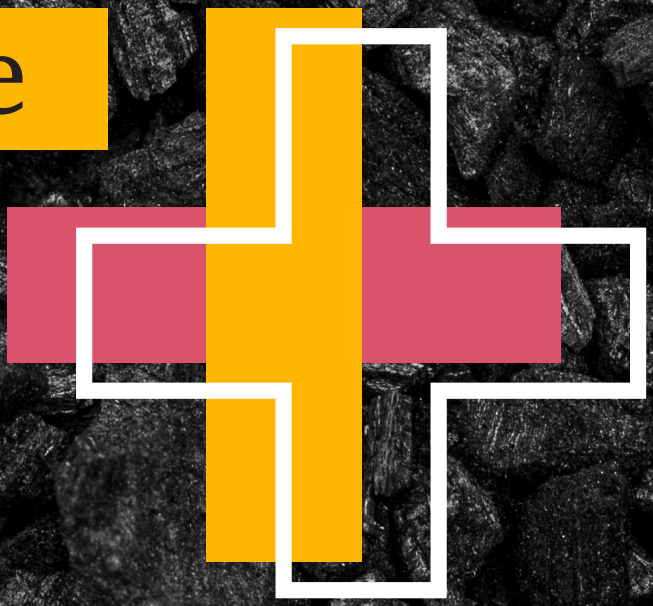
Our Take

June 2022



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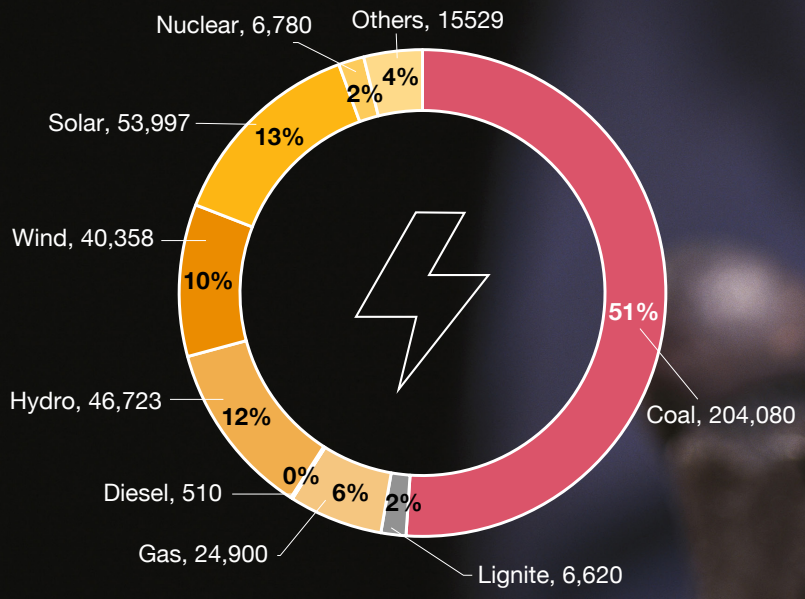
Coal: Challenges and opportunities

India, it is evident, will continue to be significantly dependent on coal in the near to medium term. To reduce the severity of the coal shortage that impacts electricity generation and in turn the Indian economy, it is important to work on a three-pronged strategy focussed on better planning, infrastructure development and increase of domestic supplies.

Coal has been in the news over the past few months. Not without reason. The recent power crisis in some of the states of India has moved coal to the centre stage. India's energy sector depends heavily on coal as fuel for its thermal power plants. The ability of coal-based power plants to operate round-the-clock and provide base load capacity is central to meeting the growing electricity demand to fuel India's economic growth.

India is the world's third largest electricity producer with an installed capacity of 399 giga watts (GW)[1] and annual generation of 1,490 billion units.[2] Coal currently accounts for approximately 70% of the total generation and dominates India's energy generation mix.[3] Therefore, any aberration in the demand and supply patterns that result in a coal shortage would have a domino effect on India's energy markets and economy.

India's power generation capacity (MW) as on 31 March 2022



Source: Ministry of Power

1 Ministry of Power
2 Power Ministry - Generation Data
3 IEA (2021), India Energy Outlook 2021, IEA, Paris

While several reports and articles have been written on the energy crisis and the primacy of coal in the current context, now is the time to take a step back to understand:

the genesis of the crisis

the role of coal in future energy mix possibilities

initiatives taken to contain its harmful environmental impact

This is especially crucial as India takes decisive steps down the green path to achieve its 2030 Conference of Parties (COP) 26 goals. India's COP 26 goals for 2030 include an increase in non-fossil fuel-based energy capacity to 500 GW and reduction of total projected carbon emissions by 1 billion tonnes.

What caused the power crisis

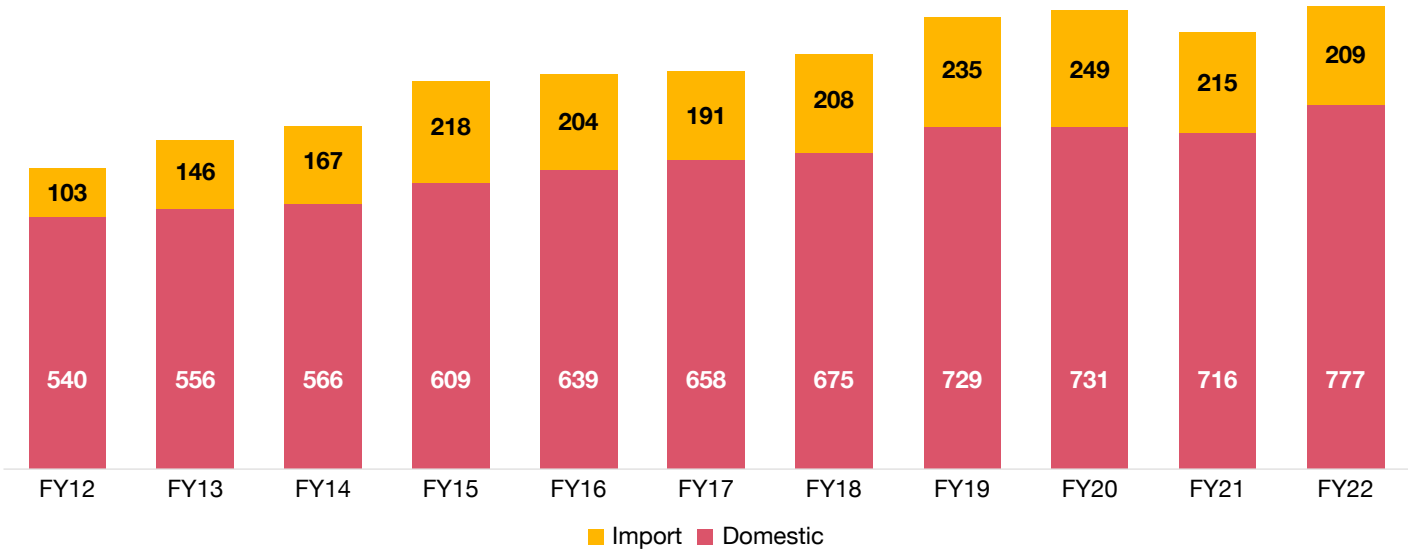
The recent power crisis in India may be attributed to the following factors:

- **Sudden growth in electricity demand:** As economic activity recovered post the COVID-19-induced shock, electricity demand surged in industries. The onset of record temperatures in the summers, reopening of commercial complexes and offices, and increased consumption contributed to the recent sudden peak in power demand.
- **Inadequate demand forecasting:** While domestic coal production for FY22 registered 8.55% year-on-year growth at 777 million tonnes (MT),[4] there is still a coal shortage at power plants. As on 1 June 2022, out of 165 operational coal-based power plants, 92 are running at critical coal stock.[5] Thermal power plant generation increased by 7.60% in April 2022[6] compared to April 2021, while the planned increment was only 2.15%. This coal shortage has been exacerbated by inadequate planning and demand forecasting.
- **Transportation issues:** The coal evacuation infrastructure across the country has been inadequate. As on 1 June 2022, there was an average actual coal stock of 82% of the normative requirement for 17 pithead coal-based plants. This figure is usually 28% on an average basis for 156 non-pithead power plants, which require transportation of coal over large distances.[7] While coal production in April 2022 increased by 29% compared to last year, the rake movement from Coal India Limited (CIL) mines remained constant, at around 275 rakes per day.[8] Railways, being the most efficient and economic mode of coal transportation, are expected to increase capacity to 450 rakes per day[9] by 2030 to improve coal supplies to the non-pithead power plants.
- **Increase in global coal prices:** Since September 2020, global coal prices have witnessed a steep increase. This is on account of a confluence of factors, including demand resurgence in China and droughts in Brazil, China, Turkey and the US that reduced hydel generation, thereby increasing reliance on fossil fuel based generation. Flooding in parts of China and Indonesia impacted the supply side, leading to an upward spiral. The Ukraine conflict and the resultant sanctions on Russia resulted in a drastic reduction in the global supply of natural gas, which in turn led to an increased demand for an alternative fuel, i.e. coal. Consequently, global coal demand increased by 9% during 2021 to nearly 8 billion tonnes. Coal prices touched an all-time high in March 2022 due to increased demand for coal, as a substitute for natural gas, in electricity generation.[10] According to the World Bank commodity outlook for April 2022, coal prices in the international markets are forecast to average over 80% higher in 2022 relative to 2021.[11]

4 *Ministry of Coal- Statistics*
5 *National Power Portal - Reports*
6 *National Power Portal - Energy Generation report*
7 *Daily coal report, CEA*
8 *Ministry of Coal-Monthly Coal Statistics*
9 *Ministry of Coal-Strategy for coal evacuation*
10 *World Bank-Commodity Markets Outlook report*
11 *World Bank-Commodity Markets Outlook report*

India still depends on imported coal for about 20% of its total coal requirement. In FY2022, about 209 MT of coal was imported, of which 152 MT was non-coking coal used for power generation.[12] Indian power producers have long term power purchase agreements that may not allow full pass-through of the elevated coal costs. At these price levels of imported coal, the variable cost of power generated by the plants based on imported coal becomes unviable. This resulted in these plants curtailing generation and also relying on domestic coal for power generation. However, the Ministry of Power has issued directions for blending imported coal, as well as modifying norms for pass-through of the higher cost of imported coal, to address the current coal challenges.

Domestic coal production and imports (Million tonnes)



Source: Ministry of Coal

- **Delays in coal mines operationalisation:** The deallocation of 204 coal blocks by the Supreme Court of India in 2014 and the subsequent reallocation disrupted the growth of coal supplies from captive/other coal mines, which took another five years to reach the production levels of 2014–15.[13] Although the Government of India has taken the right steps by introducing commercial coal mine auctions in 2020 to further increase domestic supply and enhance Atmanirbharta (self-reliance) in coal security, the operationalisation of these mines may take some time. Currently, of the 104 coal blocks allocated/auctioned since 2015 under the Coal Mines (Special Provisions Act), 2015 and Mines and Mineral (Development and Regulation) Act, 1957, only 24 coal mines have been able to start production.[14]

12 Ministry of Coal-Data on production-and-supplies

13 Ministry of Coal-Production data

14 Ministry of Coal-Allocated mines status

- **Delayed payments:** Delayed payments by some generation companies (gencos) in the past have led to CIL regulating the quantity of coal supplied to them. Delayed payments by gencos are due to delays in payments by the distribution companies (discoms); these in turn are triggered by inadequate tariff revisions that do not result in recovery of costs for the power supplied by the discoms and cause delays in receipt of government subsidies. The stretched financials of the discoms in turn lead to a buildup of receivables for the gencos (INR 1,23,000 crores as on April 2022), triggering a ripple effect across their supply chain.

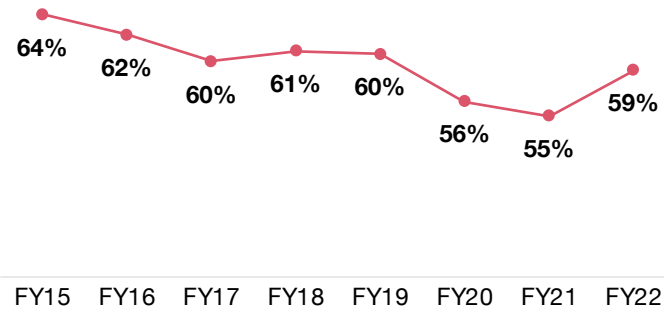
This issue underscores the importance of proper estimation of emerging electricity demand, meeting it with appropriate fuel linkages and a sound logistics supply chain. It is also about managing peak demand during specific time periods rather than the average demand with available generation resources. In a developing nation, several other energy-intensive industries such as aluminium and steel compete for the available coal. This will therefore require a suitably calibrated transition from coal to renewable sources of energy.

Factors influencing decarbonisation in the near to medium term

The power crisis in some states of India has put the focus back on coal-based thermal assets. This may seem like an opportune time to move away from coal and drive decarbonisation of the economy. But as the reliance on coal is very heavy, it is expected to remain India's primary source of energy, at least in the near to medium term. There are several reasons for coal being India's dominant source of energy security:

- **Meeting increasing electricity demand:** The coupled effect of being one of the world's fastest growing economies and the second most populous country (accounting for approximately 18% of the world's population) is expected to propel future energy growth in India. With current per capita electricity consumption at about a third of the global average and significant urbanisation plans, power demand is expected to double in the coming decade. Due to a variety of reasons including commercial competitiveness from generation through solar power, the utilisation (PLF) of coal-based thermal power plants decreased gradually from 64% in FY 2015 to 55% in FY 2021. It improved considerably last year to 59% when industry demand bounced back; however, it is significantly lower than the historical levels, indicating the need for optimising and improving the utilisation of already installed coal-based power plants. One way to improve utilisation would be to improve the availability of coal stocks.

PLF for coal-based power plants (in %)

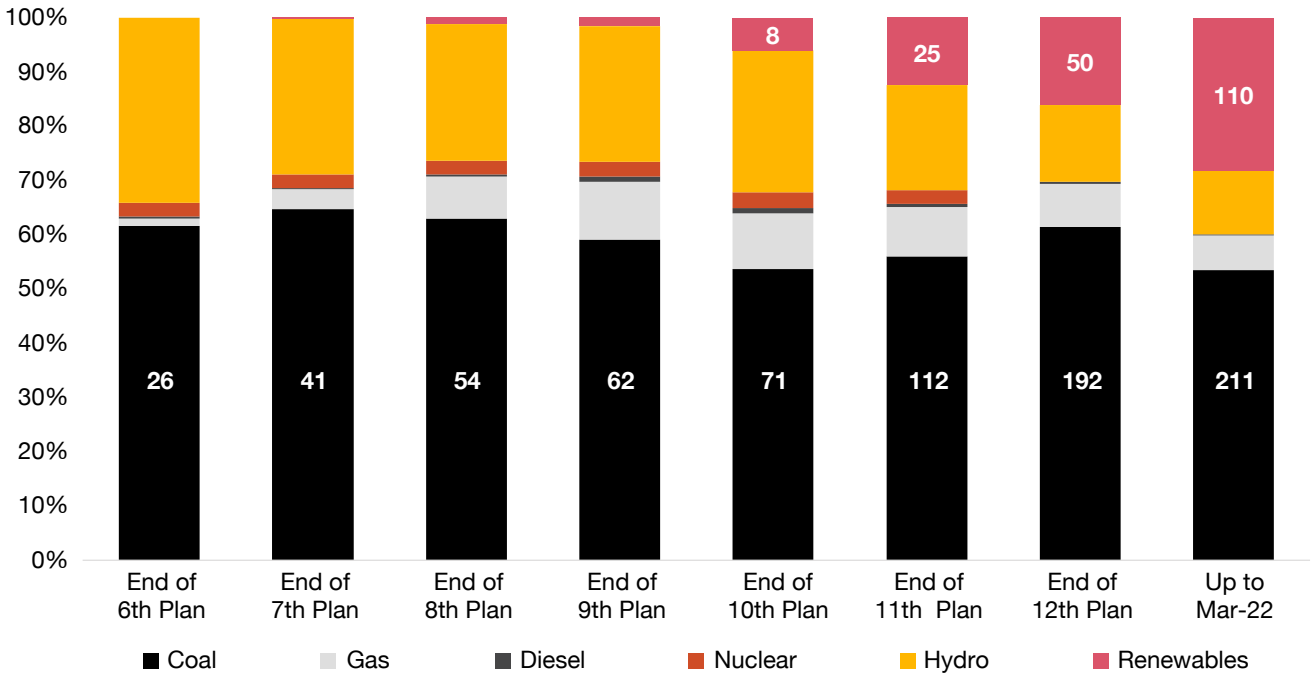


Source: CEA

- **Intermittency issues in non-coal sources of energy:** With a strong push owing to various schemes of the Government of India, subsidies and improving technologies, power generation from renewable sources, especially solar, has become cost effective compared to coal-based power generation. In fact, with the increasing penetration of renewable energy (RE) and the advent of various cost-effective technology solutions, the rates for solar and wind power are as low as INR 1.99/kWh and INR 2.43/kWh respectively.[15]

15 *MNRE - Press release*

Growth of installed capacity in India (GW)



Source: CEA

Although the share of thermal-based sources in the capacity mix has reduced from around 72% to around 60% in FY22, it still accounts for approximately 75% of the total electricity generation.[16] Given this scenario, it is believed that coal will continue to be India's primary energy source, led by its usage in the electricity sector. This is primarily because of the intermittency issues typical of renewables and lower penetration of round-the-clock/storage linked RE plants, which make it difficult for RE plants to replace coal for meeting the base load.

- **Utilisation of coal:** India ranks fifth in the world in terms of coal reserves and is the world's second largest coal producer.[17] It has a limited supply of steel grade coking coal but huge resources of power grade thermal coal. Due to this abundance, coal is the go-to energy source for meeting the growing energy demand. With more than 200 GW of coal-based generation capacity that provides both energy security and base load power, coal-based power is fundamental to India's energy ecosystem and economy. Further, about 20% of the thermal coal requirement is sourced from abroad. This impacts not only the foreign exchange reserves – as thermal coal imports cost more than INR 70,000 crore – but also leads to a higher cost per unit of power generation. This could have been addressed by increasing domestic coal supplies by promoting auction, allocation and operationalisation of greenfield coal mines in the country, accompanied by strong monitoring of Environmental, Social and Governance (ESG) aspects.

  A report by NITI Aayog[18] has indicated that coal-based capacity in India will peak at about 250 GW by 2030, while coal-based utility electricity generation will slow down and likely peak in 2040 as India progresses towards its net zero targets.

16 *Central Electricity Authority - Executive Summary*

17 *Year End Review 2020- Ministry of Coal*

18 *NITI Aayog: Energizing India*

- **Dependence of heavy industries on coal:** In addition to high dependence on coal for generating electricity, coal is also a vital source for Indian heavy industries, such as steel, aluminium and cement production. As per the International Energy Agency's (IEA's) report, there are not many technologies available that can replace the usage of coal in steel production. India, therefore, is slated to add 130 million tonnes (MT) to meet the coal demand,[19] and this in turn will contribute to GDP growth. Coal consumption is expected to increase at an average annual rate of 3.9% and reach 1,185 MT by 2024,[20] when India will overtake China as the world's largest metallurgical coal importer.
- **Socio-economic impact:** India is the second largest producer of coal in the world, and the greatest challenge in the phase-out of coal is the social aspect. In India, about 13 million people are employed in various sectors associated with coal, including mining, transport, power, sponge iron and steel.[21] Thus, the socio-economic impact of the transition away from coal poses a key challenge.
- **Coal's role in Indian Railways' freight revenue:** Coal and the railways in India are heavily interdependent. The dominant evacuation mode for coal is the rail route. With the PM Gati Shakti Mission, the Indian Railways plans to expand its modal share from 64% to 75% by 2030.[22] On an average, the railways account for over 85% of the costs of transporting coal to thermal power plants. Coal accounts for about 43% of Indian Railways' freight revenue and India's fare-to-freight ratio at 0.3 times is significantly lower compared to that of countries such as China, Germany and Japan. The freight operations and the revenue generated facilitate cross-subsidies and therefore, the shift away from coal would necessitate an attendant change in the overall tariff structures, as the volumes of the key cross-subsidy providing component, viz. coal, would see diminution.

In FY22, the demand for coal was about 980 MT, while domestic supplies added up to approximately 777 MT. India continues to be heavily reliant on coal imports to the tune of around 210 MT, mainly from Indonesia, Australia and South Africa. More than 80% of India's coal production is driven by CIL. Of the total domestic coal production of 777 MT in FY22, CIL and its subsidiaries produced 622 MT. CIL plans to achieve coal production of 1 billion tonnes by FY26. Given the past rate of increase in coal production, India's reliance on imported coal may continue for a while.

On the other hand, the Government of India has taken several initiatives to increase domestic coal supplies to meet the demands on the domestic front. These include

planned investment of more than INR 50,000 crore on coal evacuation infrastructure

introducing commercial coal mining for private companies

allowing captive miners to sell upto 50% of coal in the open market

auctioning of abandoned mines of CIL on revenue share mechanism and

introducing national coal index for coal trading.

19 *IEA report*

20 *IEA Coal 2021*

21 *Indian coal sector employs 13 million people in India*

22 *PIB*

Our take

1. Strategies to avoid the recurrence of a power crisis and coal shortage

It is evident that in the near to medium term, India will continue to be significantly dependent on coal. To reduce the severity of coal shortage that impacts electricity generation and in turn the Indian economy, it is important to work on a three-pronged strategy focused on better planning, infrastructure development and increase of domestic supplies.

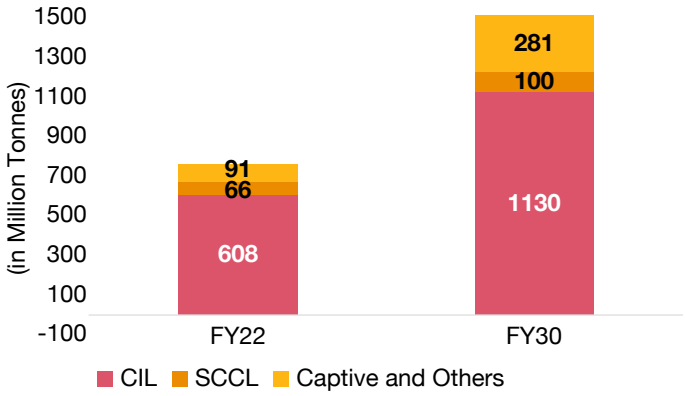
- **Better demand forecasting and management:** Electricity demand has become increasingly complex over the years. Institutions entrusted with planning are supposed to forecast demand profiles taking into consideration multiple factors. Multiple stakeholders need to come together to effectively manage the power sector, starting with detailed planning of the power system. There is a need to develop strong planning, scheduling and monitoring mechanisms coupled with optimisation of utilisation of coal resources.
- **Use of data analytics for accurate forecasting:** Advanced data analytics can help in accurate forecasting of peak and energy demand.[23] Accurate forecasts for the days ahead as well as in the short, medium and long term are imperative. These forecasts need to be made more granular, factoring in key variables impacting that geography. These include climate and weather patterns, GDP growth, urbanisation and industrialisation, water tables and cropping patterns, festivals and sports events; it is also important to adopt ground-up econometric models of peak and energy demand forecasting.
- **Aligning consumption and generation of energy:** Instead of average demand management, the management of peak demands during specific time periods is crucial. In addition, adoption of time of use tariffs can also help nudge positive consumer behaviour, so that requirements of specific user groups may be synchronised with renewables power generation. Dedicated feeders could be used for specific user groups to align energy consumption with renewable generation.
- **Better planning:** Better demand forecasting will enable better planning, including sourcing of imported coal, adequate logistics arrangements by the railways, ramping up of coal production, along with the availability of transmission and distribution corridors. Th coal import strategy will also need to be based on a diverse sourcing mix so that geopolitical events or climatic surprises can be factored in. The government, on its part, has advised all gencos to import 10% of the coal requirement for blending.[24]
- **Improving coal evacuation infrastructure:** India's coal-based capacity is skewed towards non-pithead based plants, with pithead based plants accounting for approximately 20% of the total installed capacity. This results in high dependence on logistics infrastructure. Recognising the criticality of the evacuation infrastructure, the Government of India had announced an INR 50,000 crore plan for its augmentation in May 2020. Development of common rail corridors, dedicated freight corridors, promotion of coal washery at mine-end and conveyor systems can alleviate the current evacuation and transportation concerns. In the absence of effective infrastructure, large volumes of coal are transported by road using diesel-operated trucks that are costlier, more polluting as well as inefficient, leading to avoidable diesel consumption and forex expenditure.

23 Institutions planning and forecasting power demand are failing: Sambitosh Mohapatra

24 Directions from Ministry of Power dated May 5, 2022

- **Focused approach for increasing domestic coal supplies:** Apart from addressing issues related to demand and logistics, there is a need to focus on increasing the coal production capacity of the country. As per recent demand and supply projections by the Ministry of Coal, domestic coal supplies will increase to 1,511 MT by FY30, which requires domestic coal to increase at a CAGR of 8.88% – that is double the historical growth rate of coal production in the last decade. It is therefore imperative to focus on addressing issues related to statutory approvals and project development, including delays in environmental clearance, land acquisition and Resettlement and Rehabilitation (R&R) for coal mining projects.

Distribution of domestic coal supply



In addition to laying emphasis on project proponents, the Ministry of Environment, Forest and Climate Change (MoEFCC), Ministry of Coal (MOC) and state government authorities need to collaborate to address impediments related to the commencement of production from coal mines already allocated and auctioned. This will help increase coal production from non-CIL/SCCL mines from 91 MT (in FY22) to 281 MT (in FY30) at a CAGR of more than 15%.

- **Blending of biomass:** The policy of compulsory blending of biomass pellets that comes into effect from October 2022 starts with a blend of 5%, progressively increasing to 7% for certain categories of thermal plants. This will help ease some of the pressure on the coal requirement. Among various agri residues, paddy straw alone has the potential to generate about 45 billion units (about 3% of the overall electricity generated). Biomass blending will also have attendant benefits that include reduction in stubble burning, thereby reducing the overall air pollution levels. Also, the market mechanism for sale of agri-residue will result in additional income for farmers; and pellet-manufacturing units will provide avenues for rural entrepreneurship and employment. The power thus generated will allow discoms to meet their Renewable Purchase Obligations (RPOs). Currently, about 25 GW of coal-based capacity across 17 plants has engaged in the co-firing of biomass. Strict enforcement of blending norms will substantially increase this number, resulting in a win-win situation for all stakeholders.

- **Use of digital solutions to enhance production:** Promoting the use of high production technologies and digital solutions to enhance production from already existing coal mines of CIL and other coal-producing companies can also help address the issue to some extent. This may require policy support from the government, investments from the market, and establishment of institutions around capacity building, governance, and sustainability; but in the long run, there would be enormous gains.

2. Containment strategies to reduce environmental pollution

To live with coal-based generation, it is important to adopt containment strategies that reduce the adverse impact of coal combustion on the environment. The following are some of the focus areas and initiatives taken to achieve this objective:

- **Pruning of inefficient thermal capacities, and renovation and modernisation (R&M) and life extension of plants:** The Ministry of Power, under the National Mission on Enhanced Energy Efficiency (NMEEE) is undertaking retirement of old and inefficient thermal units. These will typically include plants that have completed more than 25 years of operation. The pace of activity under this initiative has picked up in recent years and till March 2021, 15 GW capacity across 177 units had been retired:[25]

Time period	No. of units	Capacity retired (MW)
2002–07	9	629.50
2008–12	38	2,135.00
2013–17	49	4721.50
2017 onwards	81	7615.38
Total	**177**	**15,101.38**

  This is supplemented by ongoing programmes for R&M and life extension of capacities so as to improve the key operational metrics including plant availability factor, station heat rate and auxiliary consumption. These measures will result in plants that are more efficient and hence will have a less severe impact on the environment.

- **Flexible operation of coal-based capacities to meet peak power requirements:** The large capacity addition envisaged in the renewables space makes it essential that the coal-based capacity acts as a bulwark to take care of variations that naturally occur in RE generation, prompting the need for flexible operations of coal-based capacities. Conventionally, coal-based plants are designed for base load operations. Currently, trials are underway on about 4 GW of coal-based capacity across 36 units, to test the feasibility of flexible operations of the plants.

- **Implementation of flue gas desulphurisation (FGD):** Given the harmful effects of sulphur dioxide (SO_2), including acid rain and severe health consequences, there is a need to reduce the SO_2 emission in the flue gases of coal-based power plants. While installation of FGD equipment has been mandated by the Government of India, the timelines have seen progressive shifts, and as of December 2021, FGD installation for only 2 GW capacity, of the 168 GW identified, was completed. The revised timelines envisage the installation of FGD equipment over a period ranging from December 2022 to December 2025, based on the type of capacity and its proximity to population centres. Environmental compensation ranging from 5 paise to 20 paise per unit, in case of delays, is expected to result in improved adherence to the revised schedules. FGD implementation will be an essential component of the measures to be undertaken to enhance our ability to live with coal-based power generation.

25 CEA Annual report FY 21

- **Carbon capture utilisation and storage (CCUS):** CCUS aims to reduce carbon emission by either storing or reusing carbon dioxide (CO_2) so that the captured CO_2 does not enter the atmosphere. It is an important component of India's journey towards net zero as it can help facilitate a more gradual transition from fossil fuels to renewables. The Department of Science and Technology has launched a Mission Innovation challenge and 20 proposals have been identified for support. In addition, there are various initiatives on CCUS underway in India that adopt different techniques and target multiple end results, including enhanced oil recovery using CO_2, conversion of CO_2 to methanol and flue gas carbon capture. CCUS technologies are currently very expensive, and their widespread adoption would be predicated on a robust carbon pricing mechanism, so that a price is placed on the carbon emissions.

Need for optimising the current requirements while promoting sustainable energy security

India's push in the last decade towards renewables is aligned with the global move away from fossil fuel-based energy. Over the past decade or so, the share of thermal capacity and specifically coal has been decreasing, while RE-based capacity has been gaining significant momentum.

As mentioned at the onset, India, as part of its COP 26 goals, has pledged to develop 50% of its installed generation capacity based on non-fossil fuel sources by 2030, reduce its projected carbon emissions by 1 billion tonnes, reduce the carbon intensity of the economy by 45% and have 500 GW of non-fossil fuel-based energy capacity in place. These form part of India's five-point action plan, 'Panchamrit', announced at the Glasgow summit in 2021, with a long-term commitment of net zero carbon emissions by 2070. This will necessitate tilting the mix of capacities under implementation in favour of RE projects.

On the flip side, we are structurally dependent on coal for the majority of our energy needs. With one of the world's largest coal reserves, coal is more than an engine of economic development for India, as it plays a critical role in ensuring energy security. But for the greater good and for building a sustainable ecosystem, it is crucial to optimise coal-based generation and make it more efficient and cleaner. Also, it is worthwhile to remember that coal can only sustain us in the interim period; critical measures need to be taken to balance our dependence on coal and ensure a smooth transition to a green economy.

Having an appropriate mix of generation technologies is needed to meet India's changing demand profile. The decarbonisation of the economy underscores the development of non-fossil fuel-based sources of generation. At the same time, partially utilised thermal power plants need to be retrofitted to offer additional flexibility (ramp-up/ramp-down), which will help integrate variable RE sources without impacting grid stability. As we transition into an ESG-led clean energy future, our dependence on coal will gradually decrease. In the interim, we also need to optimise our utilisation of this abundant resource to meet the nation's energy needs.

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