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Critical Challenges in Realizing the Energy Transition: An Overview of Indian States

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ABSTRACT

This paper studies three of the many challenges that State governments will face as India transitions away from a fossil fuel-driven economy. It estimates the current dependence on fossil fuels by way of State government revenues from fossil fuels, ownership of thermal (coal) power units and those employed in coal mining. It looks at the expected time path of the various transition processes in each of these three areas. While all transitions will be challenging in various ways for each state, some states will require greater efforts in managing the process smoothly. It finds that budgetary revenues are likely to take a significant 'hit' as fossil fuels currently account for a significant share of all State government revenues, though there are significant state-level differences. It also finds that many states have fairly significant ownership of coal power capacity replacing which will impose an additional burden on the states. However, it finds that direct employment in coal mining is limited or insignificant in most but a handful of

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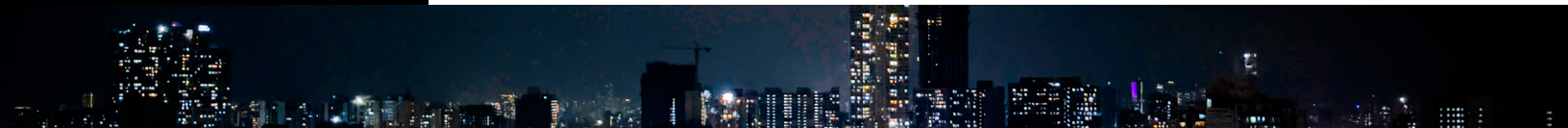


states, and therefore, the necessary protection and support required for the labor transition may not have an inordinately high expenditure burden for most, barring a handful of states.

Keywords: India, energy transition, fossil fuels, coal, revenue, transition impacts

INTRODUCTION

Over the next few decades, like most other countries, India will go through a significant energy transition, with a steady reduction in the share of fossil fuels in its energy portfolio. This transition will have many different impacts, including on government revenues, investments and potential loss of fossil fuel-based assets, and employment. Such impacts have been discussed and analyzed by a host of recent studies (Bhandari and Dwivedi, 2022; Pai, 2021; Prayas, 2021; Tongia et al., 2020). Most of these studies have looked at this issue from a national perspective and have tended to focus on quantifying the scale of the challenge. However, while the transition will be on a national—indeed, a global—scale, it will occur across districts, cities and states and impact each differently. This paper examines three key challenges related to the energy transition that State governments in India will face and quantifies the extent of this challenge.

The national (central) government and sub-national (state) governments in India often have different priorities with respect to the energy sector. The Centre's perspective is informed by macroeconomic stability, economic growth and geostrategic issues while states are driven more by local and state-level concerns as well as political-economic realities affected by factors such as energy access, affordability, local jobs and economies. A transition in the energy sector is likely to bring such differences into sharper focus since its ramifications would be different for the Centre and each state. After Prime Minister Narendra Modi's announcement at the 26th United Nations Climate Conference (COP26) on India's commitment to a net-zero target of 2070, a firm date has been established for India. However, the target for India will require each state to act differently as access to resources, dependence on revenues, underlying employment conditions and fossil fuel dependence differ.

India's net-zero commitments will eventually require each State government to engage with the Central government, and the Central government will need to engage with each State government differently as each will have different imperatives formed by its own political-economic realities. Moreover, the country's federal structure allocates different domains between the Central and State governments. This is done via three lists specified in the constitution. The Union list allocates exclusive powers to the Central government and includes powers over, among others, defense and foreign policy, interstate trade and commerce, regulation and development of oilfields and minerals, and regulation of labour and safety in mines and oil fields. In the State list, only State governments have the power to decide over, among others, agriculture, regulation of mining activity, taxes on minerals and energy including fossil fuels subject to exceptions. The third, or Concurrent list, is one where both the central and State governments have the power to decide on relevant issues. These include, among others, forests, protection of animals and birds, trade and labor disputes, contracts and partnerships, and mechanical vehicles and taxes on them. Both the states

and the Centre collaborate and coordinate through many informal and formal mechanisms. Formal mechanisms include entities such as the Inter-state Council and the Goods and Service Tax (GST) Council; even Central government ministries and departments have formal mechanisms for engagement with State government departments. Such formal mechanisms have their own well-specified rules of engagement and decision-making. Informal mechanisms, however, work in many different ways including through personal and political engagements.

In the context of energy transition, different states will be impacted differently on revenue, employment and energy investments. An understanding of the underlying forces impacting each state's position will therefore be necessary for a well-designed transition process. This paper identifies three major areas: where states are heavily 'invested' in fossil fuels, such as budgetary revenues from fossil fuels; thermal (coal) power generation; and employment in coal mining. These three directly map with fiscal, capital and labor issues associated with energy transition. Given their differing importance in the political economy of states, we analyze the same on a state-by-state basis. The paper delves into each of these three issues and identifies both difficulties and opportunities within each of these spaces. The study, however, does not delve into specific solutions and focuses instead on identifying the key energy transition challenges for each of the major states of India.

The rest of this paper proceeds as follows: Section 2 estimates the extent of tax and non-tax revenues from fossil fuels across all major states and union territories (UTs) in India. It finds that almost all states will be severely affected by the loss of fossil fuel revenues, though, of course, there are significant inter-state differences. Section 3 identifies the distribution of ownership and capacities of coal power plants. It finds that State government-owned plants have a significant share of total capacity in many states. Moreover, most such capacities will not complete their normal lifespan in the next three decades, and as a result, such ownership may make State governments less flexible in hastening the energy transition. Section 4 delves into those employed in coal mining. It finds that coal mining constitutes a large share of total mining-related employment in India, which runs into hundreds of thousands, and is concentrated in a few states, which will be the most affected. However, it also finds that coal mining employment is a small share of the total and most employed are in 40+ age distribution. Section 5 briefly integrates the challenges identified in the preceding three sections, and Section 6 is the conclusion.

FOSSIL FUEL REVENUES FOR DIFFERENT STATES

Climate change is one of the most urgent challenges facing the world today, and energy transitions away from fossil fuels are crucial components of the strategy to tackle global warming and climate change. During COP26, more than 130 countries committed to achieving net-zero targets between 2050 and 2070. Accordingly, every country has begun devising its own energy transition.

One factor common to all countries is the impact of transition on government finances. Many, if not most, governments across the world—whether consumers or producers of coal, oil or

gas—are heavily dependent on these for revenues. This is also true for India, as it is a minor producer of oil, a major producer of coal, and a major consumer of both. The government in India obtains revenues from both the consumption and production side. In our earlier work, we studied the quantum of these and how the revenues may change over time (Bhandari and Dwivedi, 2022). This section looks at similar issues at the level of states in India.

Current Dependence on Fossil Fuel Revenues

We first estimate the total tax and non-tax revenue for coal, oil and natural gas from the revenue sources mentioned above. In the process, this section compiles the total tax and non-tax revenues for each State and Union Territory (UT) government in India for the period of 2017-18 to 2020-21. The choice of the year is to cover the post-GST time period. We calculate the revenue from coal, oil and natural gas in the most disaggregated way possible with the publicly available data.[1]

TABLE 1 Sources of Revenue for State Governments

Fossil Fuels	Tax Revenues	Non-Tax Revenues
Oil and Natural Gas	Value Added Tax (VAT), Octroi, Entry tax, Duties including electricity duty	Royalty and Dividend
Coal (and Lignite)	State GST, Integrated GST, VAT	Royalty, Additional Royalty including District Mineral Fund (DMF), royalty for National Mineral Exploration Trust (NMET) and Dividend

Note: State GST and Integrated GST: These are the two components of GST that accrue to State governments, the former is collected by the State government and later by the Central.

As briefed in the table above, a host of tax and non-tax revenues accrue to State governments. The Appendix (Table A1-A6) provides details of the quantum of revenues under each of these heads during the period from 2017-18 to 2020-21 for each state. The primary source of information for revenues related to oil and natural gas is Petroleum Planning and Analysis Cell (PPAC). PPAC provides information both on the tax and non-tax revenues like sale tax or value-added tax (VAT), State GST, royalties, dividends, duties and so on. For coal-based revenues, we use annual reports of Coal India Limited (CIL), annual reports of the Singareni Collieries Company Limited (SCCL), Coal directory of India and Prayas (2022). As coal is under GST, the State GST and Integrated GST are two major sources of tax revenue. Note that one of the biggest sources of coal-based revenue for states is royalties from mining, which is concentrated in a few states.

Table 2 below summarizes the revenues for the year 2020-21 from different sources for each state as a share of the State government's own revenues (OR) (not including those transferred by the Central government)[2]. Appendix 1 provides details on the calculations. As is

[1] Prayas (2022) has conducted a similar exercise using similar data sources. We however go much further in terms of analysing the potential path of such revenues as the transition plays out.

[2] Own Revenues (OR) include taxes on professions, trades, callings and employment, land revenue, stamp and registration fees, urban immovable property tax, sale tax, state excise, entertainment tax, interest receipt, dividends and profits, and revenues from general, fiscal and economic services etc.

TABLE 2 State Level Revenues from Fossil Fuels, 2020-21

		Fossil Fuel Revenues (Rs crore)			Fossil Fuel Revenues as a percentage of OR (%)		
	States Own Revenue (OR)	Oil & Natural Gas	Coal	Total Revenue	Oil & Natural Gas	Coal	Total Revenue
Andhra Pradesh	60753	10,324	-	10,324	17.0	-	17.0
Arunachal Pradesh	2,116	27	-	27	1.3	-	1.3
Assam	32,061	4,116	54	4,170	12.8	0.2	13.0
Bihar	38,906	6,383	-	6,383	16.4	-	16.4
Chhattisgarh	34,340	3,886	3,718	7,604	11.3	10.8	22.1
Delhi	40,350	3,884	-	3,884	9.6	-	9.6
Goa	8,522	763	-	763	9.0	-	9.0
Gujarat	113,840	17,138	-	17,138	15.1	-	15.1
Haryana	57,977	8,333	-	8,333	14.4	-	14.4
Himachal Pradesh	10,377	445	-	445	4.3	-	4.3
Jammu & Kashmir	17,689	1,476	-	1,476	8.3	-	8.3
Jharkhand	32,679	3,312	4,252	7,564	10.1	13.0	23.1
Karnataka	109,248	15,649	-	15,649	14.3	-	14.3
Kerala	69,015	8,245	-	8,245	11.9	-	11.9
Madhya Pradesh	65,230	10,818	3,763	14,581	16.6	5.8	22.4
Maharashtra	216,385	27,917	1,700	29,618	12.9	0.8	13.7
Manipur	1,409	194	-	194	13.8	-	13.8
Meghalaya	2,691	0	-	0	-	-	-
Mizoram	1,033	92	-	92	8.9	-	8.9
Nagaland	1,310	116	-	116	8.9	-	8.9
Odisha	48,050	5,687	2,952	8,640	11.8	6.1	18.0
Puducherry	4,835	6	-	6	0.1	-	0.1
Punjab	41,701	5,676	-	5,676	13.6	-	13.6
Rajasthan	89,948	13,495	-	13,495	15.0	-	15.0
Sikkim	1,720	130	-	130	7.5	-	7.5
Tamil Nadu	135,005	18,737	551	19,288	13.9	0.4	14.3
Telangana	83,603	10,066	1,954	12,020	12.0	2.3	14.4
Tripura	2,502	402	-	402	16.0	-	16.0
Uttar Pradesh	168,545	20,731	645	21,376	12.3	0.4	12.7
Uttarakhand	17,391	1,501	-	1,501	8.6	-	8.6
West Bengal	69,824	-	1,968	10,055	11.6	2.8	14.4

Source: Authors' calculation.

Note: Not all states are coal-producing.

evident, revenues for each state differ depending upon the size of their economy, economic structure, fossil fuel extraction and beyond. Overall, petroleum products account for the bulk of fossil fuel revenues for most State governments. In the case of coal, a small number of states, about seven to eight, account for the bulk of coal production and consequently, revenues.

Bhandari and Dwivedi (2022) estimated the dependence of central and State governments in the aggregate on revenues from fossil fuels. It showed that for the central and State governments, fossil fuel share in total tax plus non-tax revenues were 20 percent and 8 percent, respectively, for the year 2019-20. In the above table, we focus only on 'own revenues' as that is what states have a greater degree of control over. We find that, from this perspective, the role of fossil fuel revenues is even higher. The above table also reveals the wide variation between states.

Many coal-producing states naturally rely heavily on fossil fuels for revenues as they benefit from both coal-related royalties from mining but also tax revenues from sales of oil and natural gas. Jharkhand, Chhattisgarh and Madhya Pradesh obtain 22 to 23 percent of their own revenues from coal, oil and natural gas, combined. Further, for the states of Odisha, Bihar, Andhra Pradesh and Rajasthan, between 15 to 18 percent of their own revenue are from fossil fuels. Even smaller and special category states like Assam, Tripura, Sikkim and Manipur obtain 10 to 15 percent of their own revenues from coal, oil and natural gas. States have a relatively higher dependence on oil and natural gas in comparison to coal. The percentage of own revenue generated via oil and natural gas varies from 4.3 percent in Himachal Pradesh to 17 percent in Andhra Pradesh. All the major industrialized states in India like Gujarat, Maharashtra, Tamil Nadu and Karnataka receive about 15 percent of their own revenue from oil and natural gas.

The future transition, therefore, will play out differently for different states not only because of different starting points in terms of current revenue dependence, but also because of the different sources that these revenues arise from. For instance, more coal-dependent states may have a lower fiscal impact simply because current taxes on coal are relatively lower than those on oil and natural gas.[3]

Energy Transition at the State Level and Fiscal Impact

We now look at a possible transition path over the next two decades to better understand how the experiences of transition will be different for each state. We take a transition path for India as a whole shared by the International Energy Association (IEA, 2021). IEA (2021) projects energy usage under different scenarios, namely, Stated Policies Scenario (STEPS), India Vision Case (IVC) and Sustainable Development Scenario (SDS). STEPS provides an assessment of the direction in which India's energy system is heading, based on policy settings and constraints as of 2021, and the assumption that COVID-19 will be broadly under control. Note that IVC and SDS transitions would be more rapid than STEPS. Under all three

[3] The average VAT across different Indian states stands at 32.02% as of 1st June 2022. There are various taxes imposed on coal. However, it is taxed relatively less.

scenarios, the IEA (2021) study estimates the total energy required, and also the fossil fuels consumed.

We focus on the STEPS case in this discussion as it is the most conservative in terms of the pace of change and therefore provides an illustration of what might occur in the near future. We follow Bhandari and Dwivedi (2022) on the methodology that follows (Details in Appendix 1 and 2). The Appendix has detailed estimates of each of the scenarios and also a discussion of the various steps (see Appendix 2, and Appendix Tables A2-A4).

As is shown in Table 3, we can expect a significant fall in the revenues from fossil fuels as a share of our own revenues, and as a share of gross state domestic product (GSDP) as well. Consider how fossil fuel revenues are going to change as a share of own revenues in 2030, and by 2040. By 2030, almost all states can expect a significant decline in the percentage of their own revenue generated via coal, oil and gas if they were to follow the IEA transition path. We also calculate the share of fossil fuel revenue as a share of State's own non-fossil fuel revenue[4] (Table A8 in the Appendix). The own non-fossil fuel revenue for any state is own revenue minus the own fossil fuel-based revenue. As expected, the share in 2019-20 increases in this case but falls significantly by 2040. However, notwithstanding the scenarios and the way we calculate the share, the coal-producing states face the maximum decline.

This serious decline in revenue shares is not as much due to a decline in usage, but due to a slowdown of growth. While revenue from fossil fuels can be expected to increase in nominal terms, it will fall in relative terms both as a share of GSDP and ORs for all states by 2040. This is because the expected growth rate of fossil fuel revenues is going to be lower than the growth rate of GSDP and their own revenues. This, therefore, is among the key challenges that State governments in India are likely to face in the forthcoming decades; namely, finding alternative revenue sources to cover the loss of fossil-based revenues.

It must also be noted that Maharashtra shows an increase in the proportion of own revenue from fossil fuels as it has a disproportionately high consumption of natural gas in comparison to other states. By 2040, every state including Maharashtra is expected to face a further decline in revenue share. By 2040, irrespective of which state we consider, the fossil fuel revenue as a share of own revenue of states and UTs fall to around 2 to 3 percent. Some states such as Gujarat, Assam and Jharkhand have a higher value at 4 to 5 percent in 2040.

As a share of GSDP as well, all major coal-producing states—including Jharkhand, Chhattisgarh, Madhya Pradesh and Odisha—face a steep shortfall in revenues from fossil fuels. Similar to the case discussed earlier for Maharashtra, the share increases in 2030 before falling in 2040 because of greater natural gas consumption during the early transition years.

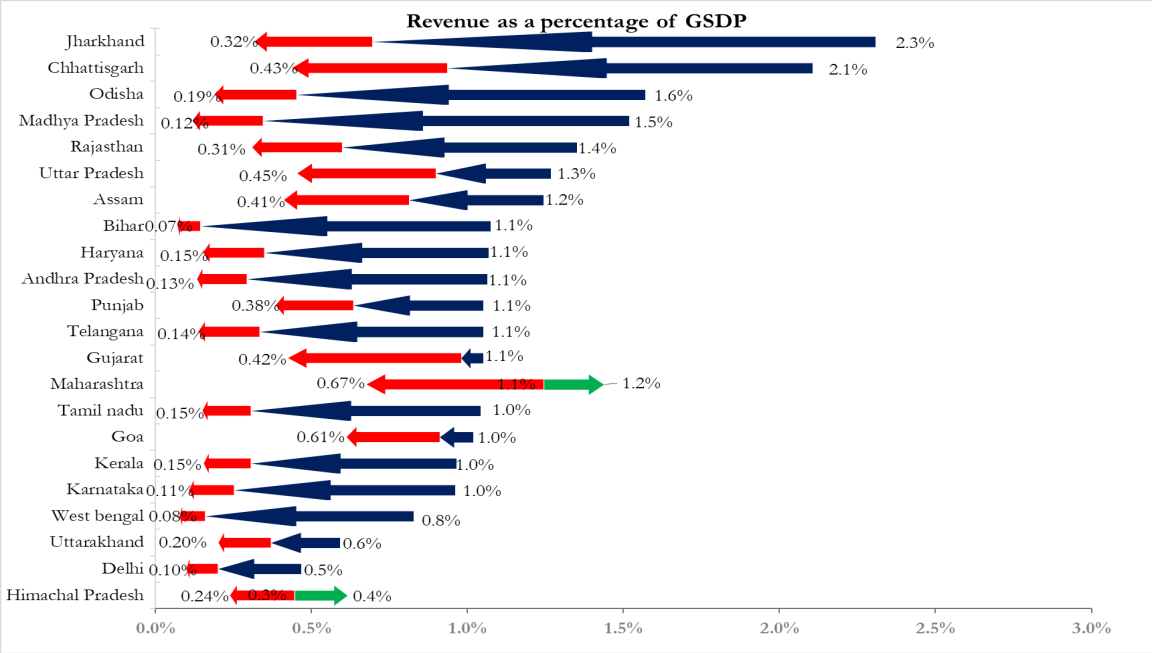
[4] While calculating fossil fuel revenue as share of own revenue of states there is an implicit assumption that going forward the non-fossil fuel component of own revenue will compensate. So, we calculate fossil fuel revenue as share of own non-fossil fuel revenue for comparison.

TABLE 3 Fossil Fuel Revenue as a Share of Own Revenues and Gross State Domestic Product in Major States

	Fossil fuel revenue as a percentage of OR			Fossil fuel revenue as a percentage of GSDP		
	2019-20	2030	2040	2019-20	2030	2040
Andhra Pradesh	16.99	2.9	1.31	1.06	0.29	0.13
Arunachal Pradesh	1.25	7.06	3.19	0.09	0.45	0.2
Assam	13.01	11.6	5.83	1.24	0.81	0.41
Bihar	16.41	2.19	1.07	1.07	0.15	0.07
Chhattisgarh	22.14	9.69	4.51	2.2	0.94	0.43
Delhi	9.63	3.71	1.8	0.47	0.2	0.1
Goa	8.95	7.55	5.07	1.02	0.91	0.61
Gujarat	15.05	13.62	5.88	1.05	0.98	0.42
Haryana	14.37	4.64	2.02	1.07	0.35	0.15
Himachal Pradesh	4.28	6.22	3.31	0.27	0.45	0.24
Jharkhand	23.15	8.85	4.03	2.36	0.69	0.32
Karnataka	14.32	3.33	1.41	0.96	0.25	0.11
Kerala	11.95	3.72	1.87	0.96	0.31	0.15
Madhya Pradesh	22.35	3.97	1.36	1.56	0.34	0.12
Maharashtra	13.69	16.67	9.02	1.05	1.24	0.67
Manipur	13.76	16.93	7.95	0.61	0.72	0.34
Meghalaya	0.01	19.94	14.5	0	1.32	0.96
Mizoram	8.92	4.89	1.49	0.37	0.23	0.07
Nagaland	8.87	13.47	6.47	0.39	0.55	0.26
Odisha	17.98	5.15	2.14	1.58	0.45	0.19
Puducherry	0.12	1.86	0.97	0.02	0.24	0.12
Punjab	13.61	8.04	4.86	1.05	0.63	0.38
Rajasthan	15	7.18	3.71	1.35	0.6	0.31
Sikkim	7.53	2.42	0.98	0.42	0.17	0.07
Tamil Nadu	14.29	3.9	1.91	1.07	0.31	0.15
Telangana	14.38	3.88	1.59	1.26	0.33	0.14
Tripura	16.05	8.41	3.22	0.72	0.4	0.15
Uttar Pradesh	12.68	9.76	4.9	1.27	0.9	0.45
Uttarakhand	8.63	6.02	3.28	0.59	0.37	0.2
West Bengal	14.4	2.76	1.34	0.83	0.16	0.08

Source: Authors' calculations.

FIGURE 1 Fossil Revenue as a Share of Gross State Domestic Product (STEPS)



Source: Authors' calculations. The blue arrows denote the effects of the transition in the period 2020-2030 and the red arrows for the period 2030-40.

Figure 1 above clearly shows that for almost all States and UTs, barring Maharashtra and Himachal Pradesh, we expect a significant decline in the revenue from fossil fuels as a share of GSDP. Even for anomalous states like Maharashtra and Himachal Pradesh, the share rises in 2030 but falls substantially in 2040. The exceptions, such as Maharashtra and Himachal and to a lesser extent Gujarat and Goa, are because in these states, the increase in revenues from fossil fuels is not expected to stabilize as much in the next few years.

Assumptions and projections notwithstanding, some facts are evident. First, fossil fuel revenues are substantial for most states. Second, they will decrease over a period of time. Third, the fall in the share of fossil fuel revenues would be front-loaded and the bulk of the fall in their share would occur between 2020 and 2030 for most states.

In conclusion, we find that most states will have significant pressure on their fiscal conditions over the next few decades.

COAL POWER PLANTS

Coal is the largest source of energy, providing 44 percent of the total primary energy demand in the country, as of 2021.[5] It is also the single largest source of greenhouse gases (GHG) in the country as well.[6] The power sector is the largest consumer of coal and lignite in the country and about three-fourths of total coal and lignite is consumed for power generation

[5] IEA (2021)

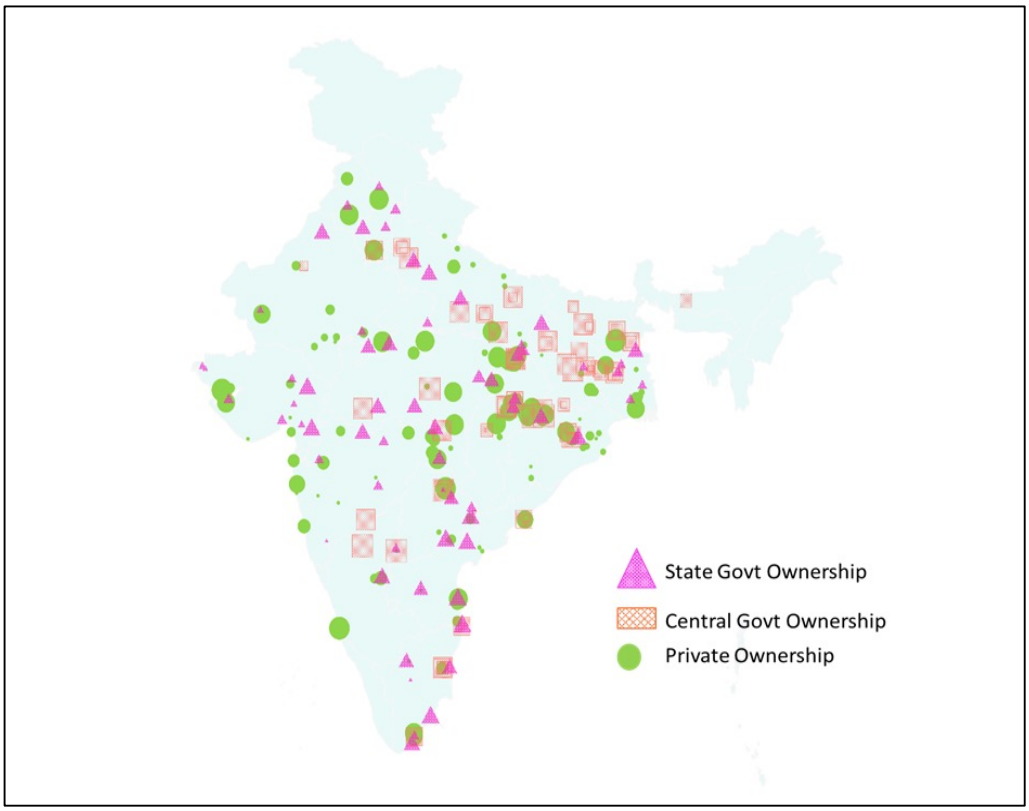
[6] Karstensen et al. (2020)

(IEA, 2020). Keeping aside the COVID-induced decline in 2020, the demand for coal has steadily increased witnessing a compound annual growth rate (CAGR) of 5 percent in the last decade.[7] Moreover, given its centrality in India's energy mix, it has strong linkages with other parts of the economy as well.

Power is produced by units owned by State governments, Central government (via the National Thermal Power Corporation) and also by independent (private) power producers. Private power producers are playing an increasingly important role and their shares in overall capacity are increasing over time. However, of the current thermal capacity, a large share is that of the public sector, whether owned by the State or Central government.

The data for coal power plants has been sourced from Global Energy Monitor's Global Coal Plant Tracker (GCPT). The database tracks individual coal plant units and includes information such as plant sponsor and parent company, plant status, plant and coal type, and location. For lifetime emissions, it assumes 40 years of operation. For plants that are 40 years or older, five more years of operation are assumed. The database is updated bi-annually, in January and July. In the analysis, we have used data as of July 2021.[8]

FIGURE 2 Ownership Distribution of Coal Power Plants



Source: Authors' calculation.

[7] Ministry of Coal, GoI, Production and Supplies, 2022 https://coal.gov.in/en/major-statistics/production-and-supplies

[8] We have tried to compare the former with CEA's steam-based thermal power plant data as well. Please note that the GCPT data is till July 2021 in contrast to CEA data, which dates to March 2020.

Figure 2 presents the distribution of coal power plants in India. Note that a larger number of coal power plants are located in Eastern and Central India. This is not surprising since coal mines are located predominantly in these parts of the country, more specifically, West Bengal, Jharkhand, Madhya Pradesh, Chhattisgarh and Odisha, among others. During the pre-1991 planning era, the government had a policy of freight equalization aimed at promoting well-spread industrialization. This policy involved ensuring that a mineral user would be able to get such inputs at the same price irrespective of how far they were located from the mine head. This resulted in a fairly large dispersion of thermal power plants. However, the policy was dropped in 1993, and since then, there is a greater likelihood of mineral-using units to be located closer to the mines. Moreover, many new units also use imported coal and are more likely to be located near major ports.

Table 4 shows the ownership-wise distribution of units and capacities across the states. Each power 'plant' may have one or more units; these data are at the unit level. As is evident from Figure 2, coal power units and capacities are spread across each state but unevenly so. But more interestingly, State government-owned units account for a significant share of the total in many states. Haryana, Punjab and Rajasthan are some of the states whose state-owned units are higher in terms of their total units. Uttar Pradesh, followed by Chhattisgarh, Maharashtra and Madhya Pradesh have the highest total capacity. Private-owned capacity has a maximum share in the aforementioned states except for Uttar Pradesh where central owned capacity is more. Apart from Assam and Uttarakhand, all other states have some state-owned coal power capacity. Similarly, Punjab and Uttarakhand do not have centrally owned coal power capacity in the state, and Assam is the only state that does not have privately owned capacity. Further, it is the only state that has only Centre-owned capacity of around 750 MW, which is spread across three units.

As is evident from the table below, the greatest coal power capacity exists in states that are either large demand centers or where coal mines are located. The total of 288 GW capacity is spread among 944 units in this data, which translates to about 305 MW average unit capacity. These are no doubt small units by current global standards, irrespective of ownership. About a third (31 percent, to be precise) of the total coal power capacity is State government-owned. For Telangana, Tamil Nadu and Rajasthan, more than half the total capacity in the state is State government-owned, for Gujarat, Maharashtra and Andhra Pradesh as well it is fairly high at 38 percent, 40 percent and 45 percent, respectively. These are economically larger states and for each of these, the absolute capacity is greater than 6,000 MW, with Tamil Nadu topping the list at greater than 11GW.

For 12 of the 18 states considered, coal power capacity is more than 25 percent of total capacity in the state. Perhaps more importantly, the total State government-owned capacity is greater than 90GW. Whatever type of capacity (solar, wind, etc.) is created to replace this, the replacement cost of this capacity itself will run into many billions of US dollars.

TABLE 4 Coal Power Capacities Across Ownership and States* (Sorted by Total Capacity)

States/UTs	Centre		Private		State		Total		State Capacity as % of Total	
	Units	Capacity (MW)	Units	Capacity (MW)	Units	Capacity (MW)	Units	Capacity (MW)	Units	Capacity (MW)
Uttar Pradesh	40	16,070	39	9,734	**28**	**9,434**	107	35,238	26	27
Chhattisgarh	19	8,540	70	17,928	**9**	**2,840**	98	29,308	9	10
Maharashtra	6	3,640	54	12,606	**32**	**10,726**	92	26,972	35	40
Madhya Pr.	17	7,680	33	12,055	**18**	**6,720**	68	26,455	26	25
Odisha	32	10,350	70	10,715	**7**	**4,140**	109	25,205	6	16
Tamil Nadu	24	7,460	26	3,551	**26**	**11,260**	76	22,271	34	51
Gujarat	0	0	34	11,275	**30**	**6,910**	64	18,185	47	38
West Bengal	22	7,260	14	2,665	**21**	**5,450**	57	15,375	37	35
Telangana	12	4,290	11	2,564	**16**	**8,043**	39	14,897	41	54
Andhra Pr.	9	2,315	22	5,632	**18**	**6,640**	50	14,621	36	45
Rajasthan	2	250	24	4,655	**25**	**7,830**	51	12,735	49	61
Jharkhand	21	7,276	18	4,161	**2**	**420**	41	11,857	5	4
Karnataka	5	4,000	11	3,930	**11**	**3,420**	27	11,350	41	30
Bihar	27	9,950	0	0	**2**	**1,320**	29	11,270	7	12
Haryana	3	1,500	2	1,320	**12**	**3,160**	17	5,980	71	53
Punjab	0	0	7	3,920	**8**	**1,760**	15	5,680	53	31
Assam	3	750	0	0	**0**	**0**	3	750	0	0
Uttarakhand	0	0	1	43	**0**	**0**	1	43	0	0
Grand Total	**242**	**91,331**	**436**	**106,753**	**265**	**90,073**	**944**	**288,190**	**28**	**31**

Source: Global Coal Plant Tracker, https://globalenergymonitor.org/projects/global-coal-plant-tracker/

Note: A unit is a generation unit within a coal power plant, a typical plant consists of many units. The number of plants whose status is announced, construction, operational, pre-permit and permitted are around 303, whereas the number of plants which are operational is 280.

To better understand the timeline of such replacement, we studied the *remaining lifespan* of each of the 265 coal power units owned by State governments.[9] There is a wide dispersion related to the age of the coal power plants and the units therein. Some are fairly new, and there are many over 35 years old. However, since transition needs to be studied in the context of a shorter time span, we look at units that have a remaining lifespan of less than 20 years, 20 to 30 years and more than 30 years.

[9] Global Coal Plant Tracker provides information on coal-fired power units generating 30 MW and above. Lifetime emission assumes 40 years of operation, which is the basis of lifespan calculation. For plants that are 40 years or older, 5 more years of operation are assumed.

TABLE 5 Lifespan of Currently Operating State-Owned Power Units in Major States

States/UTs	Older Units - Lifespan <=20 Years		Medium aged units - Lifespan 20-30 Years		Newer Units - Lifespan >30 years		Total		Capacity of Older Units % in total
	Units	Cap. (MW)	Units	Cap. (MW)	Units	Cap. (MW)	Units	Cap. (MW)	
Tamil Nadu	12	2,520	1	40	13	8,700	26	11,260	22
Maharashtra	17	4,300	5	1,500	10	4,926	32	10,726	40
Uttar Pradesh	14	3,054	3	670	11	5,710	28	9,434	32
Telangana	3	563	2	1,000	11	6,480	16	8,043	7
Rajasthan	8	1,600	9	1,890	8	4,340	25	7,830	20
Gujarat	18	3,235	5	575	7	3,100	30	6,910	47
Madhya Pradesh	8	1,670	2	710	8	4,340	18	6,720	25
Andhra Pradesh	9	1,710	4	1,130	5	3,800	18	6,640	26
West Bengal	12	2,220	5	1,320	4	1,910	21	5,450	41
Odisha	2	420	0	-	5	3,720	7	4,140	10
Karnataka	6	1,260	3	960	2	1,200	11	3,420	37
Haryana	6	860	6	2,300	0	-	12	3,160	27
Chhattisgarh	4	840	2	500	3	1,500	9	2,840	30
Punjab	6	1,260	2	500	0	-	8	1,760	72
Bihar	0	-	0	-	2	1,320	2	1,320	0
Jharkhand	2	420	0	-	0	-	2	420	100
Major States	127	25,932	49	13,095	89	51,046	265	90,073	29
Above as % of Total Units & Capacity	48	29	18	15	34	57	100	100	29

Source: Global Coal Plant Tracker, https://globalenergymonitor.org/projects/global-coal-plant-tracker/

Note: Of 275 functional power plants, there are a few coal power units in other states that are not included in the data.

Table 5 above reveals that, of the 265 state-owned units having a combined capacity of 90,073 MW, the bulk of the capacity has a remaining lifespan of more than 30 years. To put it in numbers, a third of the state-owned units having a capacity of 57 percent of the total have a lifespan of greater than 30 years. However, almost half the units have a remaining lifespan of less than 20 years, and these units account for slightly less than a third of the total state-owned capacity. (Appendix Table A7 displays the distribution of lifespan for all coal units including those owned by the Central government and the private sector).

We have drawn a few conclusions that are pertinent to coal power ownership from states. First, we find that the coal power units whose remaining lifespan is less than 20 years are smaller ones having an average capacity of less than 200 MW. Typically, such small units are fairly inefficient, and their eventual closure may only improve the aggregate financials of state-owned power production. Second, if State governments were to merely focus on replacing such capacity with renewable energy, it would be a small but significant percentage of India's overall thermal power capacity of about 300 GW. Third, a substantial part of State

government-owned capacity has a lifespan of more than 30 years, and it would be difficult for any cash strapped State government to replace such capacity before their assigned lifespan without significant monetary assistance. Fourth, Maharashtra, Tamil Nadu and Uttar Pradesh account for the bulk of state-owned capacity. These states have significantly larger economies than others, and as a result, their potential ability to access resources for replacement will be greater. Finally, for states such as Gujarat, Jharkhand, Karnataka, Maharashtra, Punjab, Uttar Pradesh and West Bengal, about a third to three-fourths of the capacity will need to be replaced within the next two decades. Barring Jharkhand and West Bengal, these are all large economies, and the transition away from coal will be relatively front-loaded for them.

EMPLOYMENT IN COAL MINING

The previous section discussed the transition and how it would impact coal power plants owned by the State governments. This section focuses on the transition and its impact on mining employment. Coal mining has two classes of impact on livelihoods. The first is related to job creation. Typically coal mines in India are in regions that are relatively isolated from the mainstream economy (Pai, 2021), and therefore, they offer gainful employment opportunities in areas where other sectors are not as developed. Moreover, it is not only the direct employment but the indirect employment that is also generated due to mining, which includes all the collateral activities that develop around coal mines (Pai, 2021). The second livelihood impact is related to the undocumented losses due to negative social cohesion and environmental degradation. The loss of social cohesion increases inequalities in these areas among the haves and have-nots, as well as increased in-migration in ecologically rich areas all contribute to social and environmental distress. The negative impact on surrounding farms due to dust and pollution also affects livelihoods negatively. This second set of impacts have been documented but is rarely quantified (FAO, 2017).

As the country transitions away from fossil fuels, employment across the value chain will undoubtedly be adversely affected. This inludes employment across mining, transport and storage, processing and manufacturing, and trade. However, those involved in manufacturing and processing, transport and trade have skills that are relatively more fungible across other activities, but this is far less true in mining. Therefore, not only are the numbers higher in fossil fuel mining, but their skills would also be less transferable to other occupations. The transition consequently can be expected to be more difficult for this segment.

Many studies have documented the difficulties of miners in India especially related to coal. They suffer from poor working conditions, low job security and more (See for instance Pai, 2021; Snyder, 2018; Shrimali, 2020 and Athawale et al. 2019). This not only reflects the lack of efficiently working mechanisms that can correct such undesirable outcomes, but it also suggests that labor protection mechanisms may not be adequate to meet the requirements of a smooth transition process.

The coal mines in India were nationalized in a staggered manner between 1971 to 1973, barring a few captive mines owned by iron and steel companies. Coal India Limited (CIL) was

set up in 1975 as a public sector enterprise owned by the Government of India (GOI) and all the nationalized coal mines were now owned by its various subsidiaries.[10] Coal mining has since been 'de-nationalized' in 2015, and private sector coal mines are now allowed. However, coal mining continues to be done mostly by CIL subsidiaries that account for the bulk of coal output in India. In 2021, for instance, of the 716 million tons of coal and lignite mined in India, 596 million was by CIL subsidiaries (about 83 percent).[11] At the national level, the burden of transition away from coal mining will need to be mostly borne by the Central government because of this centralization of coal mining. However, this transition will impact employment across the states where coal mining is concentrated. State governments not only would be adversely affected by the expected fall in revenues that accrue to them from the coal mines (discussed in previous sections), but also by the loss of employment.

Total employment in the mining sector is a small percentage of the total employed people in India. As per the Periodic Labour Force Survey (PLFS) conducted by the National Sample Survey Organization of the GOI, the total primary employment in India was 512 million for the year 2019-20. As is well known, the major sector was agriculture followed by services, construction, manufacturing and mining. Total mining employment in India was 1.5 million. Fossil fuel mining, which includes extraction of petroleum and natural gas and mining of coal and lignite, is about a third of this, 0.5 million. The bulk of fossil fuel mining employment is in coal and lignite, estimated at 0.4 million. As a share of total employment in India, those in coal mining are less than 0.1 percent. However, they are highly concentrated in a few states as we show later.

TABLE 6 Estimated Employment in Various Sectors, 2019-20

Employment	Total Employed in Millions
Total Employment	511.9
Agriculture	233.2
Services	157.5
Manufacturing	57.1
Construction	59.5
Mining	1.5
Of which Fossil Fuel	0.5
Of which Coal	0.4

Source: PLFS (2019-20), the primary employment figures are adjusted using Registrar General of India population figures projected to 2020. For a detailed discussion see Nath and Basole (2020).

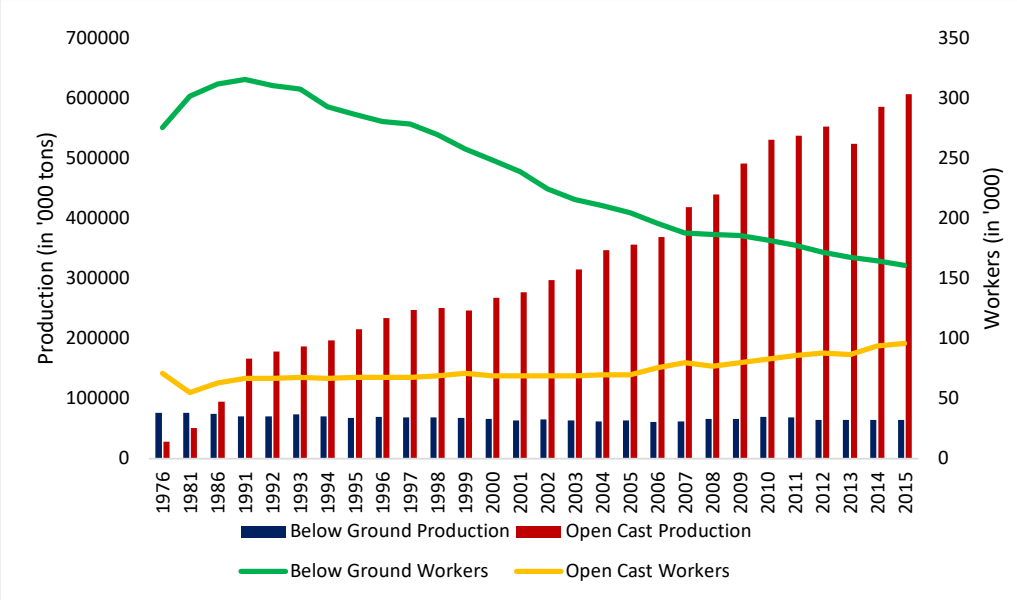
Coal mines can broadly be divided into surface (open-cast) and underground mines. There has been a steady increase in both production and employment in open cast mining in

[10] See the Seventh Report by Committee on Public Undertakings on Coal India Limited, 1991-92. Available at https://eparlib.nic.in/bitstream/123456789/761736/1/copu_10_07_1991.pdf (downloaded 4th June 2022)

[11] See discussion on production and supplies contained in https://coal.gov.in/en/major-statistics/production-and-supplies (downloaded 4th June 2022)

India and a relative stagnation and fall in underground ones. Moreover, as Figure 3 below shows, even though it has been improving over time, per worker productivity (measured as production per worker) is significantly lower for underground mines. Finally, while open cast mining employment has been increasing somewhat, total coal mining employment has reduced significantly in the last few decades. Going forward, as technologies improve, we would expect lower direct employment creation in coal mining, and a steady reduction in total employment in this domain, even without the transition process. This is also revealed in figure 3 below.

FIGURE 3 Production and Employment in Indian Coal Mines



Source: Statement 1.1 and 1.6 DGMS - https://www.dgms.net/Coal_2015.pdf

The office of the Directorate General of Mines Safety publishes coal mining employment data, although they are dated and have not been updated since 2015. As Table 7 below reveals, the bulk of the employment is concentrated within a few states in the eastern part of India. The top states—namely Jharkhand, Telangana, West Bengal, Madhya Pradesh, Chhattisgarh, Maharashtra, Orissa and Tamil Nadu—together account for more than 80 percent of India's total fossil mining employment.

Note that unlike in the previous section where economically better-off states were among the most likely to be affected by the transition, in this case, it is mostly those states that are located in the central and eastern parts of India and tend to have lower average incomes than the rest of the country. Even for Telangana, in the southern part of India, mining is located in economically disadvantaged areas (and not its capital city Hyderabad or its vicinity, which accounts for a large share of aggregate income for the state). The economically better-off states, Maharashtra and Tamil Nadu, will only be marginally impacted.

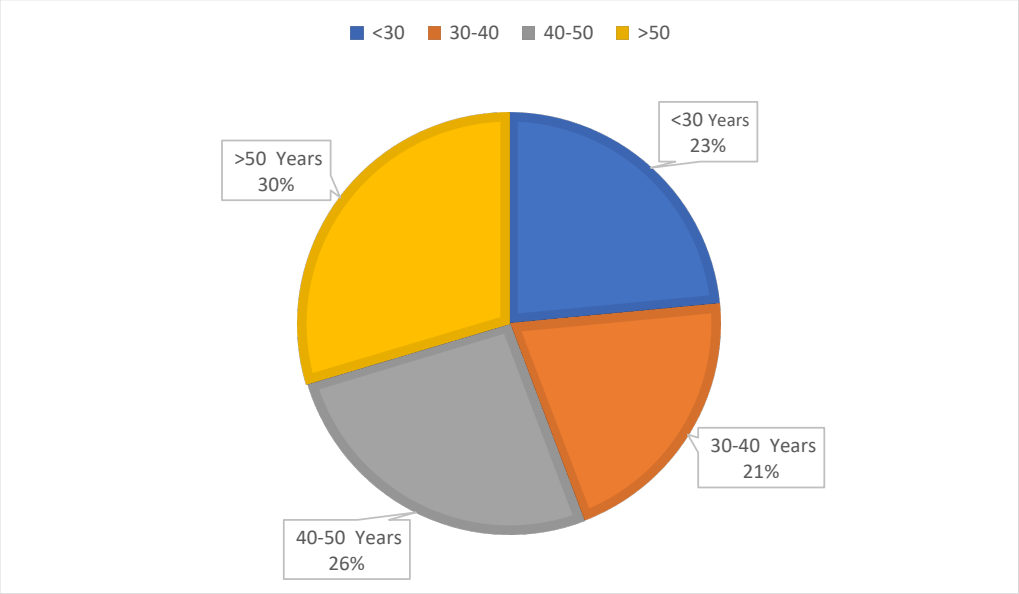
TABLE 7 Coal Mining Employment and Output in Different States

State	Employment in '000s	Production (Million Tons)
Jharkhand	94.0	118.7
Telangana	56.5	66.2
West Bengal	51.2	28.6
Madhya Pradesh	44.4	87.1
Chhattisgarh	36.2	134.8
Maharashtra	26.7	41.4
Odisha	21.2	131.4
Tamil Nadu	7.1	9.9
Sum of Above States	337.3	618.1
All India*	353.0	672.7

Source: Directorate General Mining Safety, 2015 available at https://www.dgms.net/Coal_2015.pdf (downloaded on 4th June 2022). Data for later years are not available.

The age profile of those employed in mining provides further insights into the matter (Figure 4). We find that a large share of those employed in mining are above 40 years of age (about 56 percent of the total employed in fossil fuel mining as per the PLFS data). In other words, these same cohorts are expected to retire from active service in the next two to three decades. If the transition away from mining is rapid, those in the segment of 30 to 40-year age may be adversely affected, and they account for about 21 percent of the total employed in this sector. However, those most affected would be about a quarter of those currently employed, in the less than 30-year age cohort.

FIGURE 4 Employed in Fossil Fuel Mining



Source: Estimated using PLFS (2019).

This is because, in India, the bulk of those in the mining sector are above 40 years of age. That is, most workers currently employed in fossil fuel mining in India would be retiring over the next two decades. And those less than 30 will be most affected by a faster transition and resultant loss of livelihood. These are estimates at the national level. The state-level age distributions of those involved in mining may differ.[12] Be that as it may, the overall directions are fairly apparent, that the majority of those involved in coal mining will be retiring within the next two to three decades.

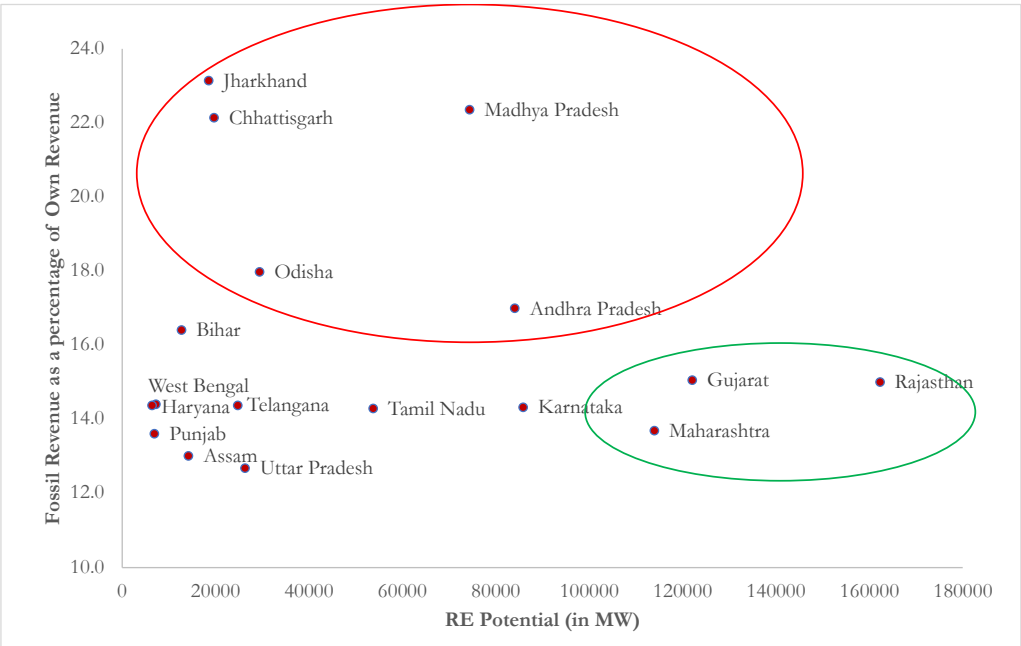
We, therefore, find that although a fall in coal mining employment would be significant, it may not be as significant a problem for the following reasons. First, the problem is maximum in a handful of states in India. Many protection and skilling-related options exist that can be addressed at little cost to the state while not endangering current livelihoods. Second, while fossil fuel mining employment may reduce over time, it is highly likely that overall mining employment would be increasing over the next many decades (FICCI, 2018). Therefore, with some re-training, it would be possible to transfer coal miners to other mines and therefore protect their livelihoods. Third, the bulk of those employed are in the 40+ age segment and can be expected to be out of the labor force for the transition and to not have any impact on their livelihoods.

THE FORTHCOMING CHALLENGE

The analyses in the above sections show that each state will bear the impact of transition differently, and while a slower transition will no doubt ease the difficulties, they will still be fairly significant for some states. One class of states will face a serious challenge related to the loss of jobs in fossil fuel mining; another class of states would be more severely affected due to the fall in revenues from fossil fuels, and some other set of states would be more affected due to the need to replace coal power assets and the consequent investment requirements. Energy transition by definition means moving away from fossil fuels to renewable sources of energy like solar and wind. In this context, some states have a natural advantage over others based on their geographical location. As highlighted below in Figure 5, the geography of transition throws a peculiar challenge for the Indian States. Most coal-dependent states are poorer and losing most in the transition like Jharkhand, Madhya Pradesh, Chhattisgarh and Odisha are located in the eastern parts, which have very low renewable capacity. On the other hand, states which are richer and relatively less vulnerable to transition, like Gujarat and Maharashtra, are located in the Western parts with one of the highest renewable capacities in the country. Further, the fiscal challenge of the falling revenue share of fossil fuel could get further aggravated for states with high levels of debt.

[12] It is not possible to obtain robust estimates of age distribution at the state level from any survey including PLFS because of sample size considerations.

FIGURE 5 Renewable Potential and Fossil Fuel Revenue



Source: Author's calculation based on MoSPI data.

The table below briefs about the challenges that will be faced by each of the major states of India.

TABLE 8 Transition Challenges for Major States

	Fiscal Considerations – Fossil Fuel Revenue as a Share of OR	State-owned Capacity of Coal Power	The Transition Challenges in Brief
Maharashtra	Moderate fall, backloaded; from 13.7 to 9.0 percent.	10.7 GW of capacity, evenly between older and newer units	Maharashtra will need to generate significant resources for power; however, it will be less challenged by transition due to moderate debt levels (19.9 percent), small numbers of those employed in mining (about 30k), and the fact that fiscal stress will be backloaded.
Tamil Nadu	High fall, frontloaded; from 14.3 to 1.9 percent	11.3 GW capacity mostly with a long remaining lifespan	Tamil Nadu will see significant stress on revenue along with high debt levels (29.4 percent), which will pose a further hindrance. But its capacity replacement will be with some time lag and mining employment levels are also relatively low.
Karnataka	High fall frontloaded, from 14.3 to 1.4 percent	Low 3.4 GW capacity with an evenly spread lifespan	Karnataka will also see a steep fall in revenues early on and moderate debt levels (24.1 percent) will worsen the burden. However, low capacity and employment will ease the transition somewhat.
Rajasthan	High fall frontloaded, from 15 to 3.7 percent	Moderate 7.8 GW capacity with most capacity being newer	Rajasthan will have a steep fall in revenue shares along with very high debt levels (42.6 percent) making the transition difficult. Capacity, though large, is mostly in newer units and mining employment is also insignificant giving it some degree of relief.

TABLE 8 Transition Challenges for Major States (continued)

	Fiscal Considerations – Fossil Fuel Revenue as a Share of OR	State-owned Capacity of Coal Power	The Transition Challenges in Brief
Uttar Pradesh (UP)	Moderate and steady fall, from 12.7 to 4.9 percent	High 9.4 GW capacity mostly in newer units	UP will see a steady fall and most of its capacity is also new, insignificant mining employment will also ease the burden of transition. However high debt burden (35.2 percent) will worsen the transition.
Gujarat	Moderate fall backloaded from 15 to 5.9 percent	Moderate 6.9 GW capacity with evenly spread lifespans	Gujarat will have a slower fall in revenue shares, moderate debt (22.8 percent) along with moderately high capacity with an evenly spread lifespan will help.
Madhya Pradesh	Steep fall frontloaded from 22 to 1.4 percent	Moderate 6.7 GW capacity mostly in newer units	Madhya Pradesh is expected to have a steep fall in revenue shares and also significant mining employment (about 50K); high debt levels (29.1 percent) will worsen the transition burden. However, the most thermal capacity is in newer units and therefore replacement burden need not be high.
Jharkhand	Steep fall frontloaded from 23.2 to 4 percent	Very low state-owned capacity at 0.4 GW	Jharkhand will be most impacted on the employment end along with a steep fall in revenue shares, and high debt levels (33.3 percent) will impose further stress. Low state-owned capacity might ease the transition to some extent.
Odisha	Steep fall frontloaded from 18 to 2.1 percent	Low 4 GW- Almost all of it in newer units	Orissa will be significantly impacted due to a fall in revenue shares, and a high debt burden (28.2 percent). Moderate mining jobs (20K) and insignificant replacement requirements might ease the burden of transition.
West Bengal	High fall frontloaded from 14.4 to 1.3 percent	Moderate 5.5GW capacity mostly in older units	West Bengal will see a high fall in the revenue share, its capacity though moderately high is mostly in older units and also has relatively high mining employment (about 50K). A high debt burden of 38.6 percent will further affect the government's ability to access resources for transition.
Telangana	High fall frontloaded from 14.4 to 1.6 percent	High capacity of 8GW, almost all of it in newer units	A significant fall in revenue shares along with relatively high mining employment (56K) and high debt levels (27.3 percent) will impose a high level of transition stress. Though most thermal capacity is new and will be replaced with some time lag.
Chhattisgarh	High fall frontloaded, from 22.1 to 4.5 percent	Low 2.8GW capacity with evenly spread remaining lifespan	Chhattisgarh will be among the states more seriously challenged with a steep fall in revenues, high employment (36K) and a high debt burden (28.6 percent). Low capacity for replacement will however not add much burden.
Punjab	Moderate steady fall, from 13.6 to 4.9 percent	Very low state-owned capacity with 1.7 GW and mostly older units	Punjab's revenue shares will fall over a period of time and therefore it can plan a smooth transition; low capacity and no mining will not add to that burden. But a very high debt burden (49.1 percent) will make it difficult to face the challenges of falling fossil fuel revenues.
Andhra Pradesh	High fall frontloaded from 17 to 1.3 percent	Moderate 6.6 GW capacity mostly in newer units	A significant fall in revenue share along with a high debt burden (36.5 percent) will impose a high level of transition stress on the state. On the brighter side, the thermal capacity is new and not very high, so its replacement will be later.

TABLE 8 Transition Challenges for Major States (continued)

	Fiscal Considerations – Fossil Fuel Revenue as a Share of OR	State-owned Capacity of Coal Power	The Transition Challenges in Brief
Bihar	High fall frontloaded from 16.4 to 1.3 percent	Very low capacity at 1.3 GW mostly in newer units	Bihar already has constrained revenue streams due to a state wide alcohol ban and limited business and industrial activities. Further, it also faces a high debt burden (36.3 percent). This will result in a significant amount of transition stress on Bihar. However, the thermal capacity is low and new, providing much-needed replacement time to the state.
Haryana	High fall, frontloaded, from 14.3 to 2 percent	Low 3.1GW capacity mostly with 20-to-30-year remaining lifespan	A significant fall in revenue share and a high debt level (30.7 percent), will pose a significant challenge. However, the thermal capacity is low with nearly three decades of replacement time.
Kerala	High fall, frontloaded, from 12 to 1.9 percent	Insignificant operational thermal power capacity	Kerala has almost no state-owned operational thermal power capacity. But the steep fall in revenues along with a very high debt burden (37.1 percent) would be quite challenging to manage.
Uttarakhand	Low/Moderate steady fall from 8.6 to 3.3 percent	Insignificant operational thermal power capacity	Uttarakhand's transition stress is significantly lower in comparison to other states. The fall in revenue share is low and state-owned thermal capacity is low too.

Source: Compiled by authors.
Note: Debt data is for 2021 (RE) from RBI.

CONCLUSION

The transition process will not be a linear, top-down process driven only by the Central government in India. Instead, it will require a series of actions at the Central government level, coordinated with State governments, in consonance with India's power regulatory set-up, and the constitution. This will be followed by both public and private sector action, impacting revenues, capital employed and employment. To better understand the process, we seek to estimate the scale of the challenge for each state on three fronts: revenues from fossil fuels, state-owned thermal power units and coal mining employment. We do not identify the possible solutions and how to implement them. This will require a separate exercise.

We find that almost all states will undergo serious fiscal stress due to a fall in the share of fossil fuel revenues and that this will be frontloaded. Further, the economically better-off states and states in central and eastern India will be the most affected, as coal power units are most likely to be located there. However, we also find that many units will have completed their lifespans in two to three decades, although the bulk of the state-government owned capacities will continue for longer. This will, therefore, be another challenge over and above that of the fiscal issue. Finally, we find that on the employment side, even-though employment in coal mining is a small share of total national employment, this is mostly located in seven states, which will have to be addressed. However, since the majority of those employed in mining will be retiring in the next two to three decades, there may not

be a major challenge. This, of course, does not mean that it will be insignificant, as indirect employment (which we did not estimate) could be a serious concern.

Future work will need to address the following issues that have been highlighted in this study. First, how will India generate and share resources between the Centre and states to compensate for the fall in revenue share from fossil fuels, is perhaps the most pertinent of all challenges. Second, how would cash-strapped State governments address the possibility of capital destruction of assets owned by them? Finally, although mining employment is a small share of the total and is concentrated in a few locations, the key questions to address are that of protecting workers from the loss of employment, re-skilling younger workers for employment in other areas (including non-fossil mining) and minimizing the quantum of distress associated with this transition process.

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APPENDIX 1: ESTIMATION OF GOVERNMENT REVENUES

Taxes on petroleum are a major source of revenue for all State governments in India. As of 2022, energy (electricity and petroleum products) is not covered under GST, and therefore, each state has the flexibility to change the tax rates. The VAT replaced a complex set of sale taxes and is a form of consumption tax imposed by the State governments. And all the revenue collected via VAT accrues to them. VAT was first introduced in 2005, but was fully implemented across India a decade later, by 2014. VAT is one of the highest contributors to the state exchequer across the country and has also increased significantly in the last few years. The royalty on crude oil is fixed as per the Oilfield (Regulation & Development) Act of 1948, which also provides that the royalty cannot exceed 20 percent of the well-head price. Royalties on output from offshore fields are payable to the Central government, whereas those from onshore areas are paid to the government of the State in which they are located. Royalties to the State governments have fluctuated quite a lot over the years but they remain a significant source of revenue. Dividends are paid out by many companies in which Central and State governments hold a significant equity stake, and are fairly unevenly distributed between the states.

The taxation structure followed for coal in India is very different from that of oil and natural gas. Unlike major petroleum products, coal does come under the ambit of GST with a rate of 5 percent that has remained the same since 2017. However, it also has an additional cess imposed on it called the Compensatory Cess which is imposed over and above the GST, the revenues from which flow to the Central government. Coal mining royalties are 14 percent of the basic price, paid to the concerned State governments and include royalties from all companies, public or private; those involved in mining for internal purposes (such as for iron smelting); or for sale to the power sector. In addition, for the National Mineral Exploration Trust (NMET), 2 percent of the royalty is charged for the funding exploration done by the State government. Additionally, a payment is made to the District Mineral Foundation (DMF), which is not more than a third of the royalty amount, and is to be decided by each concerned State government. The DMF funds are to be used for the welfare of the populations affected by mining. DMF along with royalties are the biggest source of revenue for coal-producing states.

APPENDIX 2: FORECASTING REVENUES

Estimates of energy from each source including renewable energy, coal, oil and natural gas for the years 2030 and 2040 from the IEA need to be translated into appropriate revenues for each state for the relevant years. These are explained below.

For simplicity, we take as a given that the prices of all fossil fuels and exchange rates are as those ruling currently. We also assume that tax and non-tax revenues change proportionately with the use of fossil fuels. The forecasted menu of energy sources is converted to fuel quantities using a conversion factor of energy use to calculate the quantity of different fuels. These are provided by the Ministry of Statistics and Programme Implementation (MoSPI) as used in the Economic Survey 2017. This enables us to calculate the quantity of coal, oil

and natural gas required in 2019, 2030 and 2040, from the IEA (2021) estimates at the national level. These are allocated between states and UTs on the basis of their shares in 2019, the implicit assumption being that their shares will remain the same.[13]

The revenue received from each of these sources under various tax categories is first estimated for 2019-20 and has been discussed in the previous section. Using this, we obtain a value of 'government revenue per unit quantity' for coal, oil and natural gas for each revenue category for 2019-20. Assuming that the tax rates and prices of these commodities remain the same, we use this revenue per unit to project revenues for 2030 and 2040.

Further, we calculate the State government's revenue for 2019-20. Assuming the total budgetary revenue to GSDP ratio remains constant, and using the trend projected GSDP for each state in 2030 and 2040, we estimate total revenue for these years separately for State and UT governments. The GSDP and overall government revenues for 2030 and 2040 are then used as a denominator to study how fossil-fuel revenues will change relative to overall government revenues over time.

APPENDIX TABLES

TABLE A1 Taxes Subsumed in GST

S.No.	Centre	State
1.	Central Excise Duty	State VAT
2.	Duties of Excise (Medicinal and Toilet Preparations)	Central Sates Tax
3.	Additional Duties of Excise (Goods of Special Importance)	Purchase Tax
4.	Additional Duties of Excise (Textiles and Textile Products)	Luxury Tax
5.	Additional Duties of Customs (commonly known as CVD)	Entry Tax (All forms)
6.	Special Additional Duty of Customs (SAD)	Entertainment Tax and Amusement Tax (except those levied by the local bodies)
7.	Service Tax	Taxes on advertisements
8.	Cesses and surcharge in so far as they relate to supply of goods and services	Taxes on lotteries, betting and gambling
9.	_	State cesses and surcharges in so far as they relate to the supply of goods and services

Source: https://gstcouncil.gov.in/brief-history-gst

[13] Coal is divided as per production but oil and gas as per consumption. Natural gas consumption for states was not available but was available for zones. It was further distributed into states within each zone as per population.

TABLE A2 Scenario 1 (STEPS)

S.No.	State/UT	Revenue/OR						Revenue/GDP					
		2030			2040			2030			2040		
		Oil &NG	Coal	Total	Oil &NG	Coal	Total	Oil &NG	Coal	Total	Oil &NG	Coal	Total
1	Andaman & Nicobar Islands	.	.	.	.	.	.	.	.	.	.	.	.
2	Andhra Pradesh	0.02899	0.00000	0.02899	0.01306	0.00000	0.01306	0.0029	0.0000	0.0029	0.0013	0.0000	0.0013
3	Arunachal Pradesh	0.07064	0.00000	0.07064	0.03187	0.00000	0.03187	0.0045	0.0000	0.0045	0.0020	0.0000	0.0020
4	Assam	0.11576	0.00026	0.11602	0.05825	0.00010	0.05835	0.0081	0.0000	0.0081	0.0041	0.0000	0.0041
5	Bihar	0.02189	0.00000	0.02189	0.01067	0.00000	0.01067	0.0015	0.0000	0.0015	0.0007	0.0000	0.0007
6	Chandigarh	.	.	.	.	.	.	0.0017	0.0000	0.0017	0.0008	0.0000	0.0008
7	Chhattisgarh	0.04116	0.05574	0.09690	0.02246	0.02261	0.04507	0.0040	0.0054	0.0094	0.0022	0.0022	0.0043
8	Dadra & Nagar Haveli and Daman & Diu	.	.	.	.	.	.	.	.	.	.	.	.
9	Delhi	0.03707	0.00000	0.03707	0.01796	0.00000	0.01796	0.0020	0.0000	0.0020	0.0010	0.0000	0.0010
10	Goa	0.07554	0.00000	0.07554	0.05069	0.00000	0.05069	0.0091	0.0000	0.0091	0.0061	0.0000	0.0061
11	Gujarat	0.13618	0.00000	0.13618	0.05877	0.00000	0.05877	0.0098	0.0000	0.0098	0.0042	0.0000	0.0042
12	Haryana	0.04639	0.00000	0.04639	0.02024	0.00000	0.02024	0.0035	0.0000	0.0035	0.0015	0.0000	0.0015
13	Himachal Pradesh	0.06223	0.00000	0.06223	0.03313	0.00000	0.03313	0.0045	0.0000	0.0045	0.0024	0.0000	0.0024
14	Jammu & Kashmir	.	.	.	.	.	.	.	.	.	.	.	.
15	Jharkhand	0.02525	0.06329	0.08855	0.01406	0.02620	0.04026	0.0020	0.0050	0.0069	0.0011	0.0021	0.0032
16	Karnataka	0.03333	0.00000	0.03333	0.01411	0.00000	0.01411	0.0025	0.0000	0.0025	0.0011	0.0000	0.0011
17	Kerala	0.03721	0.00000	0.03721	0.01868	0.00000	0.01868	0.0031	0.0000	0.0031	0.0015	0.0000	0.0015
18	Ladakh	.	.	.	.	.	.	.	.	.	.	.	.
19	Lakshadweep	.	.	.	.	.	.	.	.	.	.	.	.
20	Madhya Pradesh	0.02773	0.01196	0.03969	0.01033	0.00331	0.01365	0.0024	0.0010	0.0034	0.0009	0.0003	0.0012

TABLE A2 Scenario 1 (STEPS) (continued)

S.No.	State/UT	Revenue/OR						Revenue/GDP					
		2030			2040			2030			2040		
		Oil &NG	Coal	Total	Oil &NG	Coal	Total	Oil &NG	Coal	Total	Oil &NG	Coal	Total
21	Maharashtra	0.16361	0.00305	0.16666	0.08896	0.00123	0.09019	0.0122	0.0002	0.0124	0.0066	0.0001	0.0067
22	Manipur	0.16930	0.00000	0.16930	0.07946	0.00000	0.07946	0.0072	0.0000	0.0072	0.0034	0.0000	0.0034
23	Meghalaya	0.19938	0.00000	0.19938	0.14500	0.00000	0.14500	0.0132	0.0000	0.0132	0.0096	0.0000	0.0096
24	Mizoram	0.04893	0.00000	0.04893	0.01491	0.00000	0.01491	0.0023	0.0000	0.0023	0.0007	0.0000	0.0007
25	Nagaland	0.13475	0.00000	0.13475	0.06473	0.00000	0.06473	0.0055	0.0000	0.0055	0.0026	0.0000	0.0026
26	Odisha	0.02032	0.03116	0.05148	0.01001	0.01141	0.02141	0.0018	0.0027	0.0045	0.0009	0.0010	0.0019
27	Other territories (Offshore areas of India beyond 12 Nautical Miles)	.	.	.	.	.	.	.	.	.	.	.	.
28	Puducherry	0.01861	0.00000	0.01861	0.00974	0.00000	0.00974	0.0024	0.0000	0.0024	0.0012	0.0000	0.0012
29	Punjab	0.08043	0.00000	0.08043	0.04858	0.00000	0.04858	0.0063	0.0000	0.0063	0.0038	0.0000	0.0038
30	Rajasthan	0.07180	0.00000	0.07180	0.03705	0.00000	0.03705	0.0060	0.0000	0.0060	0.0031	0.0000	0.0031
31	Sikkim	0.02421	0.00000	0.02421	0.00985	0.00000	0.00985	0.0017	0.0000	0.0017	0.0007	0.0000	0.0007
32	Tamil Nadu	0.03896	0.00000	0.03896	0.01912	0.00000	0.01912	0.0031	0.0000	0.0031	0.0015	0.0000	0.0015
33	Telangana	0.03162	0.00721	0.03884	0.01357	0.00230	0.01587	0.0027	0.0006	0.0033	0.0012	0.0002	0.0014
34	Tripura	0.08411	0.00000	0.08411	0.03219	0.00000	0.03219	0.0040	0.0000	0.0040	0.0015	0.0000	0.0015
35	Uttar Pradesh	0.09518	0.00242	0.09760	0.04813	0.00091	0.04904	0.0088	0.0002	0.0090	0.0044	0.0001	0.0045
36	Uttarakhand	0.06024	0.00000	0.06024	0.03277	0.00000	0.03277	0.0037	0.0000	0.0037	0.0020	0.0000	0.0020
37	West Bengal	0.02246	0.00515	0.02761	0.01143	0.00195	0.01338	0.0013	0.0003	0.0016	0.0007	0.0001	0.0008

Source: Authors' own calculation.

Note: STEPS means Stated Policy Scenario.

TABLE A3 Scenario 2 (IVC)

S.No.	State/UT	Revenue/OR						Revenue/GDP					
		2030			2040			2030			2040		
		Oil &NG	Coal	Total	Oil &NG	Coal	Total	Oil &NG	Coal	Total	Oil &NG	Coal	Total
1	Andaman & Nicobar islands	.	.	.	.	.	.	.	.	.	.	.	.
2	Andhra Pradesh	0.0320	0.0000	0.0320	0.0154	0.0000	0.0154	0.0032	0.0000	0.0032	0.0016	0.0000	0.0016
3	Arunachal Pradesh	0.0779	0.0000	0.0779	0.0376	0.0000	0.0376	0.0050	0.0000	0.0050	0.0024	0.0000	0.0024
4	Assam	0.1276	0.0002	0.1278	0.0688	0.0001	0.0689	0.0089	0.0000	0.0089	0.0048	0.0000	0.0048
5	Bihar	0.0241	0.0000	0.0241	0.0126	0.0000	0.0126	0.0016	0.0000	0.0016	0.0008	0.0000	0.0008
6	Chandigarh	.	.	.	.	.	.	0.0018	0.0000	0.0018	0.0010	0.0000	0.0010
7	Chhattisgarh	0.0454	0.0518	0.0972	0.0265	0.0208	0.0473	0.0044	0.0050	0.0094	0.0026	0.0020	0.0046
8	Dadra & Nagar Haveli and Daman & Diu	.	.	.	.	.	.	.	.	.	.	.	.
9	Delhi	0.0409	0.0000	0.0409	0.0212	0.0000	0.0212	0.0022	0.0000	0.0022	0.0012	0.0000	0.0012
10	Goa	0.0833	0.0000	0.0833	0.0599	0.0000	0.0599	0.0100	0.0000	0.0100	0.0072	0.0000	0.0072
11	Gujarat	0.1501	0.0000	0.1501	0.0694	0.0000	0.0694	0.0108	0.0000	0.0108	0.0050	0.0000	0.0050
12	Haryana	0.0511	0.0000	0.0511	0.0239	0.0000	0.0239	0.0038	0.0000	0.0038	0.0018	0.0000	0.0018
13	Himachal Pradesh	0.0686	0.0000	0.0686	0.0391	0.0000	0.0391	0.0049	0.0000	0.0049	0.0028	0.0000	0.0028
14	Jammu & Kashmir	.	.	.	.	.	.	.	.	.	.	.	.
15	Jharkhand	0.0278	0.0588	0.0867	0.0166	0.0241	0.0407	0.0022	0.0046	0.0068	0.0013	0.0019	0.0032
16	Karnataka	0.0367	0.0000	0.0367	0.0167	0.0000	0.0167	0.0028	0.0000	0.0028	0.0013	0.0000	0.0013
17	Kerala	0.0410	0.0000	0.0410	0.0221	0.0000	0.0221	0.0034	0.0000	0.0034	0.0018	0.0000	0.0018
18	Ladakh	.	.	.	.	.	.	.	.	.	.	.	.
19	Lakshadweep	.	.	.	.	.	.	.	.	.	.	.	.
20	Madhya Pradesh	0.0306	0.0111	0.0417	0.0122	0.0030	0.0152	0.0027	0.0010	0.0036	0.0011	0.0003	0.0013

TABLE A3 Scenario 2 (IVC) (continued)

S.No.	State/UT	Revenue/OR						Revenue/GDP					
		2030			2040			2030			2040		
		Oil &NG	Coal	Total	Oil &NG	Coal	Total	Oil &NG	Coal	Total	Oil &NG	Coal	Total
21	Maharashtra	0.1803	0.0028	0.1832	0.1050	0.0011	0.1062	0.0135	0.0002	0.0137	0.0078	0.0001	0.0079
22	Manipur	0.1866	0.0000	0.1866	0.0938	0.0000	0.0938	0.0080	0.0000	0.0080	0.0040	0.0000	0.0040
23	Meghalaya	0.2197	0.0000	0.2197	0.1712	0.0000	0.1712	0.0145	0.0000	0.0145	0.0113	0.0000	0.0113
24	Mizoram	0.0539	0.0000	0.0539	0.0176	0.0000	0.0176	0.0026	0.0000	0.0026	0.0008	0.0000	0.0008
25	Nagaland	0.1485	0.0000	0.1485	0.0764	0.0000	0.0764	0.0061	0.0000	0.0061	0.0031	0.0000	0.0031
26	Odisha	0.0224	0.0290	0.0514	0.0118	0.0105	0.0223	0.0020	0.0025	0.0045	0.0010	0.0009	0.0020
27	Other territories (Offshore areas of India beyond 12 Nautical Miles)	.	.	.	.	.	.	.	.	.	.	.	.
28	Puducherry	0.0205	0.0000	0.0205	0.0115	0.0000	0.0115	0.0026	0.0000	0.0026	0.0015	0.0000	0.0015
29	Punjab	0.0886	0.0000	0.0886	0.0574	0.0000	0.0574	0.0070	0.0000	0.0070	0.0045	0.0000	0.0045
30	Rajasthan	0.0791	0.0000	0.0791	0.0438	0.0000	0.0438	0.0066	0.0000	0.0066	0.0036	0.0000	0.0036
31	Sikkim	0.0267	0.0000	0.0267	0.0116	0.0000	0.0116	0.0019	0.0000	0.0019	0.0008	0.0000	0.0008
32	Tamil Nadu	0.0429	0.0000	0.0429	0.0226	0.0000	0.0226	0.0034	0.0000	0.0034	0.0018	0.0000	0.0018
33	Telangana	0.0349	0.0067	0.0416	0.0160	0.0021	0.0181	0.0030	0.0006	0.0036	0.0014	0.0002	0.0016
34	Tripura	0.0927	0.0000	0.0927	0.0380	0.0000	0.0380	0.0044	0.0000	0.0044	0.0018	0.0000	0.0018
35	Uttar Pradesh	0.1049	0.0023	0.1072	0.0568	0.0008	0.0577	0.0097	0.0002	0.0099	0.0052	0.0001	0.0053
36	Uttarakhand	0.0664	0.0000	0.0664	0.0387	0.0000	0.0387	0.0041	0.0000	0.0041	0.0024	0.0000	0.0024
37	West Bengal	0.0248	0.0048	0.0295	0.0135	0.0018	0.0153	0.0014	0.0003	0.0017	0.0008	0.0001	0.0009

Source: Authors' own calculation.

Note: IVC means India Vision Case.

TABLE A4 Scenario 3 (SDS)

S.No.	State/UT	Revenue/OTR						Revenue/GDP					
		2030			2040			2030			2040		
		Oil &NG	Coal	Total	Oil &NG	Coal	Total	Oil &NG	Coal	Total	Oil &NG	Coal	Total
1	Andaman & Nicobar islands	.	.	.	.	.	.	.	.	.	.	.	.
2	Andhra Pradesh	0.030	0.000	0.030	0.013	0.000	0.013	0.003	0.000	0.003	0.001	0.000	0.001
3	Arunachal Pradesh	0.074	0.000	0.074	0.031	0.000	0.031	0.005	0.000	0.005	0.002	0.000	0.002
4	Assam	0.121	0.000	0.121	0.057	0.000	0.057	0.008	0.000	0.008	0.004	0.000	0.004
5	Bihar	0.023	0.000	0.023	0.010	0.000	0.010	0.002	0.000	0.002	0.001	0.000	0.001
6	Chandigarh	.	.	.	.	.	.	0.002	0.000	0.002	0.001	0.000	0.001
7	Chhattisgarh	0.043	0.036	0.079	0.022	0.009	0.031	0.004	0.003	0.008	0.002	0.001	0.003
8	Dadra & Nagar Haveli and Daman & Diu	.	.	.	.	.	.	.	.	.	.	.	.
9	Delhi	0.039	0.000	0.039	0.017	0.000	0.017	0.002	0.000	0.002	0.001	0.000	0.001
10	Goa	0.079	0.000	0.079	0.049	0.000	0.049	0.010	0.000	0.010	0.006	0.000	0.006
11	Gujarat	0.142	0.000	0.142	0.057	0.000	0.057	0.010	0.000	0.010	0.004	0.000	0.004
12	Haryana	0.048	0.000	0.048	0.020	0.000	0.020	0.004	0.000	0.004	0.001	0.000	0.001
13	Himachal Pradesh	0.065	0.000	0.065	0.032	0.000	0.032	0.005	0.000	0.005	0.002	0.000	0.002
14	Jammu & Kashmir	.	.	.	.	.	.	.	.	.	.	.	.
15	Jharkhand	0.026	0.040	0.067	0.014	0.010	0.024	0.002	0.003	0.005	0.001	0.001	0.002
16	Karnataka	0.035	0.000	0.035	0.014	0.000	0.014	0.003	0.000	0.003	0.001	0.000	0.001
17	Kerala	0.039	0.000	0.039	0.018	0.000	0.018	0.003	0.000	0.003	0.001	0.000	0.001
18	Ladakh	.	.	.	.	.	.	.	.	.	.	.	.
19	Lakshadweep	.	.	.	.	.	.	.	.	.	.	.	.
20	Madhya Pradesh	0.029	0.008	0.037	0.010	0.001	0.011	0.003	0.001	0.003	0.001	0.000	0.001

TABLE A4 Scenario 3 (SDS) (continued)

S.No.	State/UT	Revenue/OTR						Revenue/GDP					
		2030			2040			2030			2040		
		Oil &NG	Coal	Total	Oil &NG	Coal	Total	Oil &NG	Coal	Total	Oil &NG	Coal	Total
21	Maharashtra	0.171	0.002	0.173	0.086	0.000	0.087	0.013	0.000	0.013	0.006	0.000	0.006
22	Manipur	0.177	0.000	0.177	0.077	0.000	0.077	0.008	0.000	0.008	0.003	0.000	0.003
23	Meghalaya	0.208	0.000	0.208	0.141	0.000	0.141	0.014	0.000	0.014	0.009	0.000	0.009
24	Mizoram	0.051	0.000	0.051	0.014	0.000	0.014	0.002	0.000	0.002	0.001	0.000	0.001
25	Nagaland	0.141	0.000	0.141	0.063	0.000	0.063	0.006	0.000	0.006	0.003	0.000	0.003
26	Odisha	0.021	0.020	0.041	0.010	0.004	0.014	0.002	0.002	0.004	0.001	0.000	0.001
27	Other territories (Offshore areas of India beyond 12 Nautical Miles)	.	.	.	.	.	.	.	.	.	.	.	.
28	Puducherry	0.019	0.000	0.019	0.009	0.000	0.009	0.002	0.000	0.002	0.001	0.000	0.001
29	Punjab	0.084	0.000	0.084	0.047	0.000	0.047	0.007	0.000	0.007	0.004	0.000	0.004
30	Rajasthan	0.075	0.000	0.075	0.036	0.000	0.036	0.006	0.000	0.006	0.003	0.000	0.003
31	Sikkim	0.025	0.000	0.025	0.010	0.000	0.010	0.002	0.000	0.002	0.001	0.000	0.001
32	Tamil Nadu	0.041	0.000	0.041	0.019	0.000	0.019	0.003	0.000	0.003	0.001	0.000	0.001
33	Telangana	0.033	0.005	0.038	0.013	0.001	0.014	0.003	0.000	0.003	0.001	0.000	0.001
34	Tripura	0.088	0.000	0.088	0.031	0.000	0.031	0.004	0.000	0.004	0.001	0.000	0.001
35	Uttar Pradesh	0.100	0.002	0.101	0.047	0.000	0.047	0.009	0.000	0.009	0.004	0.000	0.004
36	Uttarakhand	0.063	0.000	0.063	0.032	0.000	0.032	0.004	0.000	0.004	0.002	0.000	0.002
37	West Bengal	0.023	0.003	0.027	0.011	0.001	0.012	0.001	0.000	0.002	0.001	0.000	0.001

Source: Authors' own calculation.

Note: SDS means sustainable development scenario.

TABLE A5 Coal Plant Data Comparison

States/UTs	Global Coal Plant Tracker (Only Operating status considered)								CEA (considering only steam as Prime mover)							
	Units				Plants				Units				Plants			
	Private	State	Centre	Total	Private	State	Centre	Total	Private	State	Centre	Total	Private	State	Centre	Total
Andhra Pradesh	20	16	9	45	10	4	2	16	12	15	4	31	5	3	1	9
Assam	0	0	3	3	0	0	1	1			3	3			1	1
Bihar	0	0	23	23	0	0	8	8			21	21			6	6
Chhattisgarh	66	9	18	93	29	3	4	36	38	11	15	64	19	4	4	27
Gujarat	31	29	0	60	9	9	0	18	23	25		48	5	7		12
Haryana	2	12	3	17	1	3	1	5	2	7	3	12	1	3	1	5
Jharkhand	16	2	15	33	6	1	5	12	6	2	6	14	3	1	4	8
Karnataka	9	11	5	25	4	2	2	8	6	13	3	22	3	3	1	7
Madhya Pradesh	30	16	17	63	11	4	3	18	17	16	16	49	7	4	3	14
Maharashtra	54	31	6	91	23	8	2	33	38	28	6	72	14	7	2	23
Odisha	67	4	26	97	22	1	5	28	8	4	13	25	4	1	3	8
Punjab state	7	8	0	15	3	2	0	5	7	8		15	3	2		5
Rajasthan	22	24	2	48	9	5	1	15	10	24	2	36	2	5	1	8
Tamil Nadu	25	18	22	65	13	5	5	23	7	15	23	45	4	4	7	15
Telangana	8	10	10	28	4	5	2	11		9	7	16		5	1	6
Uttar Pradesh	36	22	33	91	12	5	7	24	22	22	31	75	9	4	6	19
Uttarakhand	1	0	0	1	1	0	0	1	2			2	2			2
West Bengal	14	20	22	56	6	5	6	17	14	22	19	55	6	6	5	17

Note: The data for coal power plants have been sourced from Global Energy Monitor's Global Coal Plant Tracker (GCPT). The database tracks individual coal plant units and includes information such as plant sponsor and parent company, plant status, plant and coal type, and location. The database is updated bi-annually, in January and July. In the analysis, we have taken data as of July 2021. We have tried to compare the former with CEA's steam-based thermal power plant data as shown in the following table. Please note that the GCPT data is till July 2021 in contrast to CEA data, which dates to March 2020.

TABLE A6 District Mineral Foundation (DMF)

State	Total DMF (Rs. Billion)	Coal based DMF (Rs. Billion)	Coal Share (Percent)
Jharkhand	65.33	47.65	73
Chhattisgarh	64.7	34.43	53
Madhya Pradesh	37.55	30.4	81
Odisha	121.86	28.97	24
Telangana	29.99	18.98	63
Maharashtra	23.07	14.44	63
Uttar Pradesh	8.9	4.81	54
Tamil Nadu	7.77	3.15	41
Gujarat	8.6	1.09	13
Rajasthan	46.64	0.67	1.4
Assam	0.89	0.52	58
West Bengal	0.66	0.15	23

Source: Annual reports Coal India Limited.

TABLE A7 (1) All Coal Plants in States and UTs

States/UTs	Remaining Plant life <=20		Remaining Plant life > 20		Total	
	No. of Units	Sum of Capacity (MW)	No. of Units	Sum of Capacity (MW)	No. of Unit	Sum of Capacity (MW)
Andhra Pradesh	13	1957.5	37	12663.5	50	14621
Assam			3	750	3	750
Bihar	8	1280	21	9990	29	11270
Chhattisgarh	20	3572.5	78	25735.5	98	29308
Gujarat	21	3565	43	14620	64	18185
Haryana	6	860	11	5120	17	5980
Jharkhand	18	1707.5	23	10149	41	11856.5
Karnataka	8	1520	19	9830	27	11350
Madhya Pradesh	16	3930	52	22525	68	26455
Maharashtra	24	5440	68	21532	92	26972
Odisha	24	3035.5	85	22169	109	25204.5
Punjab	6	1260	9	4420	15	5680
Rajasthan	9	1685	42	11050	51	12735
Tamil Nadu	23	4240	53	18031	76	22271
Telangana	13	2782.5	26	12114	39	14896.5
Uttar Pradesh	43	8749.7	64	26488	107	35237.7
Uttarakhand			1	43	1	43
West Bengal	30	5445	27	9930	57	15375
Grand Total	282	51030.2	662	237160	944	288190.2

Source: Authors' own calculation based on Global Coal Plant Tracker; Status: Operating, Construction, Pre-permit, permit, announced.

TABLE A7(2) All Coal Plants in States and UTs

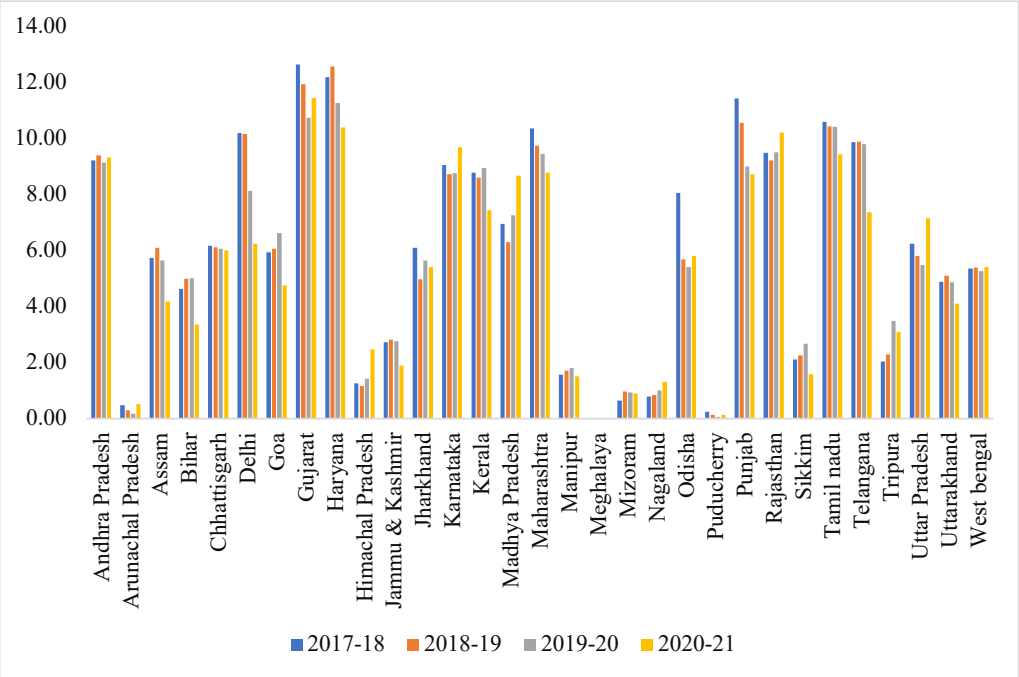
States/UTs	Remaining Plant life <=30		Remaining Plant life > 30		Total	
	No. of Units	Sum of Capacity (MW)	No. of Units	Sum of Capacity (MW)	No. of Unit	Sum of Capacity (MW)
Andhra Pradesh	23	4724	27	9897	50	14621
Assam			3	750	3	750
Bihar	11	2780	18	8490	29	11270
Chhattisgarh	51	10239	47	19069	98	29308
Gujarat	38	7735	26	10450	64	18185
Haryana	14	4160	3	1820	17	5980
Jharkhand	26	3712.5	15	8144	41	11856.5
Karnataka	17	4410	10	6940	27	11350
Madhya Pradesh	21	5675	47	20780	68	26455
Maharashtra	47	9336	45	17636	92	26972
Odisha	67	10245.5	42	14959	109	25204.5
Punjab	8	1760	7	3920	15	5680
Rajasthan	34	5305	17	7430	51	12735
Tamil Nadu	36	5591	40	16680	76	22271
Telangana	20	4466.5	19	10430	39	14896.5
Uttar Pradesh	62	14032.7	45	21205	107	35237.7
Uttarakhand	1	43			1	43
West Bengal	46	10265	11	5110	57	15375
Grand Total	522	104480.2	422	183710	944	288190.2

Source: Authors' own calculation based on Global Coal Plant Tracker; Status: Operating, Construction, Pre-permit, permit, announced.

TABLE 8 Fossil Fuel Revenue as Share of Own Non-Fossil Fuel Revenue

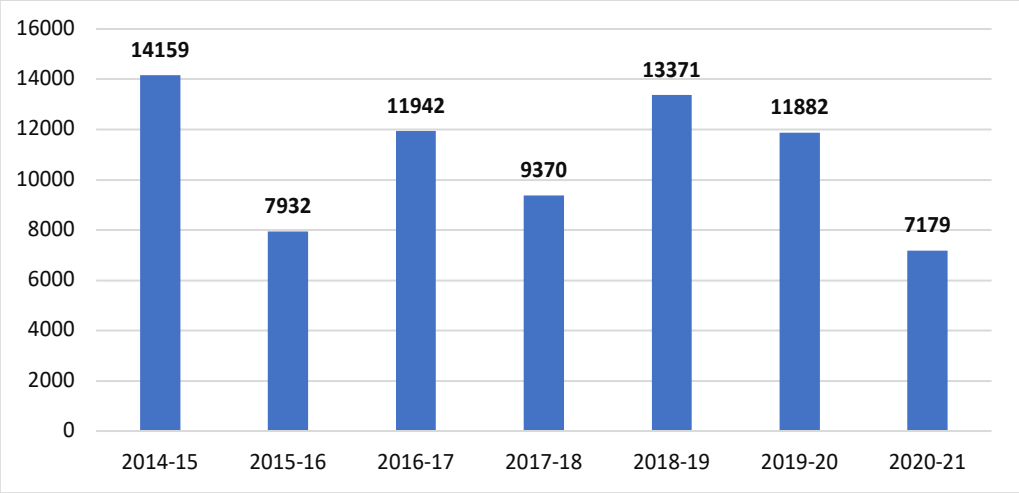
State/UT	2019	2030	2040
Andhra Pradesh	0.2047	0.0566	0.0255
Arunachal Pradesh	0.0127	0.0609	0.0275
Assam	0.1495	0.0976	0.0491
Bihar	0.1962	0.0267	0.0130
Chhattisgarh	0.2844	0.1207	0.0561
Delhi	0.1065	0.0460	0.0223
Goa	0.0983	0.0879	0.0590
Gujarat	0.1772	0.1650	0.0712
Haryana	0.1679	0.0547	0.0239
Himachal Pradesh	0.0448	0.0731	0.0389
Jharkhand	0.3012	0.0887	0.0403
Karnataka	0.1672	0.0440	0.0186
Kerala	0.1357	0.0430	0.0216
Madhya Pradesh	0.2879	0.0637	0.0219
Maharashtra	0.1586	0.1878	0.1016
Manipur	0.1595	0.1891	0.0888
Meghalaya	0.0001	0.1701	0.1237
Mizoram	0.0979	0.0627	0.0191
Nagaland	0.0973	0.1362	0.0654
Odisha	0.2192	0.0630	0.0262
Puducherry	0.0012	0.0186	0.0097
Punjab	0.1576	0.0950	0.0574
Rajasthan	0.1765	0.0781	0.0403
Sikkim	0.0814	0.0326	0.0133
Tamil Nadu	0.1667	0.0476	0.0234
Telangana	0.1679	0.0446	0.0182
Tripura	0.1911	0.1068	0.0409
Uttar Pradesh	0.1452	0.1030	0.0518
Uttarakhand	0.0945	0.0592	0.0322
West Bengal	0.1682	0.0323	0.0156

FIGURE A1 VAT as Share of Revenue Receipts



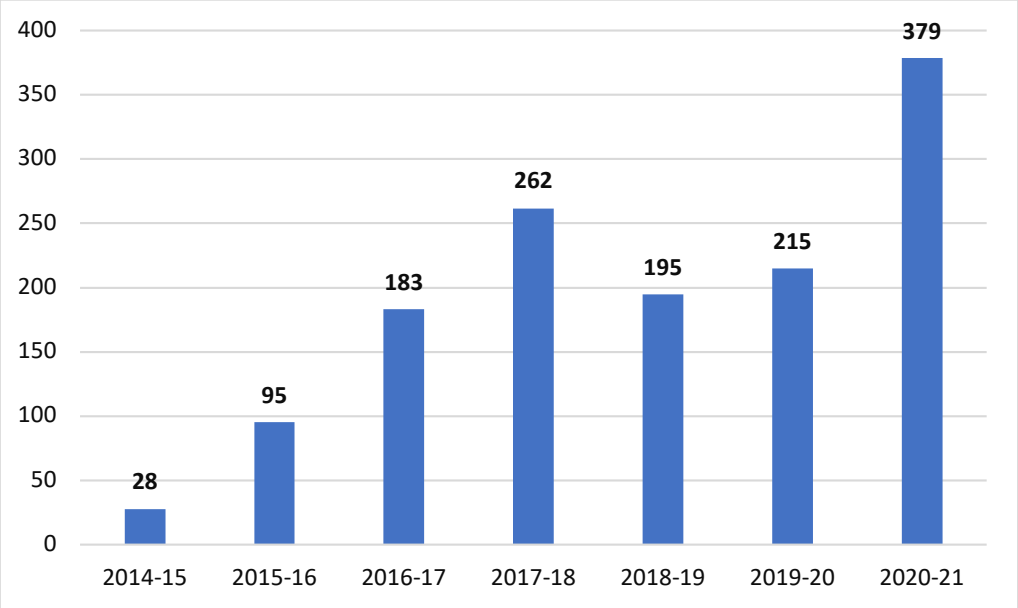
Source: PPAC.

FIGURE A2 Royalty on Crude Oil/ Natural Gas (Rs Crore)



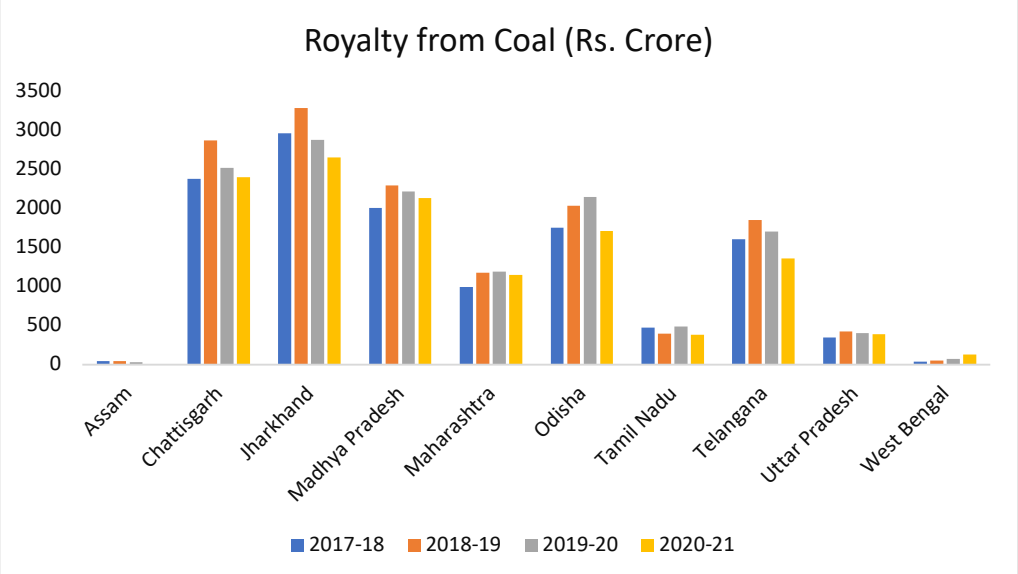
Source: PPAC (2021).

FIGURE A3 Dividend Income to State Govt. (Rs Crore)



Source: PPAC (2021).

FIGURE A4 Coal-based Royalties to Different States



Source: Annual reports Coal India Limited.