at national and sub-national levels. More than 10 million jobs in India are linked to coal directly or indirectly. It is estimated that about 60% of the fossil fuel jobs would not be created/phased out in the long-term low-carbon scenarios due to lesser coal reliance [12]. As most jobs related to fossil fuels, especially coal-jobs, are concentrated in Eastern India, there is a dire need for implementing complementary policies to ensure a just transition for Indian workers, especially focusing on states and communities that massively depend on coal activities[12]. The green jobs in 2050 will increase by about 5 million in climate compatible development scenario than BAU scenario with around 4 million jobs in the RE power generation (solar PV and wind power), around 0.3 million in biofuels production and around 0.5 million in the manufacturing of clean energy technologies such as electric cars, batteries, RE, etc. [12]. However, most of the coal producing/mining districts are in the Eastern India (producing about 62% of India's coal), they will face short fall of jobs in RE sectors to absorb coal workers while transition away from coal [22].

States (Sub-national Level)

Domestic coal production remains one of the main sources of non-tax revenue for many eastern coal-producing states to support their development policies (Table 1). For Jharkhand state, coal revenue contributes to about 50% (average of last five years) of its non-tax revenue. Thus, the developmental activities of these states are deeply intertwined with coal revenue [22]. By 2030, at least 60 out of the 120 districts in the coal producing states will start facing transition challenges [24].

The design of just transitions policies needs to be based on each state's circumstances, capacity, and capabilities. To ensure equitable and climate-justice, the just transition framework must consider ecological, socio-economic, technological and institutional implications [25]. The coal-producing states need to diversify not only their revenue sources but also pursue alternative livelihood and re-skilling [26].

Table 1. Coal revenue (royalties, DMF and NMET) as share of state's non-tax revenue for major coal producing states of India

	Chhattisgarh	Jharkhand	Odisha	Madhya Pradesh	Maharashtra	Telangana	West Bengal	Assam	UP
2018-19	41.70	57.29	17.61	20.93	9.84	31.12	0.54	0.67	1.50
2019-20	38.38	48.55	18.69	26.52	11.05	22.68	0.77	0.74	0.67
2020-21	42.32	50.21	10.52	43.00	7.88	29.41	0.40	0.18	7.31
2021-22	22.44	47.69	6.47	23.26	11.90	4.40	1.23	0.00	5.63
2022-23	26.56	48.28	11.57	18.02	17.29	33.21	1.26	0.61	6.29

Source: TERI estimates based on PIB (2024) [27] and RBI data

Conclusion

India's development aspirations and the current power mix allow for pathways that achieve net zero emissions in line with India's net zero target, mainly through scaling up renewables. Moving away from coal is causing a multi-dimensional challenge like subsequent socio-economic implications, high cost of storage technologies, grid flexibility and the likely growth in power demand due to increasing electrification across sectors, and improved accessibility. While CCS may face policy uncertainties and technological hurdles; CCU could be explored as a viable option in the industry sector. Financing low-cost transitions, especially technologies and enabling their supply chains, would be the most critical factor in determining fossil fuel dependency of Indian economy in future. Ensuring just and equitable transition and learning from experiences of countries which have successfully tackled similar challenges in recent decades may additionally facilitate the inevitable decarbonisation of the economy.

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