भारतीय प्रतिष्ठान
NATIONAL FOUNDATION FOR INDIA

Socio-economic impacts of coal transitions in India

BOTTOM-UP ANALYSIS OF JOBS IN COAL AND COAL-CONSUMING INDUSTRIES

National Foundation for India

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PREFACE

India has taken a bold step to phase down the use of coal in our economy. In its contribution to fighting climate change, India has offered ambitious targets at COP 26 in Glasgow. These commitments put India on a path to transition towards a cleaner greener economy.

Several factors will naturally decide the speed with which India is able to make these energy transitions. But regardless of the pace, this energy transition will impact the lives and livelihoods of many marginalised and poor communities across the country as our use of coal diminishes and eventually ends.

Our governments, institutions and civil society have to ensure that this transition does not leave behind the people who have so far worked in coal and coal-related industries. That would be a double whammy. Most often these are also the citizens and households who are the most vulnerable and suffer the brunt of climate change impacts. They have the least resources to cope and adapt. They cannot be allowed to pay yet again with their livelihoods, the cost of our transition to a more sustainable economy.

The primary mandate of the National Foundation for India is to work with the most vulnerable and marginalised communities in India. Therefore, in the first phase of our recently launched work on climate change, we studied how many jobs and livelihoods are directly and indirectly linked to the coal and coal-related sectors in India. This mapping is an essential first step.

In the next phase of this work, NFI will work more closely with communities and governments at the regional, sub-regional and local levels to create a shared understanding of how the phase-down of coal will impact lives, livelihoods and the local economy at all levels. To map the changes the transition will induce across the most vulnerable areas and communities and what societies and governments must do to address these emerging vulnerabilities.

We hope this research report fosters a deeper understanding of the challenging task before India. The task of transitioning to a greener economy and ensuring that in doing so, we leave no one behind.

Biraj Patnaik

Executive Director

EXECUTIVE SUMMARY

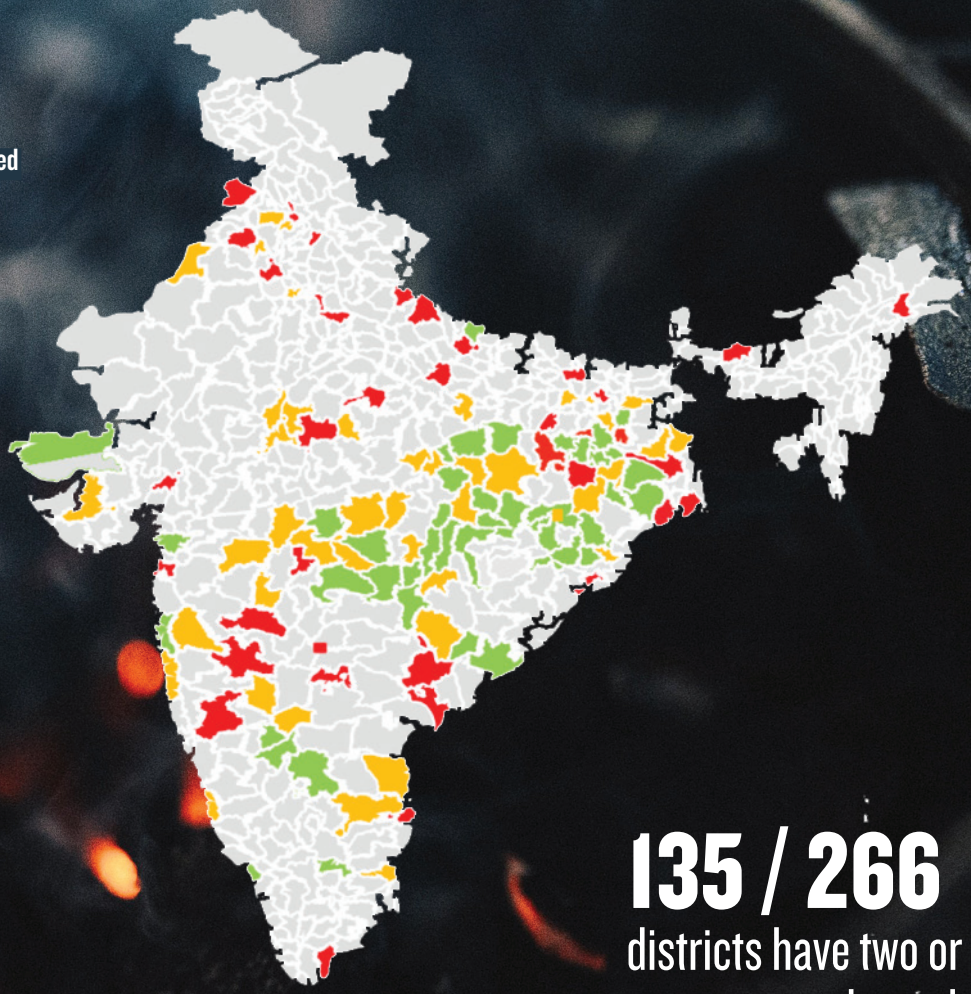
>13 million people are employed in coal mining, transport, power, sponge iron, steel, and bricks sectors.

Coal transitions in India are likely to be a messy and complicated exercise. At a conservative estimate, more than 13 million people are employed in coal mining, transport, power, sponge iron, steel, and bricks sectors. This is more than the population of at least 160 countries around the world, or the population of a country like Zimbabwe. This figure does not include those in the informal sector in coal mining, labour involved in coal imports (at the ports or transport from ports to thermal plants), indirect activities in the iron and steel sector including third party sellers, warehousing staff, iron ore mining etc, the dependents of workers or even third party vendors like equipment manufacturers. Conversations with stakeholders suggest that only including the informal coal economy would likely take this dependency to more than 20 million people or the population of Sri Lanka.

Coal transitions are likely to have the most impact on the people in the **central and eastern states of West Bengal, Jharkhand, Chhattisgarh, Odisha, and Madhya Pradesh, with some parts of UP, Telangana, Maharashtra, and Andhra Pradesh.** At the national level, 266 districts have at least one asset linked to the coal sector, and **135 of these 266 districts have two or more assets dependent on coal**, i.e., a coal mine, thermal power plant, sponge iron plant, steel plant. At least half of all the districts in Jharkhand (15) and West Bengal (11), 30 per cent of districts in Odisha and Chhattisgarh (9) are likely to be impacted in some form or the other due to the impending coal transitions (figure 1). This is the real challenge that faces India today. Transitioning entire regions and districts, finding livelihood opportunities for a population the size of smaller countries, and meeting our development and climate goals. The scale and size of this transition alone makes it unprecedented in the history of coal transitions across the world.

FIGURE 1:
Most vulnerable districts with two or more coal-linked industry

Source: Authors' analysis



135 / 266
districts have two or more assets dependent on coal

Highly vulnerable districts	Pakur,Palamu,Tinsukia, Aligarh,Muzaffarpur,South 24 Parganas,YamunaNagar,Krishna,Ranchi,Akola,Bina,Gonda,Kheri,Pilibhit,Aurangabad,Begusarai,Solapur,Bhatinda,Gautam Budh Nagar,Kota,Raebareli,Koderma,Kokrajhar,Seoni,EastMedinipur,Thoothukudi,Bardhaman,Beed,Kadapa,Khammam,Kheda,Ropar,Tapi,Belgaum,Durgapur,Hyderabad,Khordha,Mahbubnagar,Chennai,Hisar,Jhansi,Thane,Thiruvallur
Moderate vulnerable districts	Bhagalpur,Murshidabad,Raichur,SriGanganagar,Chhindwara, Deoghar, JayashankarBhoopalpally, Komaram,Bheem,Korea, Latehar,Shahdol,Surajpur,Patna,Wardha,Birbhum,Allahabad,Amravati,Baran,Cuddalore, Gondia,Jalgaon,Jamnagar, Jhajjar, Jhalawar,Mansa,Mumbai,Rajpura,Ratnagiri,Shahjahanpur,Udupi, Warangal,Bilaspur,Chittoor,FatehgarhSahib,Jalna,Ludhiana,Pune,Rourkela,Jaipur,Nellore,Umaria,Saraikela,Bijapur,Lalitpur,Purulia
Least vulnerable districts	Giridih,Sambalpur,Hazaribagh,Ramgarh,Singhbhum,Godda,Peddapalli,Surguja ,Yavatmal,Dhanbad,Durg,Burdwan,Balrampur,Janjgir-Champa,Salem,Surat,Anantapur,Keonjhar,Koppal,South Goa,West Medinipur,Bankura,Betul,Karimnagar,Chatra,Paschim Bardhaman,Vishakhapatnam,Nagpur,Chandrapur,Kutch,Dhenkanal,Raipur,Anuppur,Raigad,Angul,Bellary,Sonbhadra,Jharsuguda,Korba,Singrauli,Bokaro,Mancherial,Sundergarh,Raigarh,

Characteristics endemic to the Indian labour market complicates this transition process further. These include the large presence of contract/off-roll labour in every sector, the socio-economic profile of the labour in the sectors, and the overall sectoral roadmaps. The share of off-roll labour accounts for at least 70 per cent of the total labour across all sectors, reaching as high as 92 per cent and 80 per cent in transport and bricks, respectively (figure 2). Official labour estimates in different sectors do not account for this labour since they are employed by job contractors. Without their inclusion from the get-go, it is likely that they may not be beneficiaries of the transition policies and the costs of transitioning them will be discounted. The informality limits institutional support mechanisms like unions. The coal transport by road for example is most vulnerable to the transition given increasing mechanisation, and probably the first to be impacted, but lacks a union or other institutional mechanism to make a case for them as coal transition workers. The brick sector may not even be viewed as a coal transition sector, given the labour is employed for six months in a year, is migratory by nature and therefore there are no official records on the number of people employed in the sector or a platform for the labour to be a part of the discussion.

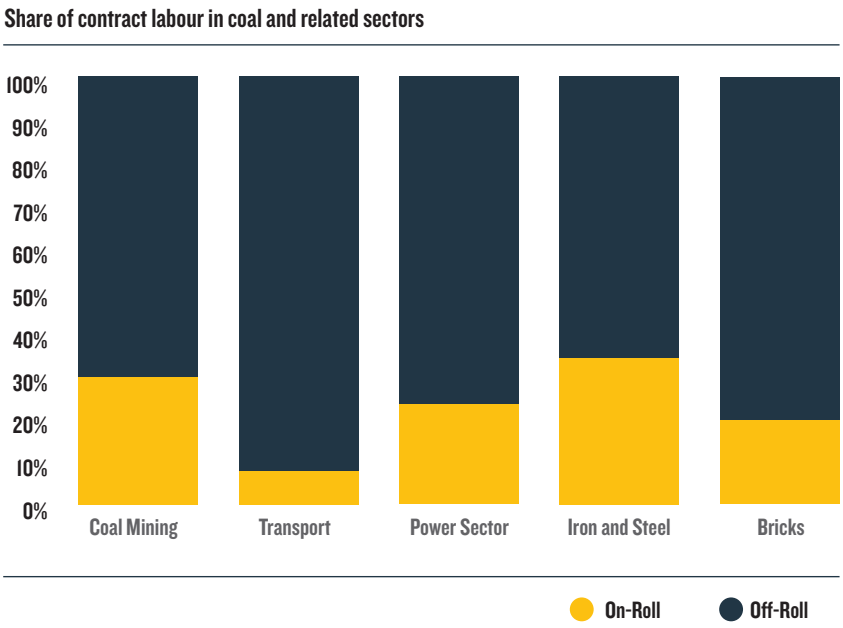


FIGURE 2:
Share of contract labour across coal and its major consumers

Source: Authors' analysis based on data on no. of units and mine-wise coal production from (CEA, 2020), (JPC, 2021), (Pai & Zerriffi, 2021), (CCO, 2020) and stakeholder conversations

No official dataset captures the socio-economic profile of the labour employed in these sectors. Capturing socio-economic profiles becomes necessary while designing policies on retraining and reskilling, since the baseline differs between sectors, and even within different job profiles in the same industry. The Periodic Labour Force Survey (PLFS) studies broader dynamics of the labour market, but the intent of the survey is not to ascertain socio-economic indicators within particular sectors. Nevertheless, it is the only available official dataset to understand labour patterns. Using the PLFS dataset, the study identified key socio-economic indicators like education, wages, training, gender split, job contracts. The results are endemic of the larger trend in the Indian labour market. 81 per cent of the labour force in India is employed in the informal sector/shadow economy (with no social benefits) and if one were to include the portion of informal sector workers (contract/casual labourers), then the proportion is as high as 92 per cent (Punia, 2020). As Mehrotra (2019) has detailed one of the reasons for growth and informal economy has been low education and skill levels of the workforce. This trend is captured in the graph below for coal and its major consumers. Mirroring broader national labour trends, women fare worse off than men across most coal-dependent sectors. Low education and skill levels and high informality will be barriers to transition. Low education levels enable information asymmetry since the labour who is likely to be transitioned is not informed of their rights. Further, the technical nature of the green industries necessitates targeted reskilling and training programmes, without which a just transition will be difficult to achieve in India.

81%
of the labour force in India is employed in the informal sector

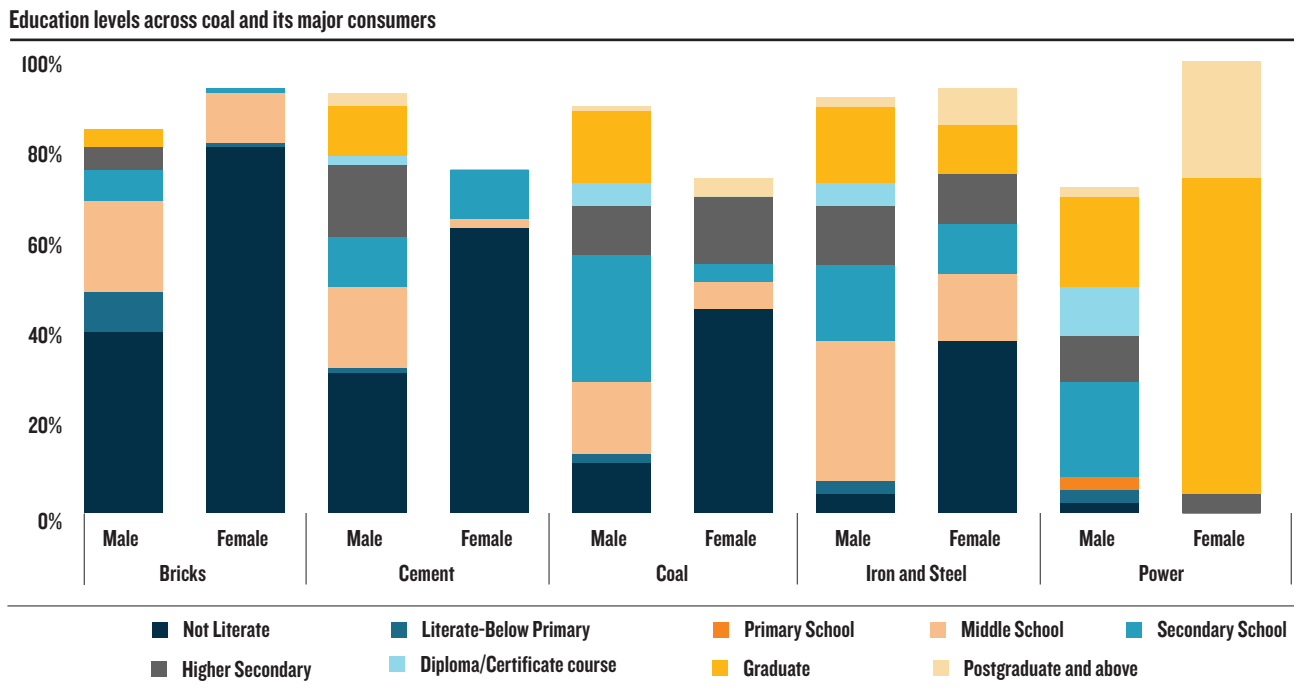


FIGURE 3:
Education profile of workers by gender across all sectors

Source: (PLFS, 2021)

The third complication is the trend of the broader sectoral roadmap. National level trajectories and policies on sectoral roadmaps are not yet aligned with the impending coal transition or with the recently announced net zero target. This prevents future planning and investments for a post-coal world. Some sectors like the Indian Railways are heavily reliant on coal, with ~44 per cent of their revenues coming from coal. In our conversations with stakeholders, the roadmap for railways remained unclear in a post-coal world. Freight revenues are important since they help bridge the gap in operational cost of passenger movement. The coal sector itself has been undergoing an expansion with recent reforms in commercial coal mining and auctioning of new coal blocks. Coal India has only recently announced plans for diversification, but these are limited forays in solar and possibly aluminium production. Despite 123 mine closures since 2008, there is very little evidence of environment remediation and land rehabilitation in these areas. In the power sector, until very recently (August 2021) there were no guideline on plant decommissioning and environment remediation. In iron and steel, there are some indications that the sector will have to undergo a consolidation (98 per cent of the industry has plants with less than 1 MT capacity), since not all firms have the capital to transition to new technology. However, it is still not clear the technology pathway the sector is likely to undertake. A pathway that chooses electrification, hydrogen or natural gas or any low-carbon technology will necessitate retraining and reskilling. It will also result in retrenchment of the contract labour that is involved in coal handling.

Despite 123 mine closures since 2008, there is very little evidence of environment remediation and land rehabilitation in these areas.

But a well-planned transition and advance planning can take care of most of these challenges. The transition will necessitate aligning state, national and sector roadmaps at the planning level. Strategies towards decarbonisation cannot be undertaken with simultaneous investment and expansion of the coal sector and its allied uses. This will impede investments needed to meet the net zero target and continue the carbon lock-in with possibilities of stranded investments. Further, India needs to define a coal transition worker across different sectors with targeted emphasis on contract/informal labour and their socio-economic profile. Without this it is possible that a significant chunk of the labour force will not be beneficiaries of the transition policies. Accounting for the contract labour force also helps accounting practices as India needs to determine the financial and economic costs required for the transition. Environment remediation and decommissioning or closure plans have to become a necessary component for all sectors with increased capacity at the central and state level for their monitoring and implementation.

Without this, it will be impossible to design strategies for economic regeneration in the 135 likely to be impacted districts. These coal bearing regions will need to be made productive again through regional strategies. The current governance structure is unlikely to yield results for the transition. Decision making for energy is concentrated at the central government level, while planning and implementation of the resulting challenges (labour, education, health etc.) is the purview of the states. This leads to an imbalance since revenues are accrued more to the central government than state governments. This structure needs to be corrected. Centre-state councils like the GST council can help bridge this imbalance. Lastly, India will need to communicate at the global level about the scale of these transitions and demand climate finance to manage and implement the strategy. Without external funding it is unlikely that the scope of the transition only on livelihoods can be met solely by domestic funding. Multilateral Development Banks will need to de-risk coal bearing areas during the transition period to facilitate green investments. In the short term, funds from the District Mineral Fund can be leveraged. Domestically, the country will also need to prepare its financial system for early closures.

The 135 districts will need to be made productive again through regional and local strategies. The current governance structure is unlikely to yield results.

Finally, all stakeholders have a role to play in this transition roadmap. District authorities become the focal point of the transition roadmap since they are the key implementors and the first point of contact for local resistance or support. Industries will need to be brought on board for their input on district level investments and preparing the transition strategy for the existing force. The existing labour force will have to be bucketed into categories of those who can be voluntarily retired (and the financial cost of this), those that can be transitioned within the same company and or another similar profile in the same area. Labour unions have to become a necessary part of this conversation since they will essentially be the communication bridge between the management, governments, and the larger labour force. In sectors with no unions, it is incumbent upon local authorities to seek an 'influencer' or group leader to lead the discussions. Local and community leaders will have a big role to play in this transition. They are essentially entrenched in the existing political economy and without their support, local resistance may increase. Therefore, their influence needs to be cultivated for the success of this transition strategy through involvement in district and state level planning.

The next steps highlighted below determine near-term strategies while we prepare for the broader transition. All efforts have to be made to not only transition the existing work force, but also put in place strategies that will prevent future generations from working in coal and related sectors.

Big and other mines which produce 85% of the coal in the country will likely be the ones running for the next 20-30 years.

Coal Mining

- **A mine-wise estimate of reserves** Given a target date of net-zero by 2070 and endorsements on clean technology, typically, the big and other mines which produce 85 per cent of the coal in the country will likely be the ones running for the next 20-30 years. Most underground mines and rest of mines will likely be shut down within this decade. Preparing a timeline of mine closure will be most effective using the reserve estimates.

- **Analyse the trend of contract workers** in every mine over a five-year period. This will help identify the actual employment provided by the mine in the district/ area. A mine-wise estimate will help quantify and codify contract workers as formal coal transition workers. Job contractors are mandated by law to register their workers with the labour commission

- **Identifying socio-economic characteristics** like age, education, technical qualification of workers in underground mines since they will most likely be shut down earlier. This will help prepare a plan to retire/transition workers. This should

be followed by an assessment of workers in rest of the mines since they will be the next ones to be shut down. Here as well, it will be prudent to begin with the mines which are almost exhausted or producing the least amount of coal.

- Based on the socio-economic characteristics, **delineate the extent of financial aid** that will be required in every mine area for retrenchment, early retirement and retraining the existing workforce. This can be useful if India decides to follow South Africa's strategy and seek global aid. At COP26 South Africa signed a pact with US, UK, Germany, France and EU to help mobilise USD 8.5 billion for the country's transition (Mkhize, 2021).

- **Prepare and implement environment remediation:** While a 2012 guideline (Ministry of Coal, 2012) document on mine closures has been notified by the Ministry of Coal, this is no evidence that this has actually been implemented in practice. Between 2008 and 2018, 123 collieries owned by CIL and SCCL have been shut down. However, there is little evidence of a robust transition in these areas.

South Africa signed a pact with US, UK, Germany, France and EU to help mobilise USD 8.5 billion for the country's transition

Coal Transport

- For the truck segment, the next steps are more or less covered under the coal mining category. Perhaps it might be useful to identify the extent of debt amongst households in the district on HEMMs (trucks etc). This will have to be added to the financial cost of transition, since eventually it may lead to a payoff.

- For Indian Railways, there is a need to diversify its revenue sources. It is also imperative that they be a part of the mine closure roadmap, since closures will have a direct impact on the railway staff in coal bearing divisions.

Power Sector

- The first step towards a smoother transition should be to **identify plants which are likely to be shut down in this decade**. Germany for example is holding auctions whereby plant owners are incentivised to shut down a plant earlier. This has to be **coordinated with mine closures timetable,** a closure of both assets in the same or nearby districts is likely to impact economic parameters for the district and households within the district.

- Workers, unions need to be a part of this conversation. Without their inputs, it is unlikely that the transition will be smooth, and their involvement will also mitigate fears of job loss.

- Thereafter, it is necessary to **categorise the age, skill level, and other socio-economic parameters** of workers within these plants. This will help identify workers who can be provided with early retirement packages, those who will need to be transitioned to other local power plants and those who may be retrenched.

- This assessment will need to include contract workers since they are about 70 percent or more of the workforce in the plant. If there is no external mandate, then it is likely that job contractors will move on, leaving contract labour stranded in the district.

- **The sites of these plants will need investments for environment remediation and land rehabilitation**, especially at the CHP and AHP sites (ash ponds, coal storage areas etc.) before they can be utilised for other economic activities. It is

necessary to assess these individual areas, analyse the necessary investment, demarcate finances, and identify appropriate funding sources. While the NGT order and the resultant draft guidelines provide a framework, these are yet to be approved. Moreover, these guidelines do not include impact on livelihood.

- At a minimum just these few steps are likely to take a decade to materialise. Therefore, even if India and the power sector does not expect early retirements, it will be imperative to begin the process of transition planning today.

Iron and Steel sector

- It is imperative for the Government of India to begin the conversation on **moving towards natural gas or alternate fuels** for the coal-based DRI industry. This will help reduce emissions from the sector and prepare them for the eventual transition.
- Supplementing this exercise, it is necessary to **identify if the labour force can be transitioned** in its existing form or if training programmes have to be conducted.
- Irrespective of the technology, it is clear that coal usage is expected to decrease in the next two decades. This will **impact workers on the coal supply chain** in this sector and they should be considered as coal transition workers under the broader transition programme
- **Districts with smaller sized units** that are expected to see consolidation should be mapped alongside power plant and coal mine districts. This will help identify districts most vulnerable i.e., if all three assets are in the same district.

Bricks sector

- **Geotag kilns across the country** to help fix the location of the kilns. This exercise has to be updated on an annual/bi-annual basis and will help provide information on the number of kilns
- **Incentivise** kiln owners financially to adopt efficient electricity-based technology.
- **Enforce environment pollution norms** that will make it easier to incentivise transition and identify unregistered kilns
- Make it **mandatory for job contractors to submit labour data** to the local labour commissioner's office every year. Once this has been done for a few years, it will help create a labour database for the brick sector. This information will also help identify socio-economic characteristics of the labour
- **Create** a cadre of workers who will be able to train new labour every year ahead of the brick making season
- **Enforce minimum wage rules** to improve socio-economic conditions of the labourers

INTRODUCTION AND POLICY CONTEXT

The Government of India (GoI) at COP 26 announced amongst other things, that the country will achieve net zero emissions by 2070 (MEA, 2021). This announcement alone sounds the death knell for coal expansion in the country. In 2021, India consumed ~932 million tonnes (MT) of coal, 77 per cent of which came from domestic production and ~90 per cent of which was used for power generation. Coal is mined across eleven states in India, with four states – Chhattisgarh, Jharkhand, Odisha, and Madhya Pradesh – accounting for ~80 per cent of the 716 million tonnes (MT) of production (CCO, 2020). Not only has coal been the backbone of the Indian economy for more than a century (figure 4), but it is a way of life in these states, with deep-rooted linkages within the social, political, and economic systems.

India consumed **932 MT** of coal, **77 per cent** of which came from domestic production and **90 per cent** of which was used for power generation.

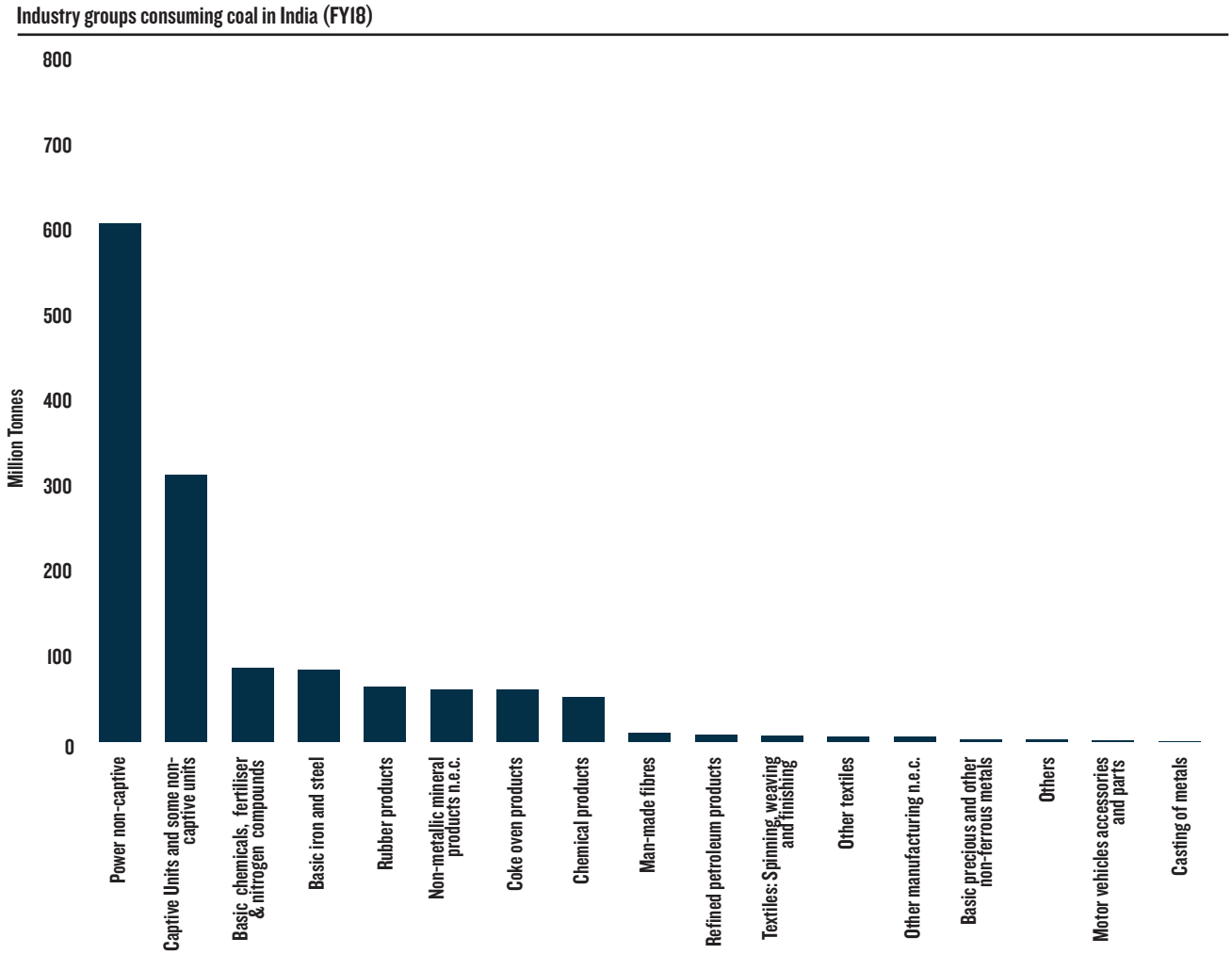


FIGURE 4:
Coal consumption across different industry groups in FY18

Source: (Annual Survey of Industries , 2018), (CEA, 2020)

Coal economy in India is complicated. For one, it mirrors trends in the larger energy sector in that it is largely governed by the State-Owned Enterprises (SOEs) across the supply chain. As aptly described by Chandra (2018), the redistributive welfare character encoded in the DNA of Coal India Limited (CIL) – the largest operator in the country – at the time of nationalisation in the 1970s created complex interdependencies between the company, local bureaucracy, and the political class which exists even today. Over the years, even as the state governments and district officials failed to provide basic public goods of electricity, piped water, roads in the coal dominant areas, local communities formed a social contract with CIL who would provide these amenities at least in the short term in exchange for smooth coal extraction. The economic value of coal as an asset class in the mining districts ensured its control by local political actors. This political and economic dependency (functional and political lock-in) at the state and district level lies at the heart of coal transitions in India.

The informal nature of the Indian economy further complicates this political and economic dependency on coal. 81 per cent of the labour force in India is employed in the informal sector/shadow economy (with no social benefits), and if one were to include the portion of informal sector workers (contract/casual labourers), then the proportion is as high as 92 per cent (Punia, 2020). The characteristics of this shadow economy are endemic to the coal and allied sectors of bricks, power, iron, and steel as well. As described by Kuntala Lahiri-Dutt (2016) the four coal economies with corresponding labour dynamics include national coal (mined by nationalised coal companies on their own or through contractors); neoliberal coal (mined by

captive producers), state-craft coal (mined in the north-east), and subsistence coal (illegal mining run by local political and social leaders bordering formal mines). This essentially means that formal numbers of coal employment are a drop in the bucket when it comes to estimating labour in coal mining. Moreover, beyond coal mining activities, there is considerable labour employed in allied industries which are linked to coal and ash handling and transportation.

To ensure a successful coal transition in the next 49 years, it is incumbent upon India to put in place an equitable plan that accounts for technical, social, and economic transition of coal districts and states, to put the people at the centre of its plan. Putting people and their needs at the centre of the ongoing energy transitions has gained considerable interest over the past few years, particularly to mitigate the resistance from fossil fuel communities. Countries across the world have been putting put coal transition plans in place using different approaches. As detailed in Dsouza (2021), an equitable transition which comes under the Just Transition framework has five major components (figure 5).

81 per cent of the labour force in India is employed in the informal sector (with no social benefits)

In India, this conversation is just beginning. The aim of this project is to facilitate this conversation, throw light on the challenges facing the country given the unique nature that coal occupies within its economy, financial, political, and social systems, highlight sectoral divisions and similarities, and aid national, state and district governments and local communities manage the transition process. This report is the first part of a larger project that seeks to quantify this impact of a coal transition in India on livelihood opportunities.

The principles of the Just Transition framework have been tweaked to suit the Indian context. In the sense that we understand that a simple quantification exercise is not enough to encompass the complexities involved with coal transitions in India. It needs to be further qualified with differences in nature of contracts, labour profiles, socio-economic parameters on age, education, gender, as well as location. These parameters are crucial to identify the barriers in retraining, reskilling of the labour force and in economic regeneration of the coal mining districts and states in India. Accordingly, the report focusses on the following four questions:

- How many jobs are linked to the coal sector across the supply chain (mine-to-mouth)?
- What is the nature of the job profiles which will put them at risk during a transition?
- What is the socio-economic profile of labourers in key coal transition sectors?
- Which districts are the most vulnerable to the impending transition?

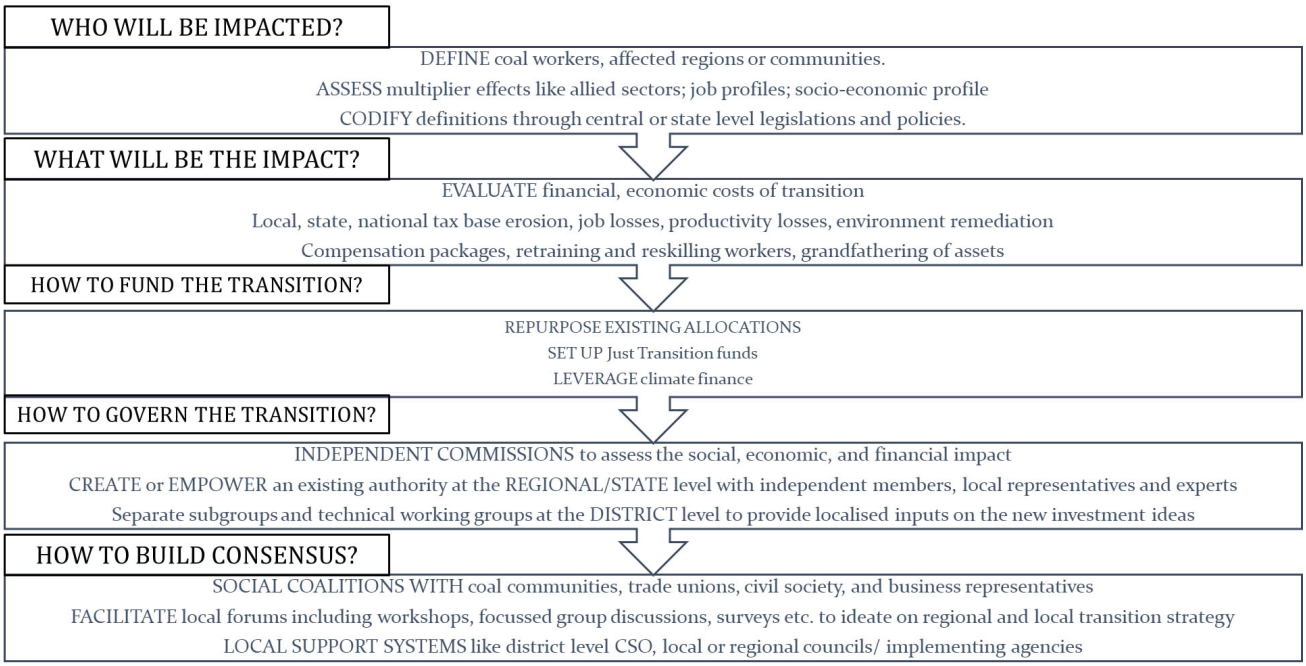


FIGURE 5:
Mapping Global Just Transitions framework

Source: (Dsouza, 2021)

Section 2 deals with the methodology and the assumptions adopted by the project in undertaking the study across coal, power, iron and steel and bricks sector. It also details the process followed for mapping labour profiles and vulnerable districts. Section 3 maps the results from different sectors along with an assessment of the job profiles at risk. It provides interim learnings and highlights next steps that have to be undertaken in each sector to manage the transition. Section 4 identifies districts which are highly vulnerable to coal transition given the prevalence of one or more assets/ industries linked to coal.

METHODOLOGY

The project classifies jobs into direct, indirect, and induced. Direct jobs are defined as those directly involved in coal extraction and production activities. Indirect jobs are defined as those jobs in the coal value chain which are dependent on coal production. This includes activities from coal transportation all the way to end consumption. In terms of risk profiles, these jobs have been further divided to identify which ones would be at most risk during coal transitions. Induced jobs are defined as jobs or activities in specific locations (particularly coal mining districts) to meet the needs of those directly or indirectly involved in coal value chain. The first part of the study estimates direct and indirect jobs across the coal value chain (figure 6).

The project classifies jobs into direct, indirect, and induced. Direct jobs are defined as those directly involved in coal extraction and production activities. Indirect jobs are defined as those jobs in the coal value chain which are dependent on coal production.

Coal Value Chain

ESTIMATING NUMBER OF JOBS AFFECTED

FIGURE 6:
Classifying jobs across the coal value chain

Source: Authors' compilation

The study followed a mixed method approach, using national and sectoral datasets, and supplementing trends via structured qualitative interviews. Using unit level data, the study did a bottom-up stock-take of the employment in coal and allied sectors. To understand coal mining jobs, the activities were divided based on coal mining, overburden removal, transport (until despatch point), crushing, ancillary activities, executive and supervisory roles. Further the kind of equipment used and mining techniques for open cast and UG mines were identified via mining plans available on the Ministry of Environment Forest and Climate Change portal (MoEFCC) (forest clearance process). The jobs were further categorised into on-roll and off-roll (contract jobs) based on inputs from stakeholders, including coal company executives, data from the ministry of coal, and labour unions.

To arrive at the number of indirect jobs created in the transportation of coal, the study estimated the total coal carrying capacity across the different modes of transport. This was done by triangulating the volume of coal reported by the Indian Railways, as well as individual reports by companies involved in coal production. Once the total volume of coal carried was known, the total transportation capacity required in the number of individual units of trains, tippers, payloaders, and other equipment was calculated using benchmarks from qualitative interviews with senior leadership in Indian Railways, labour union representatives and coal companies, along with a sense of the number of operational days and shifts. This led to the estimation of total jobs involved in the transportation of coal.

To estimate the jobs impacted in different sectors downstream, the following sectors were evaluated – power, steel, sponge iron, and bricks. As mentioned in the introduction, these sectors together consume about 90 per cent of the domestic and imported coal in India.

To estimate the total employment in the brick sector, the study triangulated reports on the total brick production in the country with bottom up reports on the average production across kilns, and stakeholder consultations on average size, technology, and employees at brick kilns. These were also triangulated with state-wise govt estimates on brick production. Further, these assumptions were validated through stakeholder consultations with brick kiln owners and researchers in the sector.

For the power sector, the team used the 2017-18 database of thermal power plants from the Central Electricity Authority (CEA), with their capacity and power generation as the base. The average number of employees for a certain capacity was arrived at through a triangulation of annual reports, as well as central and state govt reports. Since these reports only report the on-roll employees, the ratio of on-roll to off-roll

90 per cent of the domestic and imported coal in India is consumed by power, iron and steel and brick sectors

To plan a transition, it is imperative to understand the socio-economic profile of the labour force one is dealing with for retraining and reskilling initiatives

employees were estimated using stakeholder consultations based on the nature of plant (central, state, private, with captive/without). The team conducted stakeholder conversations and used actual data from some private power plant units to prepare the organisational structure including O&M staff, support staff, business staff, and bench strength. This idea of this exercise was to estimate the number of jobs and profiles which would not be replaced easily.

The iron and steel sector has been divided as per the production of crude steel and sponge iron. An attempt was made to estimate employment by categorising the sector on the basis of technology used for producing steel and sponge iron. The Blast Furnace (BF)/Basic Oxygen Furnace (BOF) route uses coking coal which is imported and is highly energy intensive, induction furnace plants and Integrated Direct Reduction (DRIs) i.e., plants with both steel and sponge iron units, which uses non-coking coal (some of which is also imported) but is less energy intensive and finally electric arc furnace plants, and independent sponge iron plants. Under each technology, plants are classified on capacity and for each capacity an average manpower was assumed based on stakeholder conversations (for contract labour), and annual reports (for on-roll labour). Further, these estimates were divided based on the nature of contract, i.e., permanent, and contractual, skill set, and job profile.

SOCIO-ECONOMIC PROFILE

To plan a transition, it is imperative to understand the characteristics of the labour force one is dealing with for retraining and reskilling initiatives. Sectoral data on labour force participation is hard to come by in India. The National Sample Survey Office (NSSO) and the Periodic Labour Force Surveys (PLFS) conducted by the Ministry of Statistics and Implementation Programme (MOSPI) can be used to understand aggregate labour dynamics of the Indian labour force. The NSSO data on labour characteristics was last updated in 2011-12, while the PLFS data is being conducted on an annual basis since 2017-18. This study used the 2017-18 and 2018-19 data set based on individual surveys to understand key characteristics of the labour in coal and allied sectors. These characteristics included age of workers, general education level, technical education level, whether vocational training received or not, primary status of work, nature of job contract, and wages. The analysis is done of 1599 data points.

LIMITATIONS

There are certain limitations to this dataset. For one the sample size is low in comparison to the actual number of employees across five sectors. Further, the intent of the survey is to understand the labour dynamics (employment and unemployment) at the national level in India, and not focus on individual sectors. Therefore, while these numbers can be used right now to understand the labour market characteristics in the coal and allied sectors, there needs to be further data collection with the intent of characteristics pertinent to a transition to better reflect the sector dynamics, especially in key impacted states.

CATEGORISING IMPACTED DISTRICTS

This exercise is aimed at ranking districts on the basis of their vulnerability to coal transition. For the purpose of selecting districts, we restricted our assessment to coal mining, power, steel, and sponge iron industry. Given the impending net-zero target of 2070, the increase in renewable energy capacity target by 2030, and other significant tie-ups at the COP26 such as the Glasgow Breakthrough endorsed by India on net zero emission steel amongst other things (UN Climate Change Conference UK, 2021), the team has assumed that the most impacted districts will have early mine closures (on the basis of coal production), power (on the basis of capacity, age of the fleet and pithead/non-pithead plants), steel and sponge iron industry (on the basis of capacity and labour). Weightage was given to each district based on these parameters resulting in a combined score and an overall vulnerability index.

RESULTS

At a conversative estimate, there are more than **13 million people**
dependent on coal in India

At a conversative estimate, there are more than **13 million people dependent on coal** in India (figure 7). If one were to exclude the bricks sector (which is mostly informal and the numbers fluctuate year on year), the number of people dependent on coal would still be around 2.5 million people, the majority of which are concentrated in the **central and eastern states of West Bengal, Jharkhand, Chhattisgarh, Odisha, and Madhya Pradesh**. The bifurcation based on number of units, capacity, and sector is provided in annexure 1. Of the 1526 sponge iron and steel units producing crude steel, 610 or 40 per cent is situated in the four states of Odisha (12 per cent), Jharkhand (9 per cent), Chhattisgarh (10 per cent), and West Bengal (9 per cent). Of the 229 thermal power plant units (including captive), 40 per cent are located in Uttar Pradesh (12 per cent), Chhattisgarh (10 per cent), Maharashtra and Madhya Pradesh (9 per cent each). Coal is mined across eleven states in India, with four states – Chhattisgarh, Jharkhand, Odisha, and Madhya Pradesh – accounting for ~80 per cent of the 730 million tonnes (MT) of production (CCO, 2020). These states will be the most affected in the coming decades when India transitions away from coal to meet the net zero target in 2070.

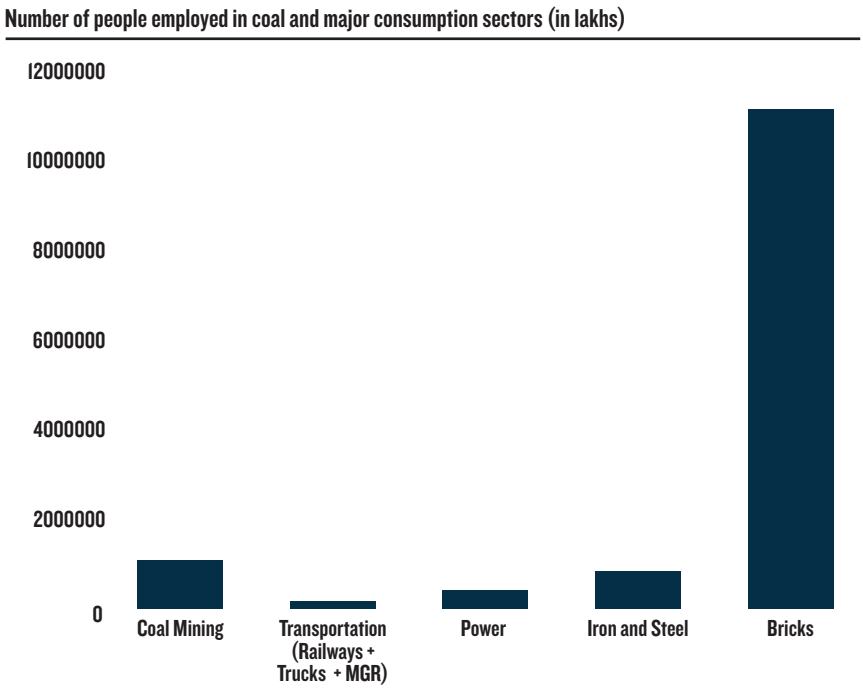


FIGURE 7:
Aggregate estimates of people employed across coal and main consuming sectors in India

Source: Authors' analysis based on base data on no. of units and mine-wise coal production from (CEA, 2020), (JPC, 2021), (Pai & Zerriffi, 2021), (CCO, 2020) and stakeholder conversations

The roadmap for coal transitions will be different across each of the sectors and within each of these states. These sectoral transitions will depend on a number of factors including the characteristics of the industry, the nature of the job contracts, availability of commercially viable clean technology for transition, the labour profile within each sector, the location of these industries and the opportunities for diversification available at the state and district level in each of these states.

COAL MINING AND PRODUCTION

India produces about 77 per cent of the coal it consumes. This coal is primarily mined through open cast mines. In 2019-20, 94 open cast mines (classified as big mines and other mines) produced 621 MT of the 730 MT of domestically produced coal; 125 open cast mines (classified as rest of mines) produced 67 MT and 182 underground mines (classified as rest of mines) produced 34 MT of coal (Pai, Zerriffi, & Kaluarachchi, 2021) (Pai & Zerriffi, 2021) (Ministry of Coal, 2021). As mentioned earlier, of the eleven states, Chhattisgarh, Jharkhand, Odisha, and Madhya Pradesh produce about 80 per cent of the domestic coal. As per a parliamentary report, only 128 of the 420 mines in FY19 were making profits, of which only four were underground mines (Ministry of Coal, 2019).

Only 128 of the 420 mines in FY19 were making profits, of which only four were underground mines

The nature of the coal industry in India has been changing since its nationalisation in the 1970s. Chandra (2018) details the history of coal mining and the role of State-Owned Enterprises in India from pre-independence to ~2017. This report only deals with the changes seen in the 2010s as it is highly relevant from a labour perspective. CIL and Singareni Collieries Company Limited (SCCL) are the two main producers of coal. CIL has seven coal producing subsidiaries, namely Eastern Coalfields Limited (ECL), Bharat Coking Coal Limited (BCCL), Central Coalfields Limited (CCL), Western Coalfields Limited (WCL), South Eastern Coalfields Limited (SECL), Northern Coalfields Limited (NCL)and Mahanadi Coalfields Limited (MCL) as well as a mine planning and consultancy company called Central Mine Planning & Design Institute (CMPDI), in addition to training institutes at mine sites.

Reforms allowing captive coal production since the early 1990s resulted in a number of blocks being allotted to private players in power, cement, and iron and steel. The

The total employees engaged in coal mining changes year-on-year since jobs are dependent on the amount of coal produced in that year.

Coal Mines (Special Provisions) Act, 2015 revamped the policy from allocation of coal blocks to auctions after the Supreme Court cancelled these coal block auctions in August 2014. In June 2016, the Ministry of Coal released the Common Guidelines for Mine Developer and Operator (MDO) projects guidelines which clarified the Draft Model Contract Agreement (MCA) released in August 2015 allowing state governments, coal companies, and local authorities to engage private companies to develop and produce coal for public sector entities (CIL and SCCL). Further, in June 2018, the Cabinet Committee on Economic Affairs approved the methodology for auctions of coal mines/blocks for sale of coal for commercial purposes. Thereafter, in June 2020, the coal sector in India was liberalised and private players were allowed to auction for coal blocks and sell the coal in the open market.

One of the reasons for the nationalisation apart from the political motivation by the Indira Gandhi-led government (Chandra, 2018) was to increase coal production in the country to meet the development goals of increasing electricity production. This led to a profusion of open cast mining technology over underground mining since it was quick and required lower investments. Moreover, the underground mine fires in Jharia and Raniganj coal fields had also created a sense of mistrust amongst the local population. The changing nature of governance and the technology being used has had a significant impact on the labour force in coal mining. Nationalisation played a vital role in empowering coal labour unions, mobilising different political groups, and increased the inter-dependence between political power and coal mining activities. The 1991 liberalisation resulted in increased hiring of subcontractors and decreasing functions by departments within the coal companies, and therefore a steady decline in the number of formal sector workers. This was further exacerbated post 2000s as the MDO model became more prevalent before it was formalised in 2015.

IMPACT BY NUMBERS

The nature of governance, technology, and role of unions plays a crucial role in the coal economy in India. This has a direct impact on the total number of workers employed in the sector. The total employees engaged in coal mining changes year-on-year since jobs are dependent on the amount of coal produced in that year. This is particularly important while understanding the number of contract or informal sector workers in the sector. From a payroll perspective, employment is divided into three categories: executives, monthly rated, time/piece-rated workers. From a supply chain perspective, profiles are divided into coal mining, overburden removal, ancillary/common activities and executives and supervisors and others. These bifurcations are relevant when understanding the labour dynamics i.e., split of formal and contract workers, between open cast and underground mines as well as dynamics in different subsidiaries.

Technical parameters such as the size of the patch, stripping ratio (ratio of overburden to coal), location and distance of overburden dump sites, location and distance to the crushing plant, use of conveyor belts for crushing, also have an impact on the number of employees as these parameters changes the mining technique and therefore the number of people employed. Open cast mining is carried out using either of the two techniques: a) Surface Miner + Dumper combination b) Shovel + dumper combination. Overburden removal is carried out via the shovel-dumper combination. Other machinery used include payloader/front end loader (based on the capacity of the bucket), wheel dozer, backhoe, dragline, drills, common/ancillary equipment including Motor Graders, Compactor, explosive vans, mobile cranes, water sprinklers, diesel bower, tyre handler, fire tender, maintenance van and ambulance. Underground mining generally uses the bord and pillaring technique. Further the nature of the project, i.e., greenfield block or brownfield expansion also has an impact on the number of workers used. In addition to mine related buildings, a greenfield project

will also include either building or instituting amenities such as the GMP office, site office, town admin office, first aid shelter, rest shelter, toilet facility, canteen, training centre, Pt head bath, substation, community building, officers club, shopping centre, garage, cycle stand, dispensary, bus sheds, workers institute, schools, bank, post office, officers rest house, staff rest house, stadium, library, children's park etc. The construction, building, operation, and maintenance of these is outsourced on a bi-annual basis.

To understand the labour involved in the coal sector, the study applied three different methodologies. The first scenario in figure 8 is based on the ratio of formal to contract workers as provided by the Ministry of Coal in 2019 to a question asked in the lower house of the parliament with appropriate assumptions being made private coal blocks (Ministry of Coal, 2019). The second scenario is based on a bottom up analysis of the coal supply chain activities right until the despatch point. The third scenario is based on stakeholder inputs and based on output per manshift. In the second scenario, assumptions were taken on activities within the coal supply chain which are generally outsourced (overburden removal, transportation within mine boundary, crushing).

Based on the first scenario one would assume that the number of formal sector workers are actually more than contract employees, but conversations with stakeholders and coal labour unions helps us understand scenario two and three. In 2019, the market size of coal mining contractors was in excess of INR 10,000 crores, with 50 per cent of the market being dominated by 5-6 big players like BGR, Sainik, Mahalaxmi, Ambey, VPR, DECO. A KPMG analysis (2019)showed that the average size of the contracts had been increasing since 2012, from ~INR 70 crores to INR 200 crores and that since 2016 more number of medium and large contracts have been awarded.

In 2019, the market size of coal mining contractors was in excess of INR 10,000 crores, with 50 per cent of the market being dominated by 5-6 big players

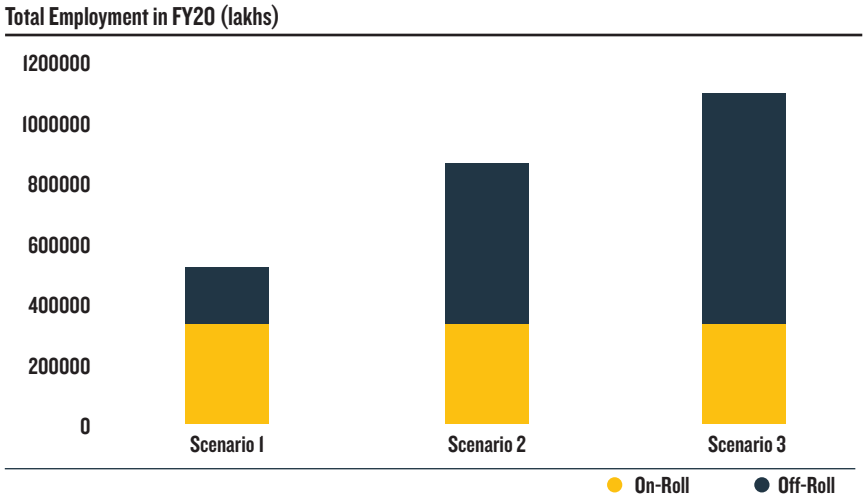


FIGURE 8:
Total formal and contract employees across coal mining and production activities

Source: Authors' analysis

Based on the analysis, inputs from Ministry of Coal, and stakeholder conversations, we observe that the new subsidiaries like MCL have a higher share of contractual workers than older subsidiaries like CCL, BCCL, and SECL. NCL employees almost the same number of formal and contract workers. When it comes to activities, coal mining in NCL big mines is fully done by the department while in all other subsidiaries it is generally split between departmental and contractual with the latter doing the heavy lifting. Overburden removal follows a similar pattern except in some big mines in CCL where it is completely outsourced. Transportation activities within mine boundary is completely sourced across all subsidiaries, while crushing activity is mostly outsourced. Of the 182 underground mines, ECL operates the greatest number of underground mines (51), followed by SECL (49), WCL and SCCL both operate 26 mines with the rest split between the other subsidiaries. This is important since most of these mines barring one ECL mine (Jhanjhar) produce less than 1MT of coal but

employs close to 300-400 workers easily (input based on stakeholder conversation) and are some of the oldest mines in the country. These characteristics along with the fact that most of these mines are unprofitable is the reason that the Ministry of Coal intends to begin shutting them down in the next few years.

The number of coal workers in this analysis does not include the additional workforce that will be used to build aforementioned amenities during a greenfield coal expansion. This number also does not include the number of informal sector workers and their families in abandoned mines or working on village commons bordering mines which according to a coal union leader amounted to about 20 million only in the state of Jharkhand. In addition to this workforce, often end consumers have their own agents at the mine end to ensure coal quality and quantity. In order to ensure materialisation, these active mine managers perform tasks like liaising with the coal company/contractor, road-cum-rail (RCR)/road transporter, handling railway authorities etc. These are dependent on individual end consumers, require local networks and local labour and is difficult to quantify and hence not included in the analysis.

IMPACT BY LABOUR PROFILE

Of the 51 UG mines operated by ECL, most produce less than 1MT of coal (barring Jhanjhar), but employ close to 300-400 workers

In terms of wages, the coal sector outperforms all other sectors consuming coal. This was also validated during stakeholder consultation and from secondary data. The National Coal Wage Board instituted in 1962 is composed of workers and company representatives. This has ensured that coal India workers are generally paid more than workers in other sectors. In almost all sectors, contract workers get paid 1/3rd that of formal workers, but in the coal sector the presence of the national coal wage board, the presence of labour unions as well as the local political economy ensures that all workers are paid similar rates. This is despite the fact that contract workers in coal are not part of the formal labour unions due to fear of repercussions by their employers (job contractors). For instance, the revised wages in 2021 peg contract worker wages to the average Consumer Price Index and ensures that the per day wage for these workers is similar to formal sector workers (table 1). Further, coal is perhaps the only sector which has its own provident fund for retired workers and employees, which is funded by the salaries of existing coal workers and CIL. In terms of work status as well, coal workers, both formal and contract outperform other sectors, with almost 93 per cent working as regular salaried/wage employees. To understand the nature of contracts, we compared the data on job contracts (most of which were unwritten) to the wages. Here we found that despite most contracts being unwritten, the pay scales were similar to those holding contracts of 3+ years.

TABLE 1:
Wages for contract workers between July-December 2020

Employee Category	Basic wages/day (INR)	Variable Dearness Allowance (INR)	Total wages/day (INR)
Unskilled	787	152	939
Semi-skilled/Unskilled Supervisory	817	158	975
Skilled	847	163	1010
Highly Skilled	877	169	1046

Source: (CIL, 2021)

However, working conditions are typically worse off for contract workers than permanent employees. Contract workers (both outsourced as well as MDO workers) typically work for longer hours (two shifts of 10 hours) than company workers (three shifts of 8 hours). The least number of workers are hired in mines operated completely by MDOs, typically private sector mines which also tend to use state-of-the-art technology. Further, while rules suggest that contract workers must be part of the Coal Mines Provident Funds (CMPF), a 2015 study by the Standing Committee on Coal and Steel found that of the 'official' estimates of 64,842 contract workers, 12,000 were not part of the CMPF (Lok Sabha, 2014). Moreover, since contract workers are not a part of the labour unions, they do not have their own representation within the coal community.

Parameters on education, technical, and vocational training mirror broader labour trends. Only 12 per cent of those surveyed have an undergraduate degree while only 3 per cent are qualified beyond that. This is likely to have an impact during the transition since currently any training undertaken on green skilling under the Green Jobs Skill Council through ITIs is applicable for graduate degree holders. On technical training, based on stakeholder conversations we learned that all workers receive on-the-job training for a defined period. Annual reports by different coal companies indicate that they too invest in formal training programmes, but it is difficult to ascertain how many contract workers actually benefit from these programmes in comparison to formal employees. A summary of the results based on the PLFS FY19 data is provided in table 2.

TABLE 2:
Labour profile of workers in the coal sector.

Source: (PLFS, 2021)

Coal Sector Profile		
Age	Mean age	44
	Less than 30 years	21%
	30-40 years	20%
	40-50 years	28%
	More than 50 years	31%
General Education Level	Not literate	9%
	Literate-below primary	6%
	Primary	12%
	Middle	22%
	Secondary	25%
	Higher Secondary	10%
	Graduate	12%
	Postgraduate and above	3%
Technical Education	No technical education	95%
Vocational Training	Received formal training	8%
	Self-learning	4%
	Learning on the job	18%
	Did not receive any training	68%
Work Status	Regular salaried/wage employee	93%
	In other types of work	6%
Type of job contract	No written contract	83%
	I year or less	14%
	I - 3 year	2%
	3+ years	2%
Work status of workers with unwritten contracts	Regular salaried/wage employee	91%
	In other types of work	9%
Wages/month (INR)	Workers	17,799
	Supervisors	41,163
	Executive	68,300

RISK ASSESSMENT

Within coal mining workforce, the share of manpower for dumper truck operation from extraction point to crushing and from crushing to despatch point is at least 35-40 per cent. In order to minimise air pollution, the Ministry of Coal is attempting to mechanise this part of the operation using conveyor belts. In some of the big mines, part of this activity, which is supply to the despatch point is already mechanised. Further, based on stakeholder conversations, we understand that while job contracts last for about two years, the contractors may migrate, but most of the workers do not migrate with the contractor since they belong to the area surrounding the colliery. Workers involved in ancillary activities like building/maintaining a road connecting mine to the despatch point are always outsourced, belong to the surrounding village/district, and are hired on a daily wage basis.

Typically, **every job profile in coal mining sector is under risk. Contract labour will likely be the first impacted, since jobs contracts are tendered based on the amount of coal/overburden lifted during a month (figure 9 and 10). In conversations with coal labour unions, we found that there was an information gap on the issue. Given these discussions happened before the Glasgow announcement, most representatives and workers believed that coal mining was unlikely to end for the next 60-70 years. The mandate given to unions and workers was to increase coal production. When we provided an explanation of the global changes, union workers and representatives stated that contract workers and local communities would be the most impacted, rather than formal sector employees.**

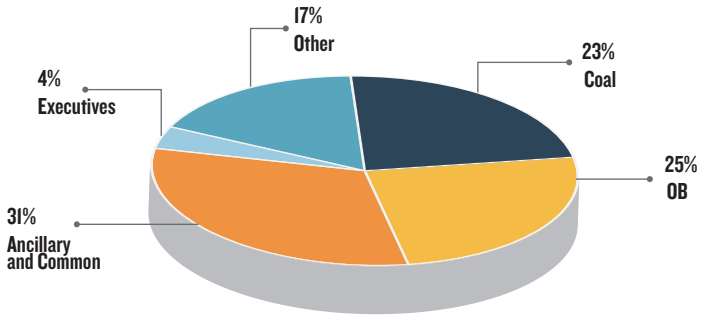


FIGURE 9:
Percentage split between manpower based on activities in an open cast coal mine until the despatch point

Source: Authors' analysis based on inputs from Ministry of Coal and CIL dataset on activity break-up in big and other mines of different subsidiaries

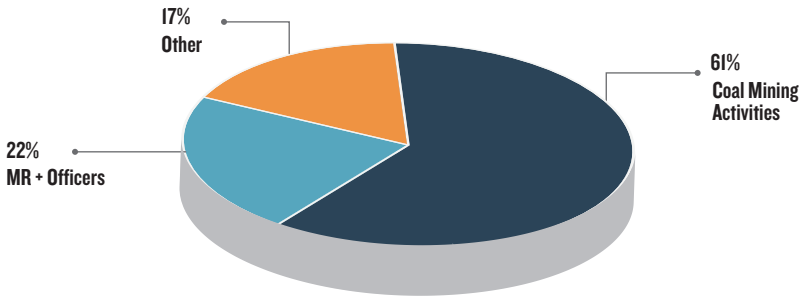


FIGURE 10:
Percentage split between manpower based on activities in an underground coal mine until the despatch point

Source: Authors' analysis based on inputs from Ministry of Coal and CIL dataset on activity break-up in big and other mines of different subsidiaries

NEXT STEPS

In the light of the discussion above, some immediate action points that need to be taken for the sector include:

- **A mine-wise estimate of reserves:** Given a target date of net-zero by 2070 and endorsements on clean technology, typically, the big and other mines which produce the 85 per cent of the coal in the country will likely be the ones running for the next 20-30 years. Most underground mines and rest of mines will likely be shut down within this decade. Preparing a timeline of mine closure will be most effective using the reserve estimates.

- **Analyse the trend of contract workers** in every mine over a five-year period. This will help identify the actual employment provided by the mine in the district/ area. A mine-wise estimate will help quantify and codify contract workers as formal coal transition workers. Job contractors are mandated by law to register their workers with the labour commission

- **Identifying socio-economic characteristics** like age, education, technical qualification of workers in underground mines since they will most likely be shut down earlier. This will help prepare a plan to retire/transition workers. This should

The total number of people employed across major modes for coal transport is ~1,65,000 annually.

be followed by an assessment of workers in rest of the mines since they will be the next ones to be shut down. Here as well, it will be prudent to begin with the mines which are almost exhausted or producing the least amount of coal.

- Based on the socio-economic characteristics, **delineate the extent of financial aid** that will be required in every mine area for retrenchment, early retirement and retraining the existing workforce. This can be useful if India decides to follow South Africa's strategy and seek global aid. At COP26 South Africa sought and will receive an initial amount of USD 8.5 billion from the US, UK, Germany amongst other countries to end its reliance on coal (Mkhize, 2021).

- **Prepare and implement environment remediation:** While a 2012 guideline (Ministry of Coal, 2012) document on mine closures has been notified by the Ministry of Coal, this is no evidence that this has actually been implemented in practice. Between 2008 and 2018, 123 collieries owned by CIL and SCCL have been shut down. However, there is little evidence of a robust transition in these areas.

COAL TRANSPORT

Transport from the despatch point occurs via road, railways, merry-go-round (MGR) and belt (figure 11). Barring NCL, SECL, and CCL, more than 60 per cent of the despatch takes place via railways. In NCL, most of the despatch happens via MGR, in SECL by road, and in CCL it is evenly split between rail and road. **The total number of people employed across major modes for coal transport is ~1,65,000 annually.**

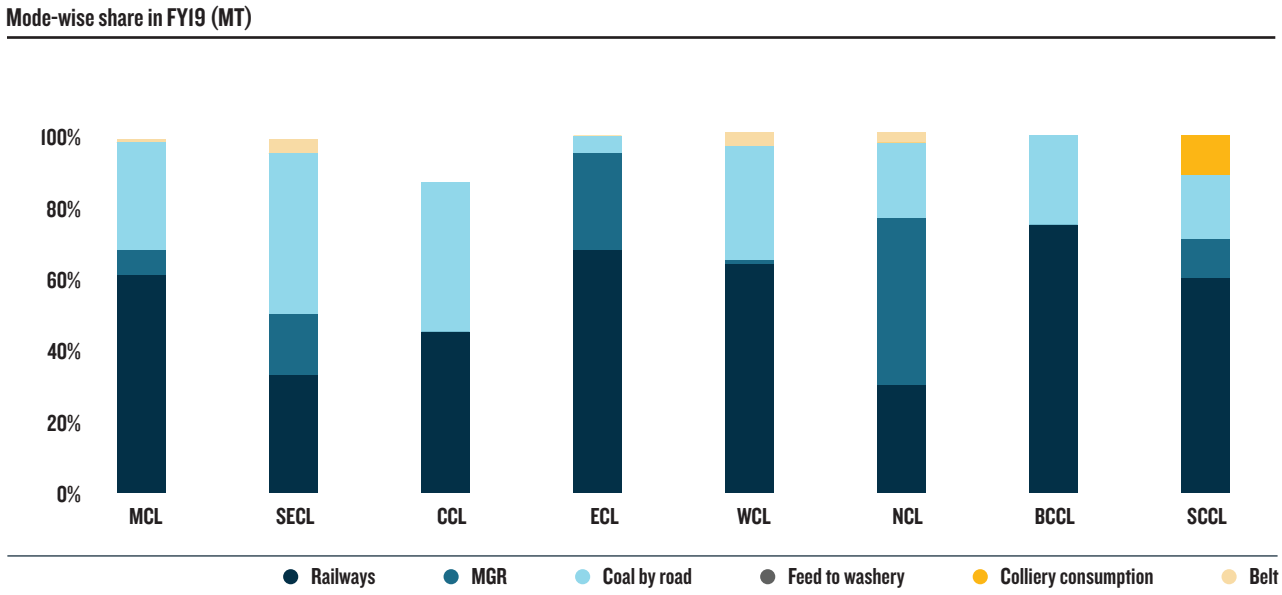


FIGURE 11:
Mode-wise share of coal transport by different subsidiaries in FY2018-19

Source: (CCO, 2020)

IMPACT BY NUMBERS

Road Segment

Most road transport for coal generally takes place within a radius of 100 km from mine to the end consumer plant using 16-20 tonne tippers. This was verified by the authors through stakeholder consultations as well as an Origin-Destination exercise carried for all CIL subsidiaries using data available on via a billing portal by the company (CIL, 2019). The study further assumed that coal was loaded in these tippers using payloaders. Based on these assumptions, the total number of tipper and payloader operators required in a year was close to a lakh (Figure 12). While road transport does not constitute a major mode share across most subsidiaries, it is still the highest employer within this part of the supply chain. The estimate of ~1 lakh workers is based on highly optimised journeys. There is also some coal that travels a distance of more than 400-500 km. This is generally used for the brick sector. However, the percentage of this coal as a portion of total coal travelled by road is not very high. The truck segment also earns supplementary income for people living in coal belt. Typically, relatively well-off households buy trucks and lease them to contractors on a monthly basis. This model of operation is seen across all mining belts and is not exclusive to coal mining.

For a few years (between 2013-2018), the share of coal being transported by road had seen an increase as a result of delays on wagon loading/rake unavailability. Further, until a siding or a new line is built and integrated at colliery end or the end consumer plant, coal is transported under a Road-cum-Rail (RCR) arrangement. These arrangements can be temporary in nature until the siding comes up or can be permanent with part load transported via rail and part transported via RCR. The temporary nature is a challenge in estimating the exact number of workers employed in coal transportation by road since it varies on a year-to-year and case-to-case basis. Further, while most of the imported coal is used for power plants which are based on the coast, some thermal units and steel plants using coking and non-coking coal also transport coal by road. However, without adequate data it is impossible to assess the total number of workers employed here.

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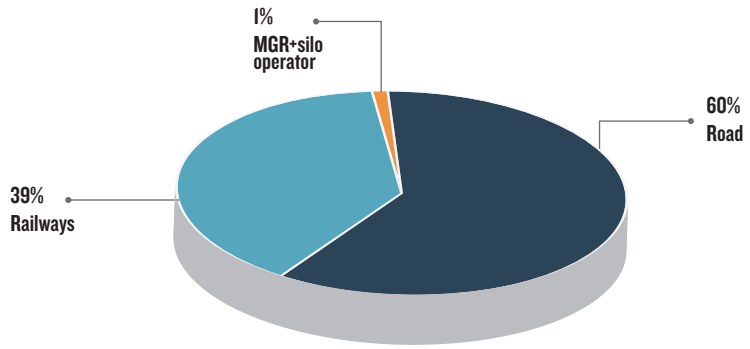


FIGURE 12:
Contractual employment across different modes of coal transport for the year FY2018-19

Source: Authors' analysis using transport estimates from (CCO, 2020) and (IR, 2019), and various mining plans

Rail Segment

There are two different types of workers involved in coal transporting via railways. One is on the railway side and the other is on the coal company and end consumer side. This analysis only includes those on the loading (i.e., coal company end), since the unloading end is covered on the industry side. There are two different methods of loading coal into wagons. One is via silo loading and the other is payloader loading. In big mines like a few at NCL or MCL, rapid silo loading systems have been initiated where in 58 wagons (1 rake) are loaded in 2-2.5 hours. If the wagon loading time is short then engines are attached to the wagons for pulling them ahead, if the loading time is longer, then engines are detached. Ideally, there are 6 silo operators/control room and if the rake hauling is contiguous then this number increases to 12 operators.

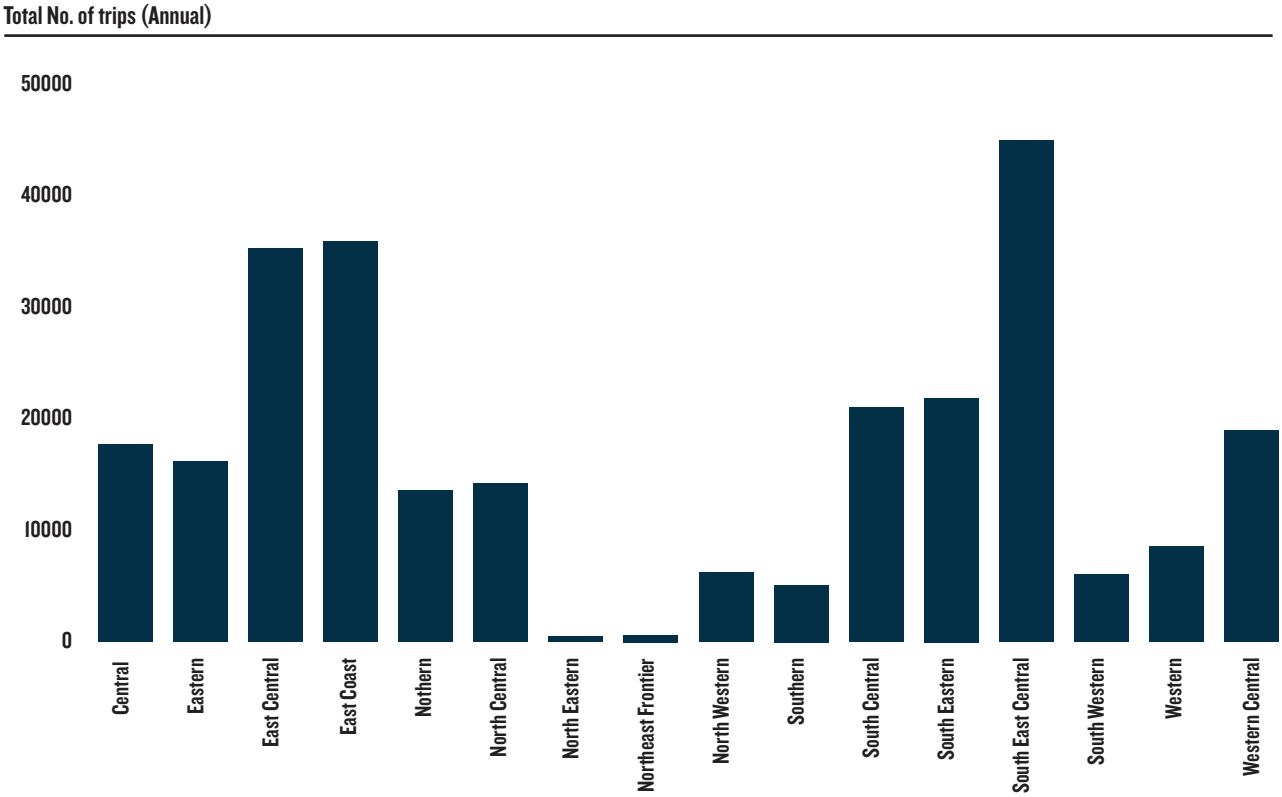
The total number of workers in coal transport activities from the railways side is ~65,000, which is 5 per cent of the railway labour force accounting for ~44 per cent of freight revenues

In small mines, the loading process is done using tippers and payloaders. Here, the tipper brings the coal to the railway siding and payloaders load each wagon Manual loading has now been eliminated in India. Payloader loading again depends on the availability of coal, availability of wagons and engines. Stakeholder consultations suggest that there are sidings where payloader with bigger bucket capacities can load 4-5 rakes within 48 hours. This operation typically comes under the purview of the coal companies and is outsourced. The box below (figure 14) presents a model contract for NTPC's captive block Pakri Barwadih which includes activities like cleaning rail tracks, water sprinkling, operation, and maintenance, etc. in addition to loading activities. The numbers on coal loading assessed in this analysis are therefore on the conservative side since they only include loading activity by payloaders. In addition to this, there are about eight-ten people involved in supervision, helpers etc.

On the railway end, workers directly employed in coal transportation include a driver, assistant driver, and a guard. In addition, at the siding, railway employees also include a traffic supervisor, panel operators (including leave reserve), operating assistants, S&T maintainers, and helpers. Therefore, direct coal employment, i.e., rake hauling operations is only about 13100 or ~1 per cent of the total railway workforce of 12.70 lakh employees. There are about 3779 sidings coal sidings and good sheds in India which account for ~52000 employees in indirect coal management. Taken together the total number of workers employed in coal transport activities from the railways side is ~65,000, which is 5 per cent of the railway labour force. It is this small percentage of the workforce which accounts for 44 per cent of Indian Railways freight revenues and an even higher share of its profits (Kamboj & Tongia, 2018). Three divisions, namely, South-East Central, East Coast and East Central encompassing the states of Chhattisgarh, Madhya Pradesh, Maharashtra, Odisha, Andhra Pradesh, Bihar, Jharkhand, Uttar Pradesh, account for 60 per cent of the traffic and close to 45 per cent of trips annually (figure 13). This also coincides with states with the greatest number of coal mines, thermal power plants, and iron and steel plants.

FIGURE 13:
Total number of trips for coal transportation by railways in FY19

Source: Authors' analysis based on transport data from (IR, 2019)



MGR Segment

The MGR network typically runs for a distance 25-50 kms from the despatch point at the colliery to the unloading point at the end consumer. These networks are generally used by pithead thermal plants, especially those which are run by NTPC. The network employs ex-railway drivers and guards and silo operators. For the purpose of this analysis, it is assumed that the coal transported by MGR is loaded using silos (Figure 12).

RISK ASSESSMENT

The biggest segment at risk is the road transport sector. This segment is typically outsourced at all subsidiaries. It employs local labour, is highly disaggregated, and does not have union representation. Not just direct drivers, but even local people who earn supplementary incomes are at risk. A case study of Keonjhar is instrumental in understanding this fallout better, where a supreme court order to ban iron ore mining in the region resulted in loan defaults and debt traps for poorer households who had brought trucks believing the iron ore boom would continue for a long time (Rajshekhar,

FIGURE 14:
Domestic Competitive bidding contract by NTPC for its captive coal mine

Source: (NTPC, 2018)

A Model Job Contract (based on an actual tender)

1 The following terms shall have their meaning throughout the contract as explained below:

EQ:
The Eastern Quarry of Pakri Barwadih Coal Mine, Barkagaon, Hazaribagh, Jharkhand,

Siding:
The northern side of Banadag Railway Siding, Hazaribagh of ECR or as indicated by EIC.

Weighbridge:
The Weighbridge installed at the siding as above

2 Loading of coal into Tippers by mechanical means from coal stock at EQ.

3 Transportation of coal up to Siding through the route directed by EIC from time to time depending on the site conditions.

4 Loading of coal into the railway wagons by pay loader of minimum capacity of 03 cubic meters or other HEMM of higher capacity and other allied jobs at the siding like

- Lime sprinkling on coal after leveling of coal loaded in wagons and doors Gutka fitting,
- Cleaning of rail tracks,
- Installation, operation & maintenance of DG set (Min 10 KVA, Silent Type)
- Maintenance of lighting at siding,
- Power to weigh bridge, assistance in periodic stamping and maintenance of weigh bridges,
- Stacking and shifting of coal if required,
- Maintenance/repair of shared coal transportation route as per discretion of EIC,
- Water sprinkling and dust suppression arrangement all along the shared coal transportation
- route as per discretion of EIC & siding,
- Security against theft and
- Any other related job in the siding, if any, as directed by the EIC.

As of June 2020, Coal India was investing in increasing the capacity of Coal Handling Plants (CHPs) with silo loading from 151 MT to 557 MT by 2023-24

2015). Even before the net zero target of 2070, new norms by the coal ministry which suggest coal companies increase the use of conveyor belts for distances between 10-50 km already threatened livelihood opportunities for truck drivers (Kapoor & Dinesh, 2020). The net zero target will begin the process of reducing coal consumption as well as shutting coal mines, and truck drivers who are paid on a daily/piece rate basis will be impacted. Transition to other jobs in coal districts may be possible for this segment given the ubiquitous nature of the driving, but these jobs will be hard to come by without a proper transition planning.

Within the railway segment, workers involved in payloading activities and those that manage sidings based on contracts from coal companies are likely to be the next impacted category. As of June 2020, Coal India was investing in increasing the capacity of Coal Handling Plants (CHPs) with silo loading from 151 MT to 557 MT by 2023-24 (PTI, 2020). This coupled with mine closures will slowly and steadily eliminate the need for payloader and operators at wagon loading points. Moreover, over the past decade the Indian Railways has been optimising siding operations. Mine closures will result in additional closure of sidings and the employment which comes along with it unless other industries are brought to the region which utilise the network.

Railway employees as a segment won't be immediately impacted. Given that all employees who are directly and indirectly involved in the coal transport activity belong to the railway union, it is unlikely that they will lose their work. In fact, during conversations with stakeholders before the Glasgow announcement, it was expected that coal traffic transported by railways will increase in this decade with the initiation of the east and west Direct Freight Corridor (DFC). Therefore, stakeholder believed that despite expected mine closures, traffic, and employment i.e., the total number of hours that a driver needs to accumulate in a year would not be impacted. Post COP26 announcement, the impact on railways remains to be seen. Given the share of coal as a percentage of its freight revenues and profits, the transporter will need another business model if it continues to subsidise passenger traffic. It is unlikely that demand will decrease immediately, but the next few years are crucial for the railways to plan for a post-coal future. Another point of worry is the revenue model for the DFC. The corridor has been in construction for a while now (more than 10 years), and it was being built to ease the congestion on the trunk lines and hasten transportation of freight, a lot of which is coal freight. This decrease and finally loss of coal must be factored into the revenue model going forward and other policies will have to enacted that makes container freight more attractive by railways instead of road, unlike what is being seen presently.

The MGR network will probably be the least affected segment given that it serves pithead plants or units in the radius of 25-50km. This is likely to see closures at the very end.

NEXT STEPS

In the light of the discussion above, some immediate action points that need to be taken for the sector include:

- For the truck segment, the next steps are more or less covered under the coal mining category. Perhaps it might be useful to identify the extent of debt amongst households in the district on HEMMs (trucks etc). This will have to be added to the financial cost of transition, since eventually it may lead to a payoff.
- For Indian Railways, there is a need to diversify its revenue sources. It is also imperative that they be a part of the mine closure roadmap, since closures will have a direct impact on the railway staff in coal bearing divisions.

POWER SECTOR

Coal thermal power plant dominates the Indian power sector both in terms of installed capacity (53 per cent) and in terms of generation (78 per cent) (CEA, 2021). Uttar Pradesh (28 units), Maharashtra (21 units), Madhya Pradesh (20 units), and Chhattisgarh (22 units) are states with the highest coal plant units. However, in terms of installed capacity, Gujarat, Andhra Pradesh, and West Bengal join these four states in having more than 10GW of capacity (figure 15). In terms of age, state sector plants are some of the oldest plants while private sector plants (many of which are stranded) are the new plants (figure 16). Captive thermal plant capacity (1 MW and above) is ~54 GW.

A number of studies (Ganeshan & Danwant, 2021), (Prayas (Energy Group), 2021) have assessed the pros and cons (improving overall efficiency, quantum of savings etc.) of retiring older plants which are also inefficient. India may not shut down older plants immediately, but environmental, and now climate drivers (net zero announcement) is likely to see planned shutdowns in this decade or early next decade, as states fulfil their increased renewable capacity obligations.

FIGURE 15:
Distribution of thermal power plant units by sectors and states

Source: (Annual Survey of Industries , 2018), (CEA, 2020)

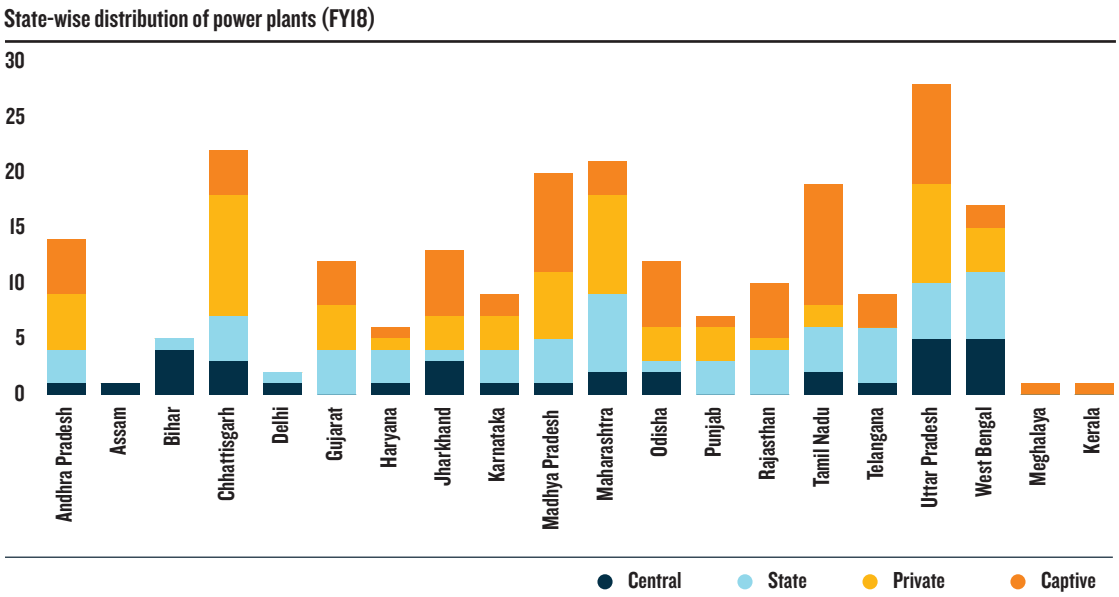
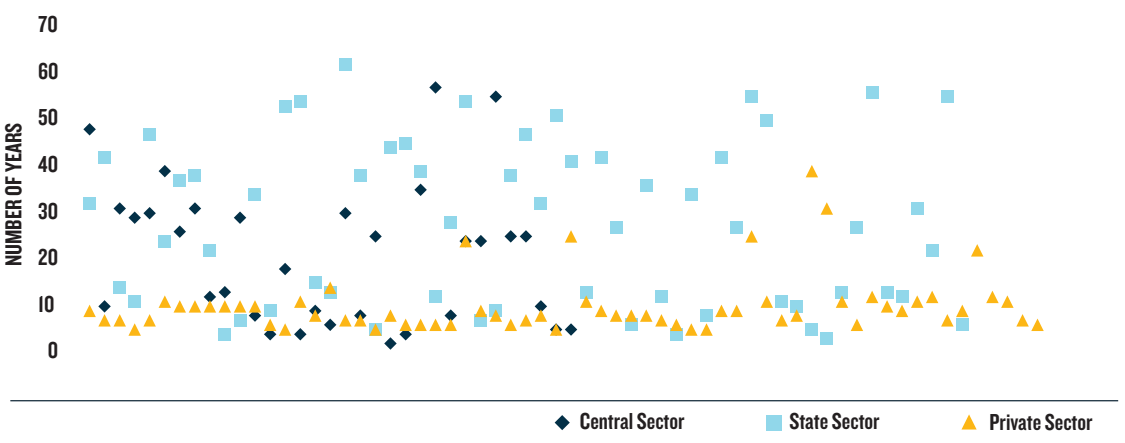


FIGURE 16:
Age of the Indian thermal power fleet in 2018

Source: CEA, 2019



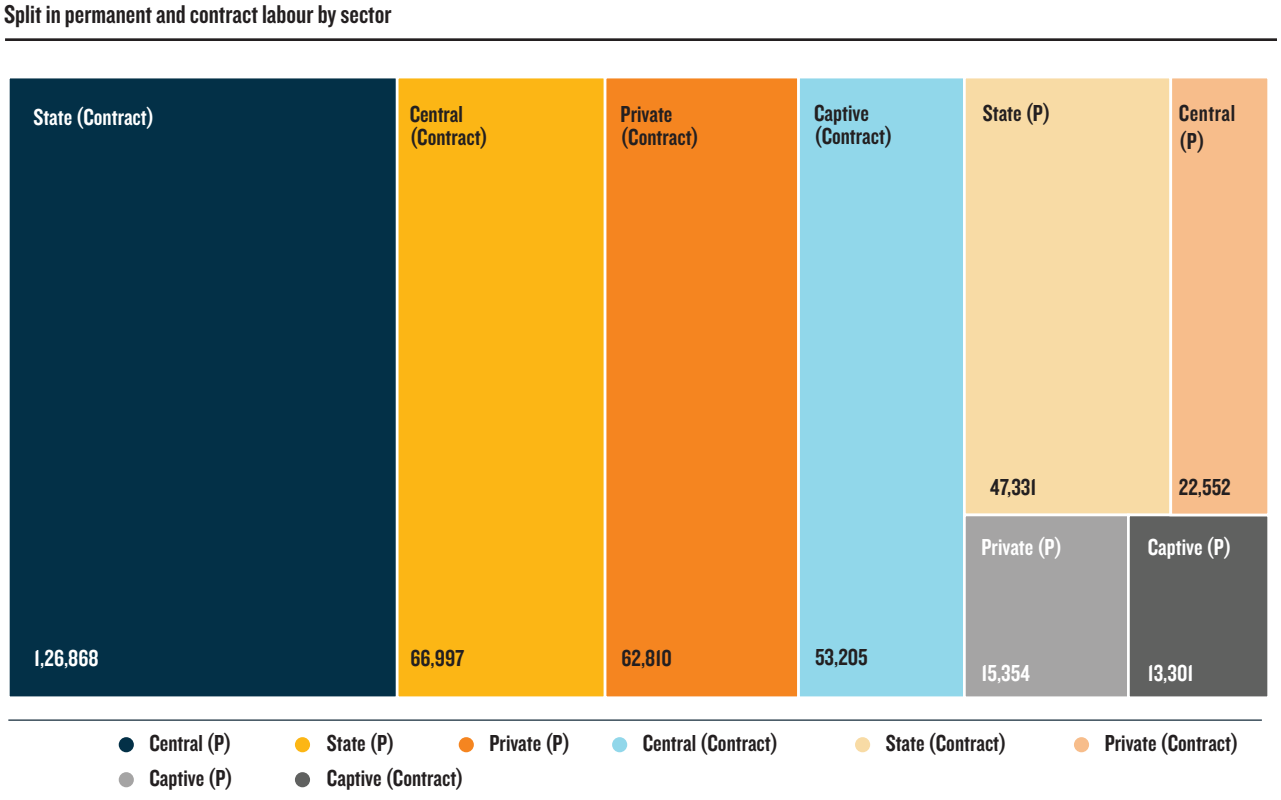
IMPACT BY NUMBERS

As with the coal sector, the general trend of the industry has been towards reduction of on-roll jobs and an increase in off-roll jobs, even in SOEs like NTPC. For instance, despite adding 17GW of thermal capacity since 2008, the number of on-roll employees at NTPC actually declined from ~23600 to ~19000 in 2018 (NTPC, 2018). Given that companies only account for on-roll employees, the overall man-MW ratio is much higher in private generation companies (~0.14) in comparison to SOEs like NTPC (0.44). This ratio in state sector plants depends on the state, size and efficiency of the fleet, prevalence of alternate energy sources, and the political economy within the state. For example, states like Uttar Pradesh and Madhya Pradesh have a very high man-MW ratio (1.18 and 0.85 respectively), while Karnataka is much closer to NTPC at 0.45 (Yeramaras TPS brings down the overall average as per official numbers) (KPCIL, 2021).

Stakeholder conversations and data from private plants have supplemented the manpower assessment to help us identify contract labour. On an average, for every formal employee there are about 2-3 contract labours on the plant sites. If one were to go by Government of India data, in NTPC in 2017, there were 17713 contract workers employed across all the company plants (Rajya Sabha, 2017). That is for every formal employee there was almost an equivalent contract employee, engaged in core jobs incidental to the business and non-core jobs housekeeping, horticulture, security, canteen, transport services, miscellaneous civil maintenance works, maintenance of office equipment. These numbers are considerably higher in private generators where most of the labour is outsourced.

FIGURE 17:
On-roll and off-roll employees in central, state, private and captive power generators

Source: Authors' analysis based on unit data from (CEA, 2020)



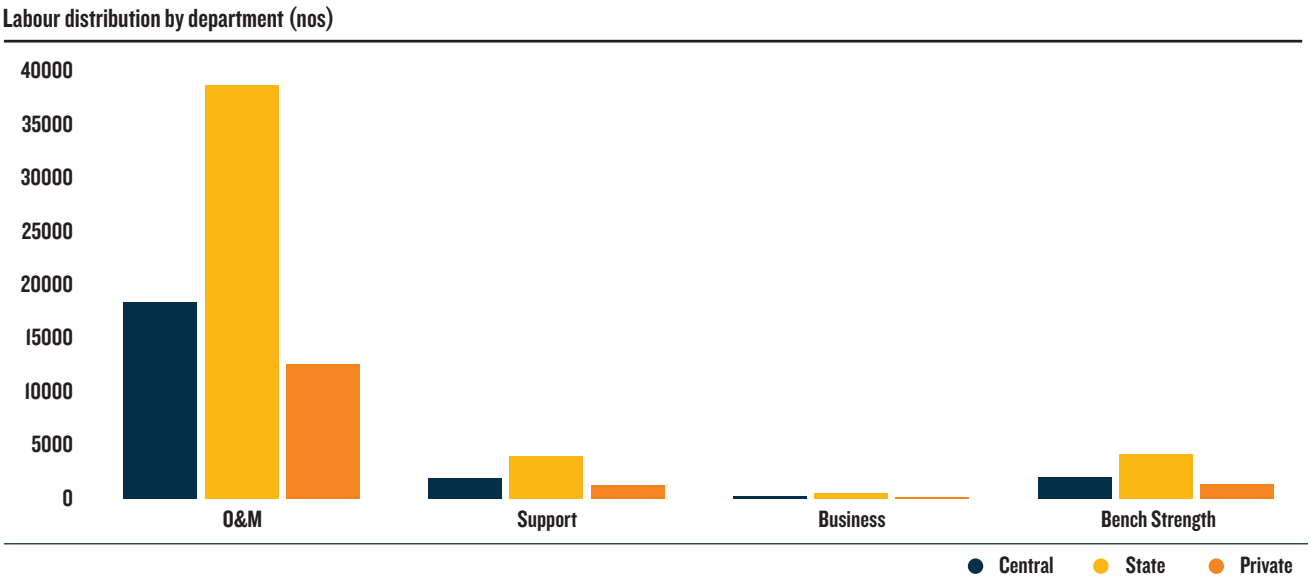


FIGURE 16:
Labour distribution by job profiles across the thermal power sector based on actual plant level data

Source: Authors' analysis based on unit data from (CEA, 2020), data from a private generator, and stakeholder consultations

Based on these conversations and data points, we determine that **there are ~4.08 lakh people employed in the power sector, of which only 24 per cent are on-rolls, the rest are off-rolls (figure 17).** State plants are the largest employers in this sector, while optimisation and increased efficiency at central plants have reduced the numbers down almost to the those of private generators. As an aside, the Working Group on Power for the 12th plan had projected manpower of ~8.30 lakhs for a capacity of 206 GW, more or less double of the existing labour force for the same capacity (Ministry of Power, 2012). In terms of job profiles split, the maximum workforce is involved in O&M activities which also typically coincides with profiles which are outsourced (figure 18). This includes profiles like Station Director, Head O&M, Efficiency, Operation, Chemistry, Head Maintenance, Electrical Maintenance, Mech. Maintenance, C & I Maintenance, CHP & OLC, Coal Handling Plant (CHP) Mine End, Ash Handling Plant (AHP), Maintenance Planning, Quality, OHS, Technical Services and Civil Maintenance. Of these, the labour involved in Operations, CHP and AHP constitute about 70 per cent of the workforce in O&M, all of which are under risk as coal consumption decreases even before the plant shuts down.

IMPACT BY LABOUR PROFILE

Labour in the power sector is predominantly in the semi-skilled and skilled category. This is also reflected in the general education levels with maximum workers holding graduate and post graduate degrees. For instance, a high pressure welder is considered as a skilled/semi-skilled worker because he/she has been working in this profile for the past 7-8 years and most likely comes from an ITI background. In comparison to other sectors, power plants have a relatively higher number of employees with some level of technical background with low proportion of unskilled labour. Unskilled labour is predominantly used at the CHP facility to manage coal movement from the unloading point within the plant.

In terms of contract, most workers hold a 3+ year contract, including those who are contract labourers. Permanent employees work over 3 shifts but contract labourers, mostly work between 8am-7pm time schedule. Hence contract workers don't necessarily work for 3 shifts despite being larger in number to permanent employees. Even in terms of wages, the sector is the second highest paymaster after the coal mining sector.

There are ~4.08 lakh people employed in the power sector, of which only 24% are on-rolls, the rest are off-rolls

TABLE 3:
Labour profile of workers in the coal sector.

Source: (PLFS, 2021)

Power Sector Profile		
Age	Mean age	40
	Less than 30 years	25%
	30-40 years	26%
	40-50 years	31%
	More than 50 years	19%
General Education Level	Not literate	8%
	Middle	15%
	Secondary	10%
	Higher secondary	16%
	Diploma/certificate course	14%
	Graduate	27%
	Postgraduate and above	7%
Technical Education	no technical education	75%
Vocational Training	Received formal training	12%
	Self learning	2%
	Learning on the job	11%
	Did not receive any training	75%
Work Status	Regular salaried/ wage employee	94%
	In other types of work	4%
Type of job contract	No written contract	59%
	1 year or less	35%
	1 - 3 years	3%
	3+ years	3%
Work status of workers with unwritten contracts	Regular salaried/ wage employee	89%
	In other types of work	11%
Wages/month (INR)	Workers	12,416
	Supervisors	40,943
	Executive	87,143

Shutdowns planned or otherwise in districts with coal mines will cause economic and social upheaval in districts, particularly if they are likely to shut down as well

RISK ASSESSMENT

If we compare the age of the fleet, coupled with retirement plans, then employees in the state sector will likely be the first affected due to the impending coal transition. Moreover, **shutdowns planned or otherwise in districts with coal mines will cause economic and social upheaval in districts, particularly if they are likely to shut down as well.** For example, Umaria in Madhya Pradesh has a capacity between 1-5 GW which is older than 25 years and a coal mine which produces less than 1MT. Two districts in West Bengal, namely Birbhum and Purulia have thermal power plants aged between 15-25 years and mines which produce less than 1MT. Therefore, shutdowns of either or both of these sectoral assets will likely have a larger consequence on the livelihood opportunities in this district without advance and adequate planning. **The labour involved in Operations, CHP and AHP constitute which constitute about 70 per cent of the workforce in O&M are under immediate risk as coal consumption decreases even before the plant shuts down. Incidentally these are also operations which have been outsourced to job contractors and are predominantly held by contract labour.**

Unlike mine closure guidelines, **the framework for power plant decommissioning did not exist before 2021.** A National Green Tribunal (south bench) directed the MoEFCC and the CEA to constitute a joint committee to prepare guidelines for decommissioning process (Environmental Guidelines for Decommissioning a Coal/Lignite-Fired Power Plant (Draft), 2021). These draft guidelines list measures for environment remediation including water, air, hazardous and other wastes, ash management, toxic materials etc. The impact on workers and their livelihoods is still not been discussed.

In our conversations with stakeholders (held before the COP 26 announcements), despite calls for coal plant shutdowns, participants believed that thermal power plants will continue for the next 20 years and therefore reskilling, or retraining was not needed immediately. Moreover, **ongoing retraining/reskilling programmes do not identify labour mostly likely to be impacted due to plant shutdowns.** Generic and entry level education are indicated for the training programs. No assessment has been done with respect to the education level of coal or thermal power-based workers at individual plants to gauge the extent of reskilling/retraining required. Therefore, while these programmes are ongoing, it is not targeted towards existing employees, but rather towards new employees who are ITI holders at the least.

NEXT STEPS

In the light of the discussion above, some immediate action points that need to be taken for the sector include:

- The first step towards a smoother transition should be to **identify plants which are likely to be shut down in this decade**. Germany for example is holding auctions whereby plant owners are incentivised to shut down a plant earlier. This has to be **coordinated with mine closures timetable,** a closure of both assets in the same or nearby districts is likely to impact economic parameters for the district and households within the district.

- Workers, unions need to be a part of this conversation. Without their inputs, it is unlikely that the transition will be smooth, and their involvement will also mitigate fears of job loss.

- Thereafter, it is necessary to **categorise the age, skill level, and other socio-economic parameters** of workers within these plants. This will help identify workers who can be provided with early retirement packages, those who will need to be transitioned to other local power plants and those who may be retrenched.

- This assessment will need to include contract workers since they are about 70 percent or more of the workforce in the plant. If there is no external mandate, then it is likely that job contractors will move on, leaving contract labour stranded in the district.

- **The sites of these plants will need investments for environment remediation and land rehabilitation**, especially at the CHP and AHP sites (ash ponds, coal storage areas etc.) before they can be utilised for other economic activities. It is necessary to assess these individual areas, analyse the necessary investment, demarcate finances, and identify appropriate funding sources. While the NGT order and the resultant draft guidelines provide a framework, these are yet to be approved. Moreover, these guidelines do not include impact on livelihood.

- At a minimum just these few steps are likely to take a decade to materialise. Therefore, even if India and the power sector does not expect early retirements, it will be imperative to begin the process of transition planning today.

Ongoing retraining/ reskilling programmes do not identify labour mostly likely to be impacted due to plant shutdowns.

IRON AND STEEL

India is the third largest steel producer in the world with the sector contributing more than 2 per cent to the country's GDP. The country's per capita steel consumption (61 kg) is much lower than the world average (208 kg) (Ministry of Steel, 2017). Crude steel is produced via three routes, namely Blast Furnace/Blast Oxygen Furnace (BF-BOF), Induction Furnace (IF), and Electric Arc Furnace (EAF). Of these, BF-BOF plants are large integrated steel plants with an aggregate capacity of 138 MT, producing about 45-50 per cent of the total crude steel in India. However, unlike other large steel producers, the Indian steel industry has a large number of smaller steel producers who utilise sponge iron, melting scrap and non-coking coal for steel making. In this analysis, these are categorised as plants with only furnace (~34 MT), integrated plants using sponge iron under the Direct Reduction Iron (DRI) or EAF route (~81 MT), plants which only produce sponge iron (~15 MT), and plants with only EAF (~7.7 MT). In all, there are 1387 iron and steel plants or 1526 units in India that produce crude steel (table 4). A chief characteristic here is that most plants in India have a capacity of less than 1 MT. Further in the sponge iron sector, only 15 of the 199 plants have a capacity of more than 1 lakh tonnes.

TABLE 4:
Iron and steel plants by technology and unit sizes

Source: (JPC, 2021)

No. of plants by size and technology			
	>10MT	1-10MT	<1 MT
BF/BOF	3	15	45
Induction Furnace	0	0	966
EAF	0	2	38
Integrated DRI	1	11	107
Sponge Iron plants	0	0	199
Total	4	28	1355

A state-wise distribution of plants by technology and units shows that the states of Chhattisgarh (160), Jharkhand (139), Odisha (176), Punjab (121), West Bengal (135), and Tamil Nadu (121) have over 100 iron and steel units (figure 19 and 20). The presence of iron ore and coal mines in the first three states is a large contributing factor to the presence of the iron and steel industry here. Punjab has the highest number of induction furnaces (116), followed by Tamil Nadu (110), most of which are less than 1 lakh tonnes per annum. A thriving auto industry and the clusters which make spare parts for the industry is one of the contributing factors for the large number of units in these states.

The states of Chhattisgarh (160), Jharkhand (139), Odisha (176), Punjab (121), West Bengal (135), and Tamil Nadu (121) have over 100 iron and steel units

A financial assessment by Hall et, al. (2020) showed that the sector had been performing poorly in terms of average profit margins and interest coverage ratio, despite a high investment intensity (net capital formation over total revenues). The authors concluded that the sector is financially fragile, with narrow profit margins, increasing interest burden, highly cyclical, and dependent on the international markets (particularly developments in China). This makes large and risky investments a challenge in the sector. The structure of the sector in terms of unit sizes and capacities strengthens this assessment given that 98 per cent of the firms have a capacity of less than 1 MT. Within the sector these are classified as medium and small scale enterprises (MSMEs), although if one is to judge by turnover, these cannot be classified as MSME units.

FIGURE 19:
State and technology wise distribution of iron and steel units in India in 2018-19

Source: (JPC, 2021)

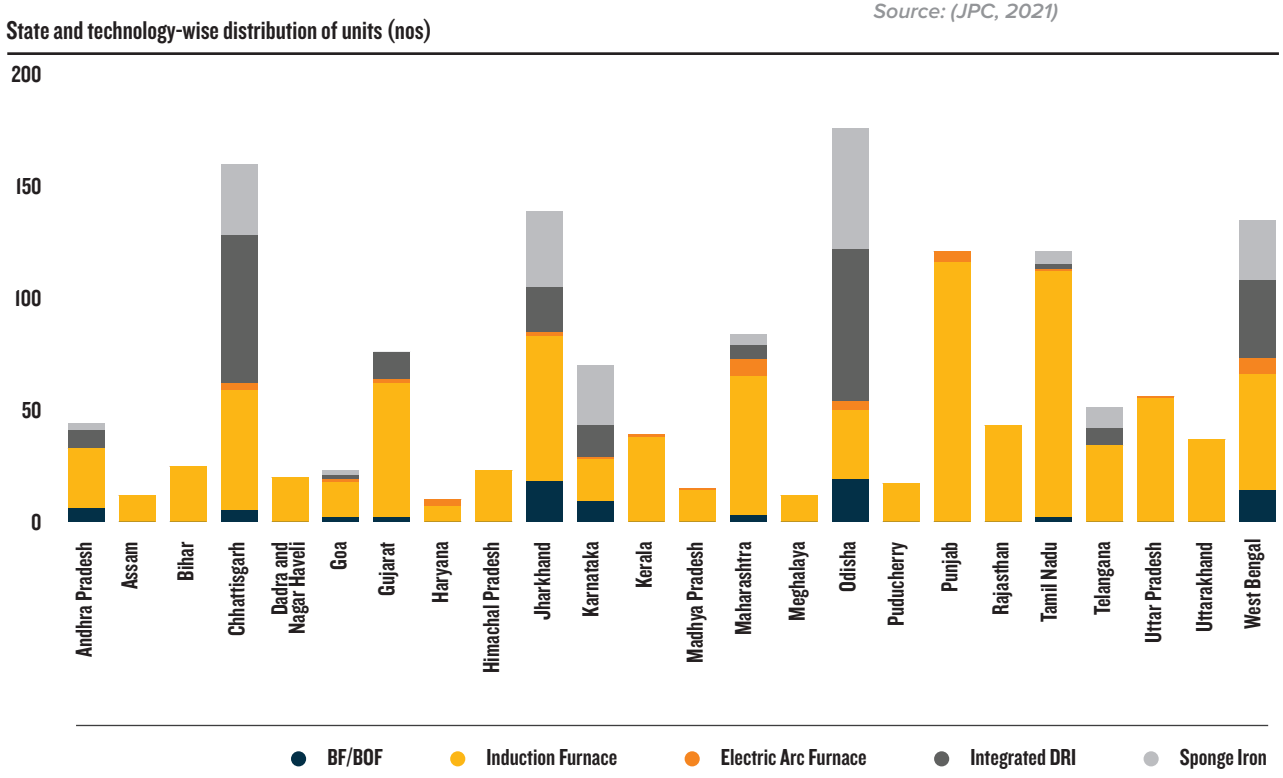
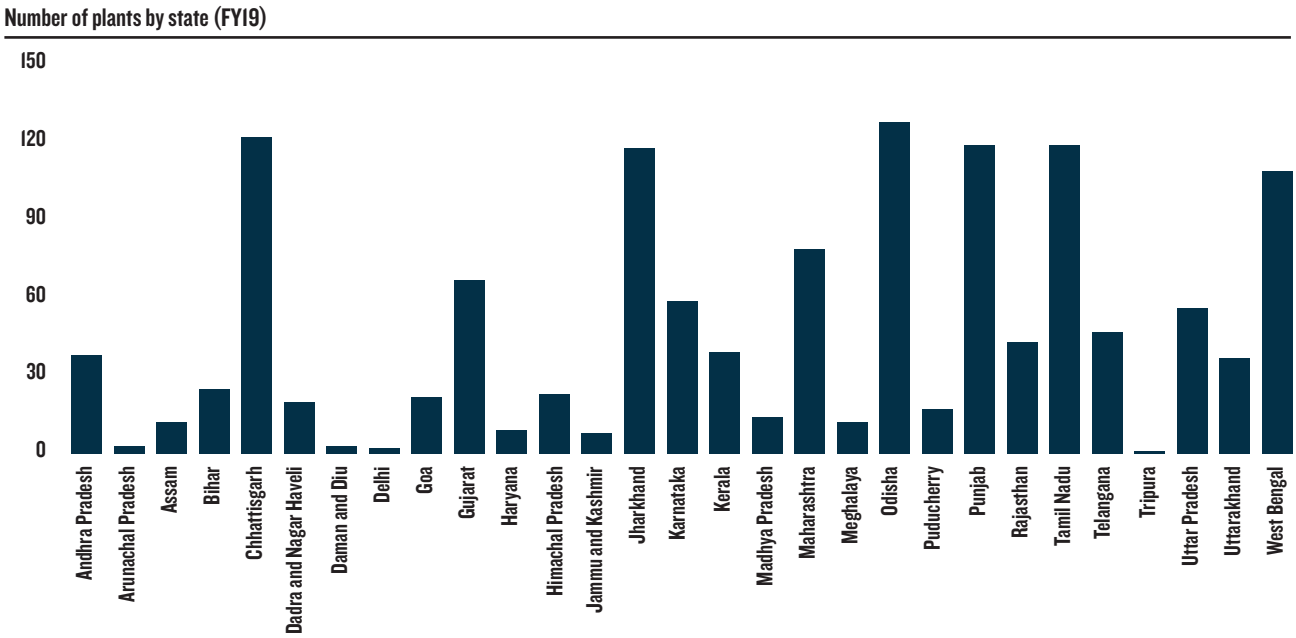


FIGURE 20:
Number of sponge iron and steel plants for crude steel manufacturing across India

Source: (JPC, 2021)

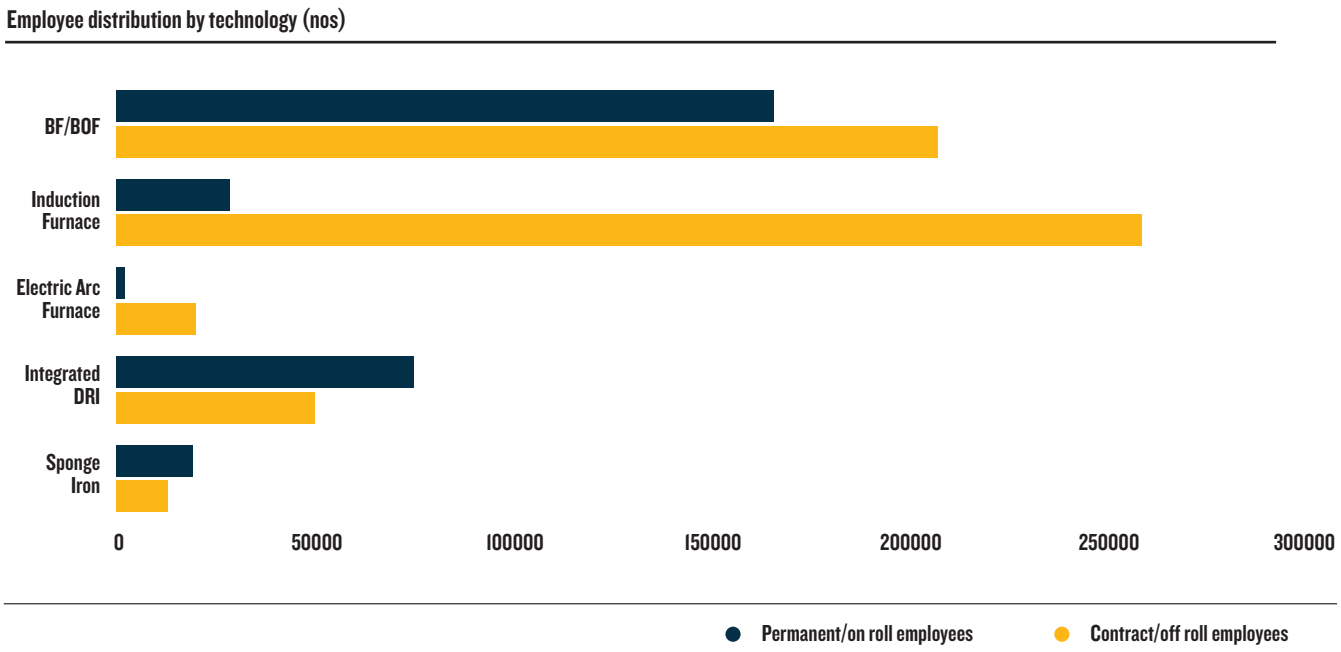


IMPACT BY NUMBERS

Labour distribution is therefore impacted by the structure of the sector. On an average the sector employees ~8,41,000 formal and contract workers (figure 21). We have only estimated the people needed to produce crude steel at individual plants. The analysis does not include the labour involved in iron ore mining and transportation or processing of crude steel, given the subject is dealing with coal transitions. If one were to include those, then the total number of workers would be well above 15 lakhs. The type of technology and the size of the plants has an impact on the kind of labour in the industry. The induction furnace segment characterised by small firms has a higher share of contract workers than other plants. A sponge iron plant will see higher indirect employment as compared to other technologies since the number of raw materials required is higher. Integrated DRI plants generally tend towards automation and therefore have a lesser share of employees (15 per cent). BF-BOF plants by virtue of their capacities have the largest share of employees in the sector (44 percent), followed by IF plants (34 per cent).

FIGURE 21:
Type of employees in the iron and steel sector divided by technology

Source: Authors' analysis based on unit level data from (JPC, 2021) and stakeholder consultations



On-roll employees in a DRI generally work in process in-charge, shift in-charge, laboratories, mechanical strippers, automobile feeding, admin staff, storage, raw material side supervisors and managers, and other employees at the executive level. Contract workers are generally engaged on the coal and other raw material handling end. At an induction furnace, the maintenance is undertaken by the on-roll employees, but activities like slag removal, melting, etc. is undertaken by contractual labour. There has been increasing trend towards contractual labour in BF-BOF plants, particularly on with SOEs. Most private plants tend to outsource operation and maintenance, coal, and other raw material handling facility. This trend is catching on within SOEs as well.

In terms of skillsets, the share of unskilled labour is minimal across different technologies in the sector. Based on stakeholder consultation, we identified that at an aggregate level, 60 per cent of the labour is generally skilled, 25 per cent is semi-skilled and 15% unskilled labour. This share increases in integrated BF/BOF and DRI plants (figure 22). One of the many reasons is because of progression within the industry. A labour union representative informed us that if a worker enters the steel industry to work at a blast furnace for the first time, they will be categorised as unskilled. After training and working at the furnace for ~2 years, the worker will be classified as a semi-skilled worker and after another 2-3 years he/she is classified as

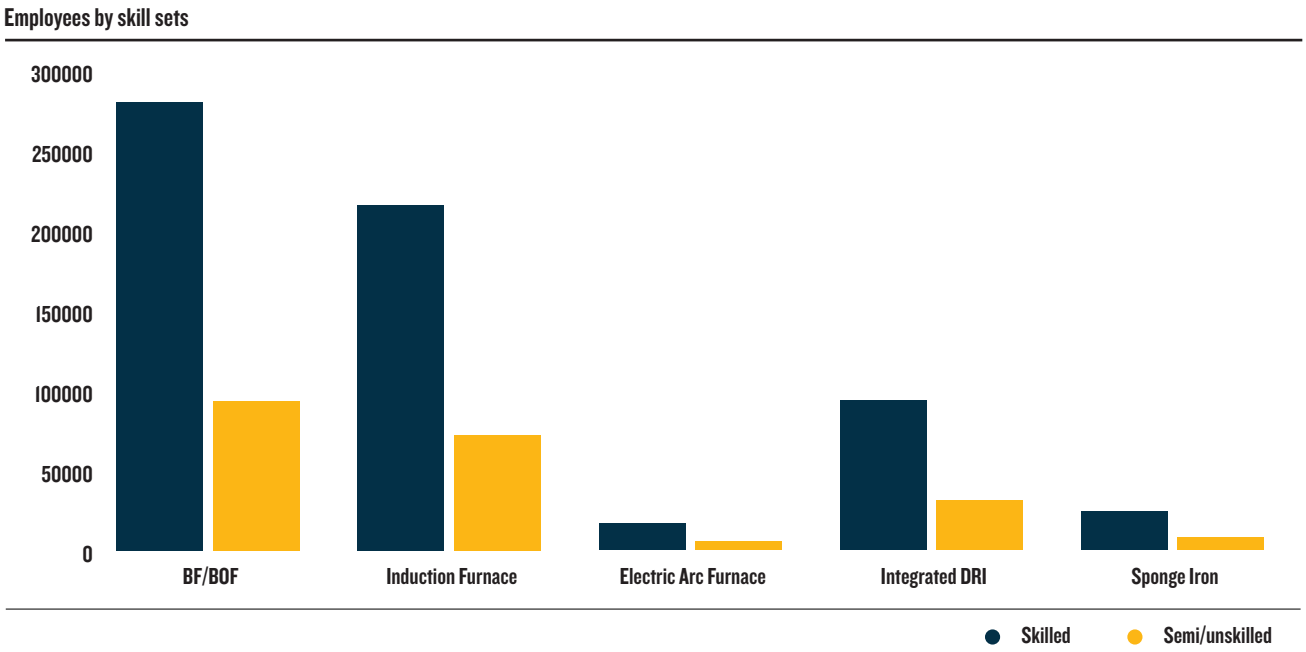


FIGURE 22:
Employee distribution by skillsets

Source: Authors' analysis based on unit level data from (JPC, 2021) and stakeholder consultations

mid-skilled level and then high skilled. Semi-skilled workforce in a steel plant usually consists of housekeeping activities like cleaning, lab testing, dusting raw material handling and maintenance.

IMPACT BY LABOUR PROFILE

With the increase in contract labour, the industry is witnessing significant strife in recent years. While as a whole, pay scales are comparable for supervisors and executives, workers are the least paid in comparison to other coal-related industries (table 5). Particularly in the case of contract workers, there are issues with payment schedules, pensions, and working conditions. This is despite the fact that both permanent and contract workers belong to unions, and there is in fact a separate union for contract labourers (for example the United Contract Workers Union at IISCO steel plant). For example, a contract worker performing the same job as a permanent staff is paid a reduced rate by least 50-60 per cent. This also differs plant to plant and state to state. While contract workers are eligible for pensions and provident fund, the medium differs for both. Permanent employees get pensions through the National Pension Scheme whereas the contract workers get it through the Regional Provident Fund Commissioner Pensions. There have been issues with pension payments for contract workers. Often job contractors show lower attendance for contract workers as a result of which the percentage deposited by plant owners (50 per cent employee contribution and 50 per cent employer contribution) is far less than what should ideally be deposited.

In terms of education, despite a lower educational qualification of workers, stakeholder discussions informed us that workers in the sector are highly skilled due to on-the-job and union training sessions. The tenure of contracts also reflects the skilling efforts. Most companies prefer workers who have been on the 'floor' for years despite changing job contractors. So, the same worker will work for different contractors despite having annual or 1-2 year contracts but be paid the wages of a regular employee.

TABLE 5

Labour profile of workers in the iron and steel sector.

Source: (PLFS, 2021)

Iron and Steel Sector Profile		
Age	Mean age	38
	Less than 30 years	30%
	30-40 years	31%
	40-50 years	20%
	More than 50 years	19%
General Education Level	Not literate	6%
	Literate-below primary	6%
	Primary	11%
	Middle	23%
	Secondary	17%
	Higher secondary	14%
	Diploma/certificate course	8%
	Graduate	12%
	Postgraduate and above	4%
Technical Education	No technical education	91%
Vocational Training	Received formal training	11%
	Learning on the job	16%
	Did not receive any training	71%
Work Status	Employer	4%
	Regular salaried / wage employee	77%
	Other types of work	10%
Type of job contract	No written contract	83%
	1 year or less	9%
	1-3 years	4%
	3+ years	4%
Work status of workers with unwritten contracts	Regular salaried/ wage employee	84%
	Other types of work	16%
Wages/month (INR)	Workers	10,946
	Supervisors	43,895
	Executive	88,293

The impact on labour will be mixed bag. Those involved in coal handling are the foremost at risk. But given expected capacity expansion, they can perhaps be absorbed as manpower requirements increase

RISK ASSESSMENT

The National Steel Policy 2017 proposed doubling the steel capacity to 300 MT by 2030, with BF-BOF route contributing 60-65 per cent (Ministry of Steel, 2017). However, at COP 26, India endorsed a decision to work towards increasing near-zero emission steel production and capacity (UN Climate Change Conference UK, 2021). This endorsement and the global movement towards decarbonising the steel sector raises questions on India's future capacity expansion. Already large players like Tata Steel are experimenting with hydrogen and CCUS (Rajshekhar, 2021). From an emissions perspective, BF-BOF plants (2.43-3.0 tCO2/tcs) emit relatively lower CO2 as compared to integrated coal-based DRI/RAF plants (3.0-3.2 tCO2/tcs) (Ministry of Steel, 2014). Plants using scarp iron under the EAF routes have the lowest emissions (0-1 tCO2/tcs) (Hall, Spencer, & Kumar, 2020). Decarbonising the Indian steel sector can go down multiple pathways.

Technology-wise, shifting from coal to gas-based induction processes and coal gasification is the most commercially viable option. This is of course dependent on the cost of gas. TERI analysis suggests that at natural gas-based DRI steel will be competitive with BF-BOF at $6-8/mmbtu (Hall, Spencer, & Kumar, 2020). This is also the first step in converting the process eventually to hydrogen. However, industry stakeholders suggest that coal to gas conversion will mean that existing plants

which have a horizontal kiln set up will have to undergo changes. These kilns can be modified with government support however there is yet no communication from the government on converting from coal-to-gas. Moreover, since most DRI plants are based in Jharkhand, Chhattisgarh, and Odisha, gas infrastructure and prices are a challenge.

In terms of expansion, stakeholders expect that the next 60 MT will come from brownfield expansion with the remaining coming from greenfield. There is a debate within the industry on which technology will likely lead the expansion plan. Given scrap from China it is likely that future expansion will come from EAF processes and climate drivers such as the Glasgow Breakthrough, Article 6 of the Paris rulebook, may put pressure on coal based DRI, considering India is the only country using coal for this process. Even without climate drivers, the DRI/IF sector is likely to see consolidation going forward due to regulatory changes.

The amendment of the Mines and Minerals (Development and Regulation) Act, in 2015 impacted sponge iron and DRI players, particularly since most have a capacity of 1 lakh tonnes or less. Sponge iron manufacturers and producers contest that iron ore auctions led to concentration of mine ownership amongst 3-4 large steel producers. Some mines were also won by old merchants at premiums. This coupled with COVID-19 and exports to China, resulted in a shortage and increased iron ore prices. Primary steel producers were able to absorb the high prices after paying the premium, but the producers of long steel did not anticipate these prices. Moreover, almost 290 units out of the 308 sponge iron units are without mines. The mines which were auctioned were the primary source of raw materials for these units. This has resulted in industry shutdown or under-utilisation, particularly in Odisha. If one is to add the complication of clean technology due to climate drivers, this sector can be expected to see consolidation as most firms will be unable to find the finances.

The impact on labour will be mixed bag. Those involved in coal handling are the foremost at risk. But given the larger trends of capacity expansion in the sector, they

There are no official estimates of the number of brick kilns in India, but on an average the number ranges from 190,000 to 280,000 kilns producing about 220-280 billion bricks

can perhaps be absorbed in the workforce as manpower requirements increase. Consolidation amongst the smaller players is likely to see labour losses (particularly in the induction furnace end) in the short to medium term, but this won't be a result of climate drivers alone, but rather the structure of the sector. Technology change will necessitate retraining and reskilling. Moving away from coal will require absorption of the labour involved in coal handling activities within the larger sector.

NEXT STEPS

In the light of the discussion above, some immediate action points that need to be taken for the sector include:

- It is imperative for the Government of India to begin the conversation on **moving towards natural gas or alternate fuels** for the coal-based DRI industry. This will help reduce emissions from the sector and prepare them for the eventual transition.
- Supplementing this exercise, it is necessary to **identify if the labour force can be transitioned** in its existing form or if training programmes have to be conducted.
- Irrespective of the technology, it is clear that coal usage is expected to decrease in the next two decades. This will **impact workers on the coal supply chain** in this sector and they should be considered as coal transition workers under the broader transition programme
- **Districts with smaller sized units** that are expected to see consolidation should be mapped alongside power plant and coal mine districts. This will help identify districts most vulnerable i.e., if all three assets are in the same district.

BRICKS SECTOR

This is the highest coal consumer amongst all the industries in the MSME sector. There are no estimates for coal consumption by the bricks sector, but at one point it was the second largest consumer after power, consuming about 72 MT. Secondary literature suggests that the sector consumes about 29-30 MT tonnes of coal annually. There are no official estimates of the number of brick kilns in India, but on an average the number ranges from 190,000 to 280,000 kilns producing about 220-280 billion bricks (ICIMOD, 2019). The sector operates during dry months between December and June in the northern states, and November-May in the southern states. In terms of technology, the sector uses Fixed Chimney Bull Trench Kiln (FCBTK) (70% production), clamp kilns (25% production), zig-zag kilns, VSBK (most efficient kilns), Hoffman, Tunnel, etc. A technology and state-wise split is shown in figure 23. The characteristics of each type of technology is as follows:

- Fixed chimney bull trench kiln:
  - Accounts for 70 per cent production
  - 30 per cent kilns use this technology
  - Production capacity of 20-50k bricks/ day.
  - Coal is the most commonly used fuel

- Clamp Kilns

  - Most basic type of kiln with no permanent kiln structure.
  - Contributes to 25 per cent of production
  - Bricks produced in batches.
  - 60 per cent kilns use this technology

- Zig-zag Kilns

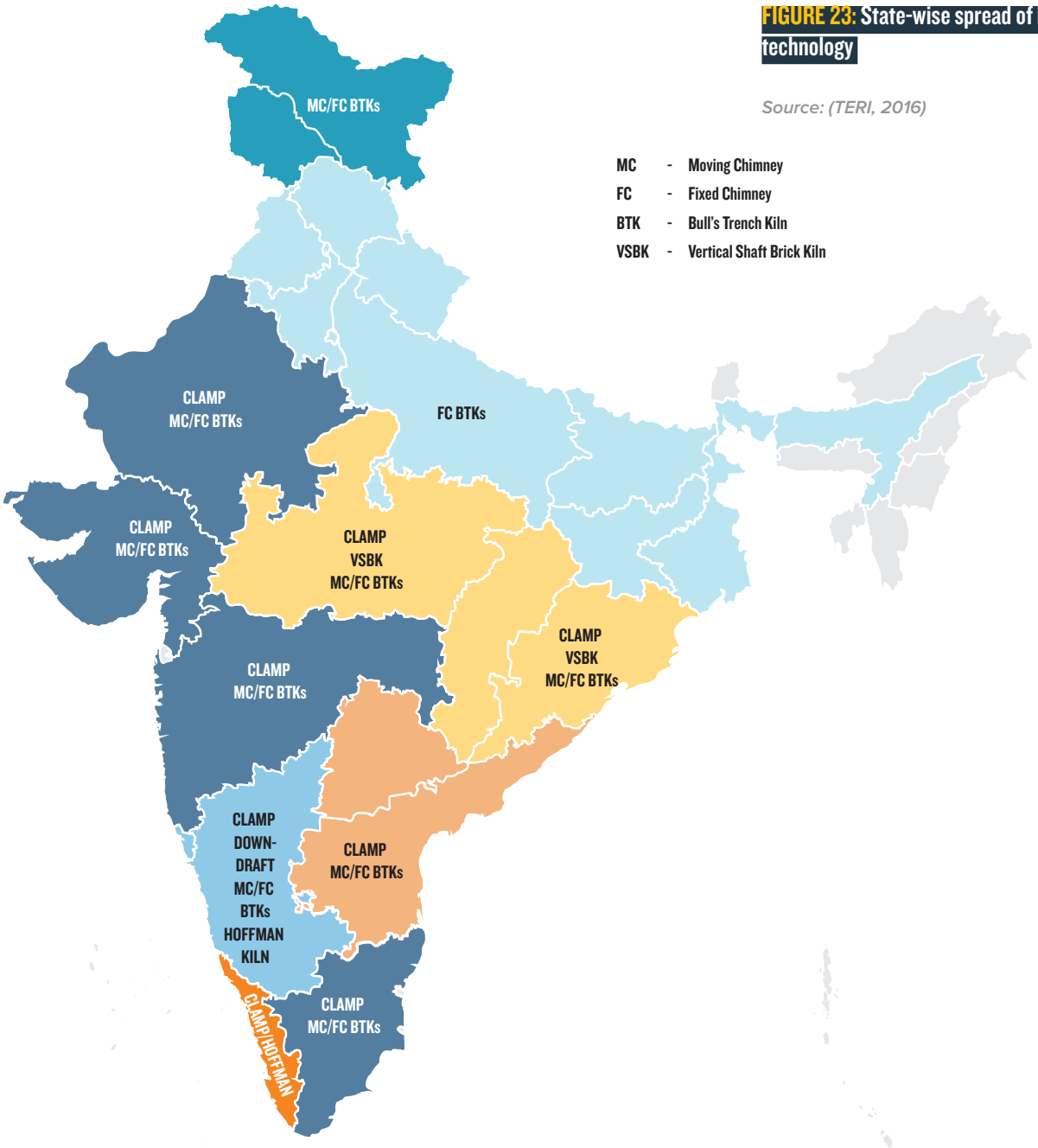
  - Improved firing technology as compared to FCBTK.
  - Moving fire kiln, air flows in a zigzag path using a fan.
  - Production capacity of 15-40k bricks/day

- VSBK, Hoffman, Tunnel

  - Considered the most efficient kiln technology in terms of energy use.
  - Around 110 VSBK and 500 Hoffman technology kilns operational in India

FIGURE 23: State-wise spread of brick technology

Source: (TERI, 2016)



IMPACT BY NUMBER

At a minimum, the sector employs **11 million people** for 6 months in a year. Most of these are workers who are contract labour (80 per cent), while regular employees are engaged in supervision (figure 24). Often entire families migrate to work in the sector, with some reports of bonded labour. It is close to impossible to understand the migration patterns in the sector. One of the reasons for this is that there is a large shadow/illegal market in the sector.

In terms of division by job profiles, ~50 per cent is employed in clay excavation and moulding and drying activities. The only profile that requires some skill is the firing and cooling process. The rest come under semi-skilled or unskilled category (figure 25). This feature will make transition considerably difficult in the sector.

FIGURE 24:
Share of permanent and contractual labour in the sector

Source: Authors' analysis based on (TERI, 2016)

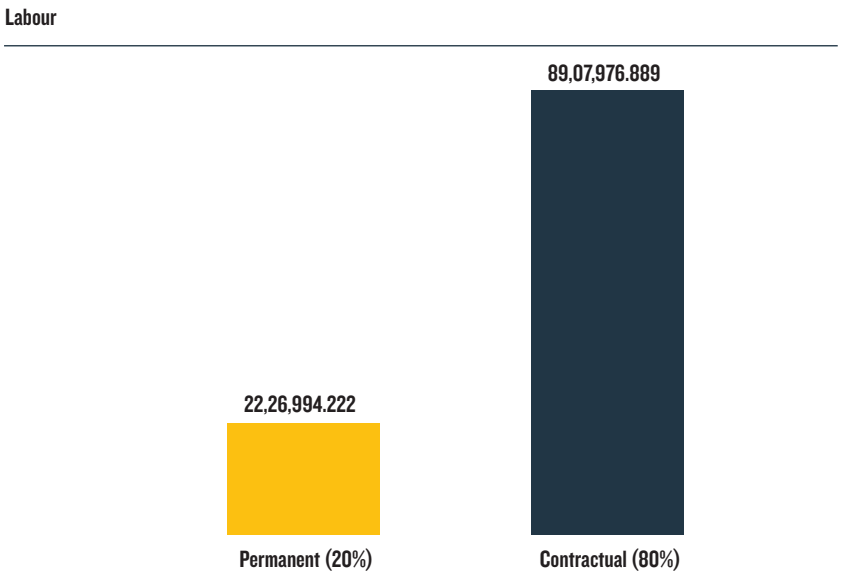
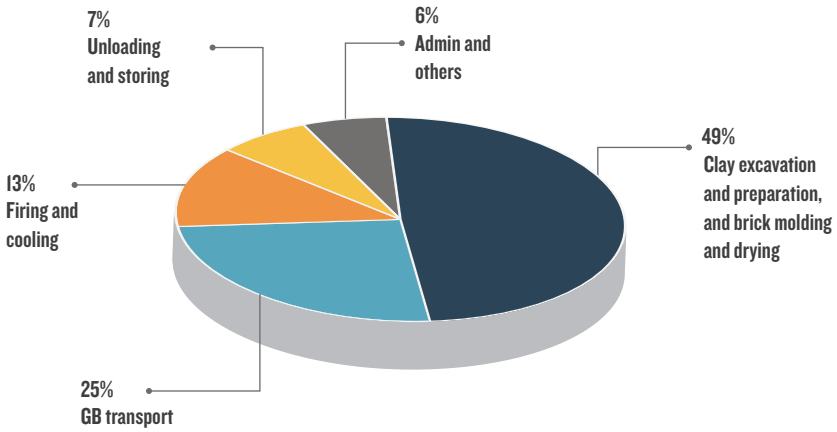


FIGURE 25:
Labour profiles in the brick sector

Source: Authors' analysis based on (TERI, 2016)



IMPACT BY LABOUR PROFILE

The data from the PLFS survey matches the conversation that we have had with brick owners, researchers, and other stakeholders. The sector has the lowest wage amongst all coal related sectors (INR 7000/month). This varies from state to state. It also depends on if the contractors have given an advance to the families while they migrate. In that case, the wages are still lower. Due to the informal nature of the sector, wage data collection is difficult, and the available data does not match ground reality. This sector sees the highest illiteracy amongst the analysed sector, i.e., those surveyed were unable to read/write their name in any Indian language. This also makes the workers susceptible to fraud. The only workers with contracts are either the employers or supervisors who are permanent staff, the rest of the workers are typically do not have a written contract. The payscale for the formal staff is comparable to other sectors. The workers in this sector have no social safety net or institutional support in the form of unions.

Brick Sector Profile		
Age	Mean age	37
	Less than 30 years	31%
	30-40 years	37%
	40-50 years	16%
	More than 50 years	16%
General Education Level	Not literate	37%
	Literate-below primary	6%
	Primary	18%
	Middle	20%
	Secondary	9%
	Higher secondary	6%
Technical Education	No technical education	99%
Vocational Training	Hereditary: received training other than formal training	3%
	Self learning	8%
	Learning on the job	7%
	Did not receive any training	80%
Work Status	Employer	2%
	Regular salaried/wage employee	20%
	Other types of work	65%
Type of job contract	No written contract	95%
	3+ years	2%
Work status of workers with unwritten contracts	Regular salaried/wage employee	14%
	Other types of work	86%
Wages/Month (INR)	Workers	7,969
	Supervisors	40,333

TABLE 6:
Labour profile of workers in the brick sector.

Source: (PLFS, 2021)

RISK ASSESSMENT

The informal nature, lack of official estimates and institutional support, and overall poor socio-economic indicators make it difficult to categorise the brick labourers as impacted by coal transitions

The main challenge of the sector and its workers is to be identified as impacted by coal transitions. The informal nature of the sector, lack of official estimates, no institutional support for workers, and overall poor socio-economic indicators are some of the reasons why it is difficult to categorise the labour in the sector as impacted by coal transitions. Air pollution in India has forced conversations on the polluting nature of the sector. Coal in the sector is mainly used for firing and burning. To tackle the issue, particularly in the northern states, state and central pollution control boards are getting kiln owners to change to zig-zag technology which uses lesser coal as compared to FCBTK and clamp kilns. However, the informal nature of the sector, coupled with the shadow market under which it functions, makes enforcement particularly difficult. With stable electricity production, it is expected that eventually coal consumption in the sector will die out as kiln owners shift to electricity. But to do that it will be imperative for the sector to be classified as an 'impact' sector due to the impending coal transition. Else owners will be unwilling to make the necessary investments for a technology change. Only sustained regulatory foresight will incentivise brick kiln owners to invest in new technology.

The second challenge is to classify brick workers as coal transition workers. Workers are only engaged in brick making for 6 months in a year, the location of the kilns is not fixed, the same set of workers may not participate in brick making year-on-year, and there may also be instances of bonded labour. Further, lack of technical training and formal education makes retraining and reskilling time-consuming and an expensive exercise. Part of the reason owners prefer coal burning over other efficient technologies is the retraining cost of labour and the fear that they may have to incur this cost every year since there are no fixed term employees. Moreover, there is an information gap on the impending transition, both among owners as well as labourers that makes it difficult to initiate a conversation on coal transition. Without a planned transition, we fear that this section of the industry, nearly at least 11 million people, will be negatively impacted due to the impending transition.

NEXT STEPS

Given this assessment, there are a few immediate actions that can help bring this sector under the larger category of coal transition workers:

- **Geotag kilns across the country** to help fix the location of the kilns. This exercise has to be updated on an annual/bi-annual basis and will help provide information on the number of kilns
- **Incentivise** kiln owners financially to adopt efficient electricity-based technology.
- **Enforce environment pollution norms** that will make it easier to incentivise transition and identify unregistered kilns
- Make it **mandatory for job contractors to submit labour data** to the local labour commissioner's office every year. Once this has been done for a few years, it will help create a labour database for the brick sector. This information will also help identify socio-economic characteristics of the labour
- **Create** a cadre of workers who will be able to train new labour every year ahead of the brick making season
- **Enforce minimum wage rules** to improve socio-economic conditions of the labourers

MAPPING VULNERABLE DISTRICTS

In all, there are **266 districts** in India which have at least one of the four industries linked to coal consumption

Based on data from all the four sectors (coal, power, sponge iron and steel), we conducted an exercise at the district level to identify the most vulnerable districts. In the first part we mapped all districts in India which have at least one of the four assets of these sectors. **In all, there are 266 districts in India which have at least one of the four industries linked to coal consumption (figure 26).** The dependency of these districts was based on capacities of the units or production from coal mines i.e., more weightage for higher capacity. Based on this assessment the top 25 districts with all four or a minimum of three of these industries are **Angul, Jharsuguda, Raigarh, Chandrapur, Sundergarh, Dhanbad, Nagpur, Korba, Singrauli, Sonbhadra, Bokaro, Bankura, Bellary, Burdwan, Hazaribagh, Ramgarh, Dhenkanal, Purulia, Raipur, Bhadradri Kothagudem, Chatra, Giridih, Mancherial, Paschim Bardhaman, and Salem. Most of them belong to the states of Odisha, Jharkhand, West Bengal, and Chhattisgarh, with select districts in Telangana, Maharashtra, and Uttar Pradesh.**

However, given that coal consumption will not peter out immediately, we believe that closures will likely be planned for districts and mines with least and less production (rest of mines and UG mines). Similarly, in the case of thermal power plants, along with age, distance from mines (pithead or non-pithead plant) should also be considered since this impacts the variable costs and with increased renewable generation in the system, least cost tariffs would be sought after. We understand that other factors like thermal efficiency of the plant, along with coal linkages also make a difference, but this will require a plant level analysis at the district level which will be developed for the next phase of the study. In the case of iron and steel units, based on our understanding and stakeholder conversation, we believe that smaller size plants may shut down or see a consolidation as climate drivers become a key driver over the coming decade. **Based on these parameters we find that 135 of the 266 districts are highly vulnerable to a coal transition (figure 27). These 135 districts have two or more assets linked to coal consumption. The 131 remaining districts only have steel plants which are less than 1 MT.** Annexure 2 provides the list of 135 districts with the detailed parameters.

We find that some districts may see multiple closures, especially if policies on mine closures and power plant decommissioning happen simultaneously, along with consolidation in the iron and steel sector. **Pakur, Palamu and Tinsukia all have mines less than 1MT with no other coal-linked asset in the district. Krishna in Andhra Pradesh has steel unit (less than 1MT0), sponge iron plant (less than 1 lakh tonnes) and between 1-5GW power plant which is more than 25 years old.** Typically, the districts with the most coal production, high iron and steel capacity and younger thermal units are towards the bottom of the pile.

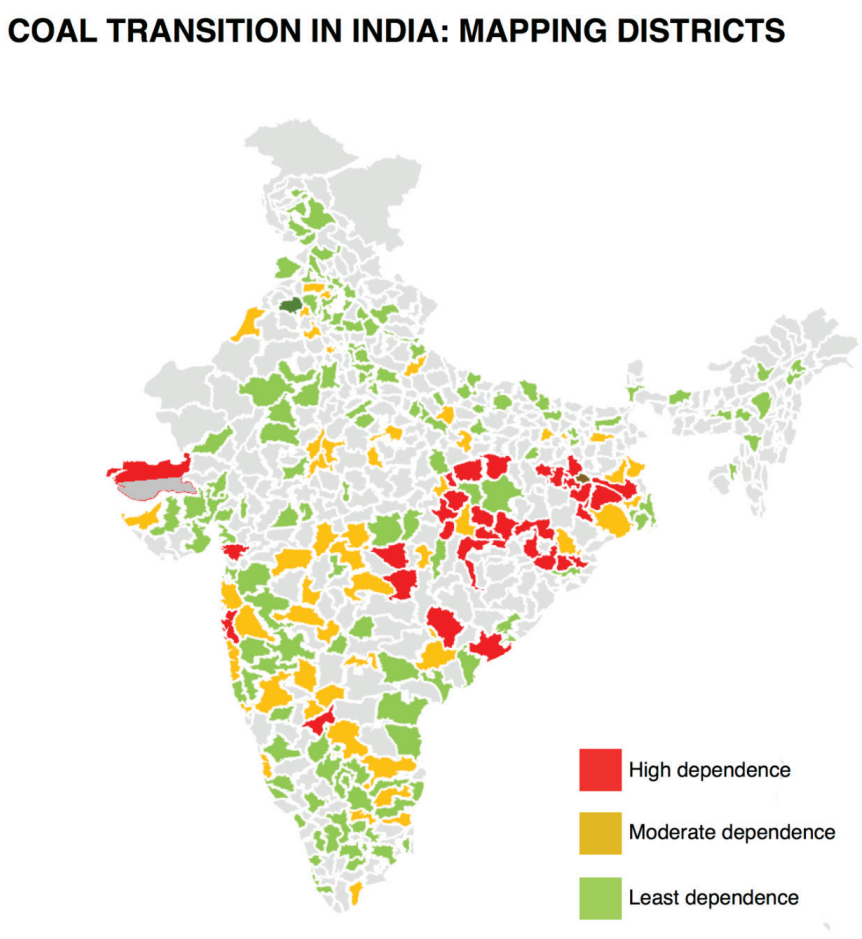


FIGURE 26:
Mapping districts with coal mines, power plants, sponge iron and steel units/plants

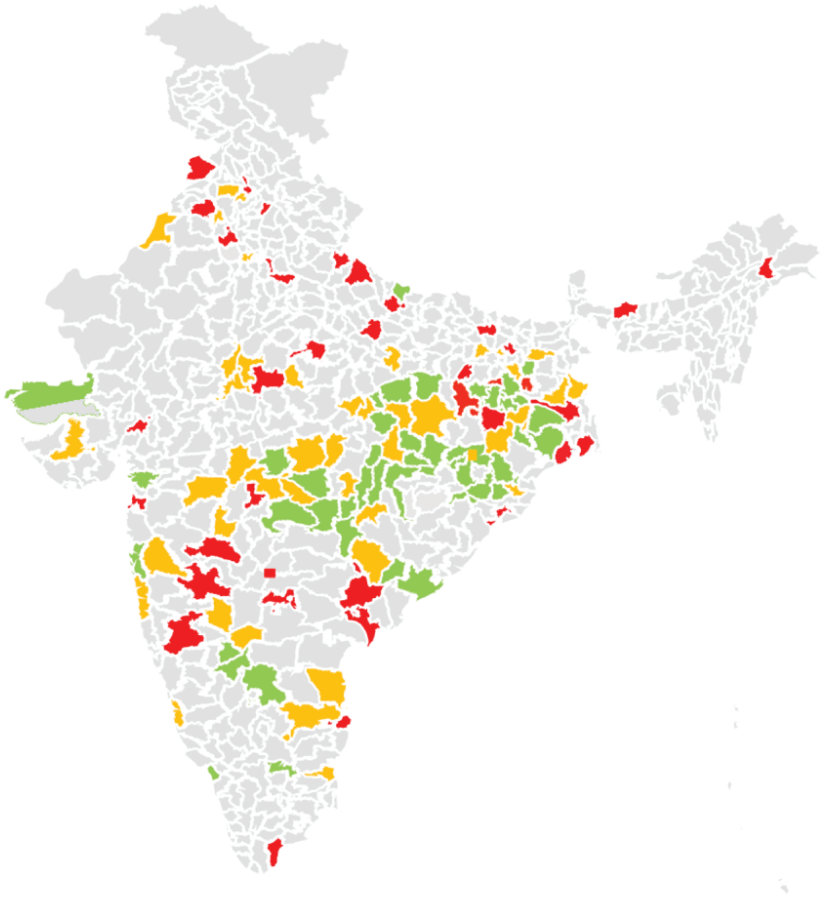
Source: Authors' analysis based on various datasets used for the sectoral analysis

COAL TRANSITION IN INDIA

Mapping Vulnerable Districts

FIGURE 27:
Most vulnerable districts with two or more coal-linked industry

Source: Authors' analysis based on various datasets used for the sectoral analysis



Highly vulnerable districts	Pakur,Palamu,Tinsukia, Aligarh,Muzaffarpur,South 24 Parganas,YamunaNagar,Krishna,Ranchi,Akola,Bina,Gonda,Kheri,Pilibhit,Aurangabad,Begusarai,Solapur,Bhatinda,Gautam Budh Nagar,Kota,Raebareli,Koderma,Kokrajhar,Seoni,EastMedinipur,Thoothukudi,Bardhaman,Beed,Kadapa,Khammam,Kheda,Ropar,Tapi,Belgaum,Durgapur,Hyderabad,Khordha,Mahbubnagar,Chennai,Hisar,Jhansi,Thane,Thiruvallur
Moderate vulnerable districts	Bhagalpur,Murshidabad,Raichur,SriGanganagar,Chhindwara, Deoghar, JayashankarBhoopalpally, Komaram,Bheem,Korea, Latehar,Shahdol,Surajpur,Patna,Wardha,Birbhum,Allahabad,Amravati,Baran,Cuddalore, Gondia,Jalgaon,Jamnagar, Jhajjar, Jhalawar,Mansa,Mumbai,Rajpura,Ratnagiri,Shahjahanpur,Udupi, Warangal,Bilaspur,Chittoor,FatehgarhSahib,Jalna,Ludhiana,Pune,Rourkela,Jaipur,Nellore,Umaria,Saraikela,Bijapur,Lalitpur,Purulia
Least vulnerable districts	Giridih,Sambalpur,Hazaribagh,Ramgarh,Singhbhum,Godda,Peddapalli,Surguja ,Yavatmal,Dhanbad,Durg,Burdwan,Balrampur,Janjgir-Champa,Salem,Surat,Anantapur,Keonjhar,Koppal,South Goa,West Medinipur,Bankura,Betul,Karimnagar,Chatra,Paschim Bardhaman,Vishakhapatnam,Nagpur,Chandrapur,Kutch,Dhenkanal,Raipur,Anuppur,Raigad,Angul,Bellary,Sonbhadra,Jharsuguda,Korba,Singrauli,Bokaro,Mancherial,Sundergarh,Raigarh,

CONCLUSIONS AND NEXT STEPS

Coal transitions in India is likely to be messy, complicated exercise, unless it is planned and managed well. This will necessitate aligning state, national and sector roadmaps at the planning level. Strategies towards decarbonisation cannot be undertaken with simultaneous investment and expansion of the coal sector and its allied uses. This will impede investments needed to meet the net zero target and continue the carbon lock-in with possibilities of stranded investments. Further, India needs to define a coal transition worker across different sectors with targeted emphasis on contract/informal labour and their socio-economic profile. Without this it is possible that a significant chunk of the labour force will not be beneficiaries of the transition policies. Accounting for the contract labour force also helps accounting practices as India needs to determine the financial and economic costs required for the transition. Environ ment remediation and decommissioning or closure plans have to become a necessary component for all sectors with increased capacity at the central and state level for their monitoring and implementation. Without this, it will be impossible to design strategies for economic regeneration in the 135 likely to be impacted districts. Lastly, these coal bearing regions will need to be made productive again through regional strategies. The current governance structure is unlikely to yield results for the transition. Decision making for energy is concentrated at the central government level, while planning and implementation of the resulting challenges (labour, education, health etc.) is the purview of the states. This leads to an imbalance since revenues are accrued more to the central government than state governments. This structure needs to be corrected. Centre-state councils like the GST council can help bridge this imbalance.

All stakeholders have a role to play in this transition roadmap. District authorities become the focal point of the transition roadmap since they are the key implementors and the first point of contact for local resistance or support. Industries will need to be brought on board for their input on district level investments and preparing the transition strategy for the existing force. The existing labour force will have to be bucketed into categories of those who can be voluntarily retired (and the financial cost of this), those that can be transitioned within the same company and or another similar profile in the same area. Labour unions have to become a necessary part of this conversation since they will essentially be the communication bridge between the management, governments, and the larger labour force. In sectors with no unions, it is incumbent upon local authorities to seek an 'influencer' or group leader to lead the discussions. Local and community leaders will have a big role to play in this transition. They are essentially entrenched in the existing political economy and without their support, local resistance may increase. Therefore, their influence needs to be cultivated for the success of this transition strategy through involvement in district and state level planning. Lastly, India will need to communicate at the global level about the scale of these transitions and demand climate finance to manage and implement the strategy. Without external funding it is unlikely that the scope of the transition only on livelihoods can be met solely by domestic funding. Multilateral Development Banks will need to de-risk coal bearing areas during the transition period to facilitate green investments. In the short term, funds from the District Mineral Fund can be leveraged. Domestically, the country will also need to prepare its financial system for early closures.

The next steps highlighted at the end of every sector determine near-term strategies while we prepare for the broader transition. All efforts have to be made to not only transition the existing work force, but also put in place strategies that will prevent future generations from working in coal and related sectors.

ANNEXURES

ANNEXURE I

FIGURE 28:
Number of power plants in every state

Source: (CEA, 2020)

State-wise distribution of power plants FY18 (Includes captive)

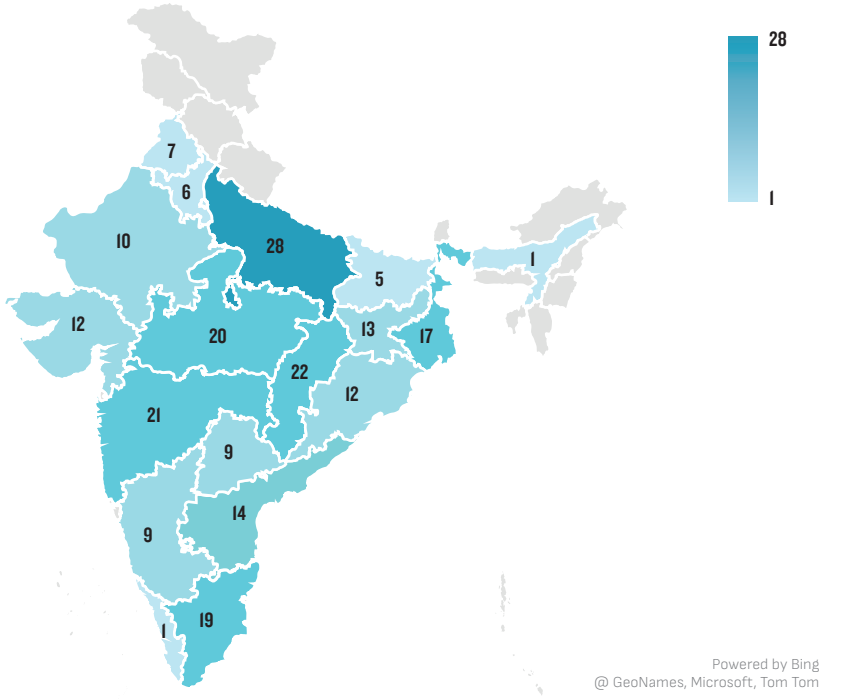
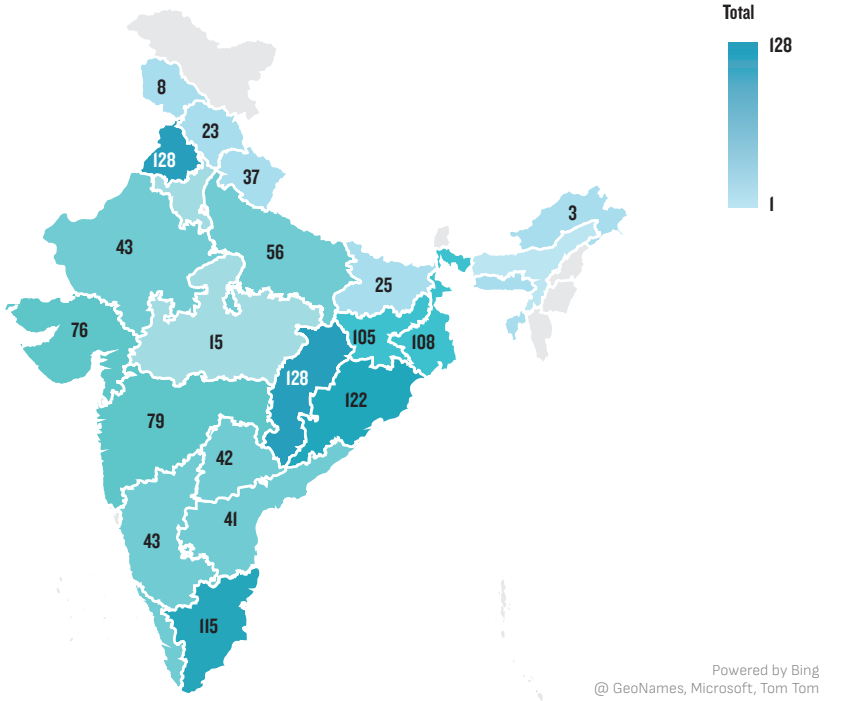


FIGURE 29:
Number of steel plants in every state

Source: (JPC, 2021)

State-wise distribution of steel plants FY19



State-wise distribution of sponge iron plants FY19

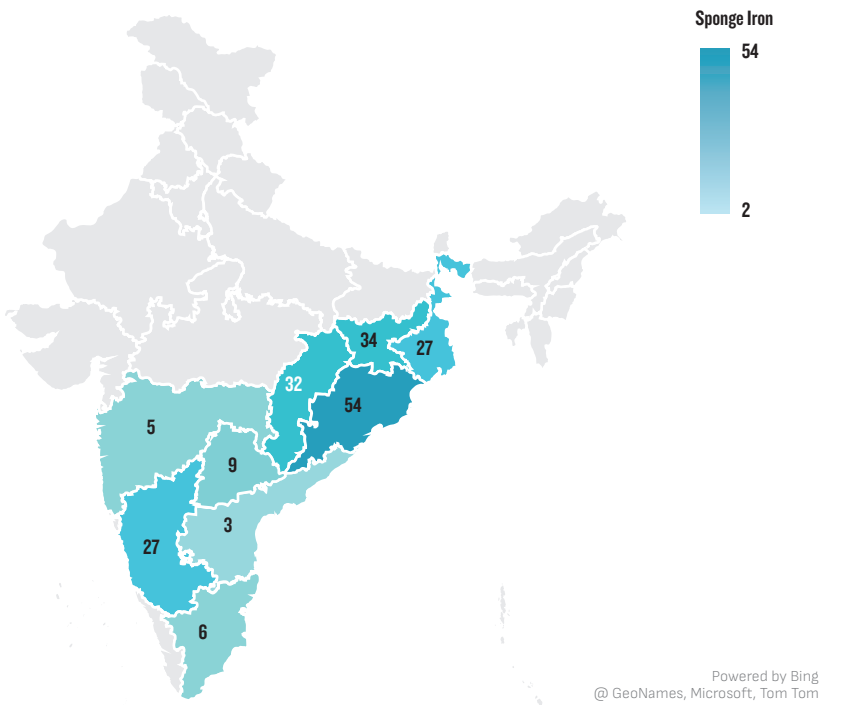


FIGURE 30:
Number of sponge iron plants in every state

Source: (JPC, 2021)

State-wise installed capacity: Power FY18

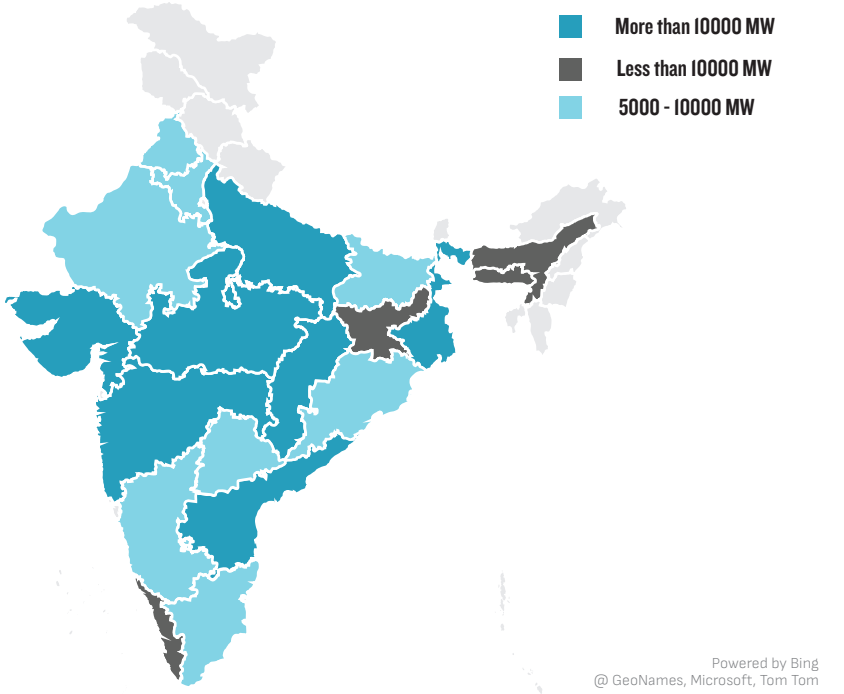


FIGURE 31:
Number of power plants by installed capacity in every state

Source: (CEA, 2020)

FIGURE 32:
Number of steel plants by capacity in every state

Source: (JPC, 2021)

State-wise installed capacity: Steel FY19

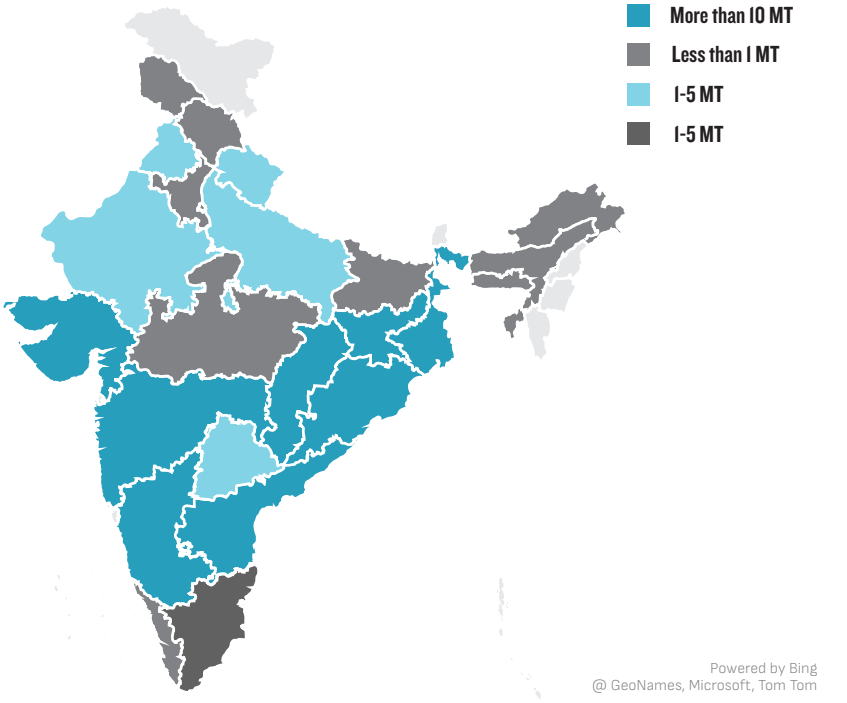
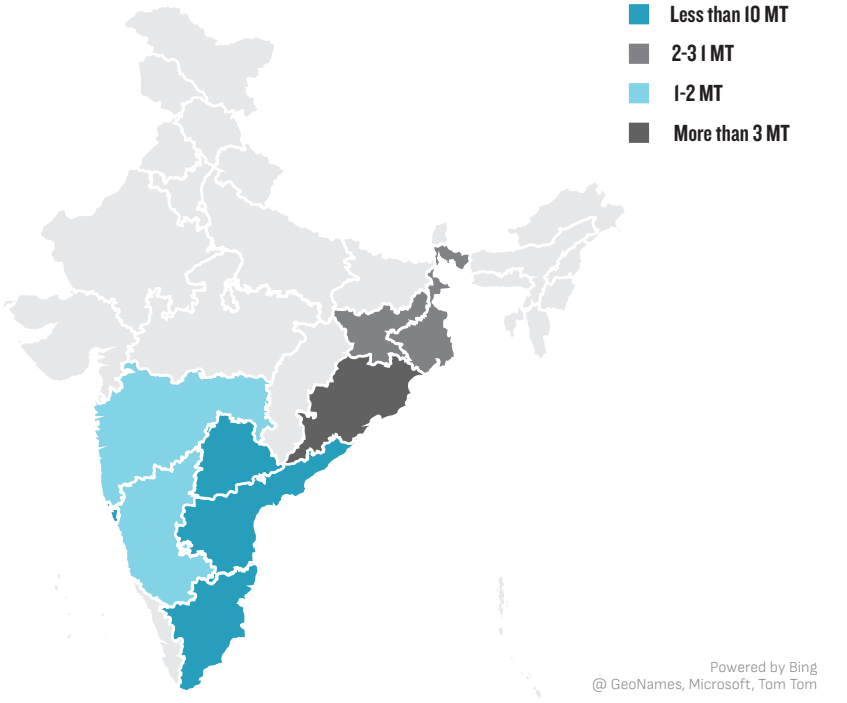


FIGURE 33:
Number of sponge iron plants by capacity in every state

Source: (JPC, 2021)

State-wise installed capacity: Spomge Iron FY19



ANNEXURE 2

States	Districts new	Steel	Sponge Iron	Power	Coal	Age
Jharkhand	Pakur				Less than 1 MT	
Jharkhand	Palamu				Less than 1 MT	
Assam	Tinsukia				Less than 1 MT	
Uttar Pradesh	Aligarh	Less than 1 MT		Less than 1000 MW		5-15 years
Bihar	Muzaffarpur	Less than 1 MT		Less than 1000 MW		5-15 years
West Bengal	South 24 Parganas	Less than 1 MT		Less than 1000 MW		5-15 years
Haryana	Yamuna Nagar	Less than 1 MT		Less than 1000 MW		5-15 years
Andhra Pradesh	Krishna	Less than 1 MT	Less than 1 lakh tonne	1000-5000 MW		More than 25 years
Jharkhand	Ranchi	Less than 1 MT	Less than 1 lakh tonne		1-10 MT	
Maharashtra	Akola			Less than 1000 MW		5-15 years
Madhya Pradesh	Bina			Less than 1000 MW		5-15 years
Uttar Pradesh	Gonda			Less than 1000 MW		5-15 years
Uttar Pradesh	Kheri			Less than 1000 MW		5-15 years
Uttar Pradesh	Pilibhit			Less than 1000 MW		5-15 years
Bihar	Aurangabad	Less than 1 MT		Less than 1000 MW		Less than 5 years
Bihar	Begusarai	Less than 1 MT		Less than 1000 MW		Less than 5 years
Maharashtra	Solapur	Less than 1 MT		Less than 1000 MW		Less than 5 years
Punjab	Bhatinda	Less than 1 MT		1000-5000 MW		More than 25 years
Uttar Pradesh	Gautam Budh Nagar	Less than 1 MT		1000-5000 MW		More than 25 years
Rajasthan	Kota	Less than 1 MT		1000-5000 MW		More than 25 years
Uttar Pradesh	Raebareli	Less than 1 MT		1000-5000 MW		More than 25 years
Jharkhand	Koderma	Less than 1 MT	Less than 1 lakh tonne	1000-5000 MW		5-15 years
Assam	Kokrajhar			Less than 1000 MW		Less than 5 years
Madhya Pradesh	Seoni			Less than 1000 MW		Less than 5 years
Punjab	Tarn Taran			Less than 1000 MW		Less than 5 years
West Bengal	East Medinipur	Less than 1 MT		1000-5000 MW		15-25 years
Tamil Nadu	Thoothukudi	Less than 1 MT		1000-5000 MW		15-25 years
West Bengal	Bardhaman			1000-5000 MW		More than 25 years
Maharashtra	Beed			1000-5000 MW		More than 25 years
Andhra Pradesh	Kadapa			1000-5000 MW		More than 25 years
Telangana	Khammam			1000-5000 MW		More than 25 years
Gujarat	Kheda			1000-5000 MW		More than 25 years
Punjab	Ropar			1000-5000 MW		More than 25 years
Gujarat	Tapi			1000-5000 MW		More than 25 years
Karnataka	Belgaum	Less than 1 MT	More than 1 lakh tonne but < 1 MT			
West Bengal	Durgapur	Less than 1 MT	More than 1 lakh tonne but < 1 MT			
Telangana	Hyderabad	Less than 1 MT	More than 1 lakh tonne but < 1 MT			
Odisha	Khordha	Less than 1 MT	More than 1 lakh tonne but < 1 MT			
Telangana	Mahbubnagar	Less than 1 MT	More than 1 lakh tonne but < 1 MT			
Tamil Nadu	Chennai	Less than 1 MT		1000-5000 MW		5-15 years
Haryana	Hisar	Less than 1 MT		1000-5000 MW		5-15 years
Uttar Pradesh	Jhansi	Less than 1 MT		1000-5000 MW		5-15 years
Maharashtra	Thane	1-10 MT		Less than 1000 MW		15-25 years
Tamil Nadu	Thiruvallur	Less than 1 MT	More than 1 lakh tonne but < 1 MT	1000-5000 MW		More than 25 years
Bihar	Bhagalpur			1000-5000 MW		15-25 years
West Bengal	Murshidabad			1000-5000 MW		15-25 years
Karnataka	Raichur			1000-5000 MW		15-25 years
Rajasthan	Sri Ganganagar			1000-5000 MW		15-25 years
Madhya Pradesh	Chhindwara				1-10 MT	

States	Districts new	Steel	Sponge Iron	Power	Coal	Age
Jharkhand	Deoghar				1-10 MT	
Telangana	Jayashankar Bhoopalpally				1-10 MT	
Telangana	Komaram Bheem				1-10 MT	
Chhattisgarh	Korea				1-10 MT	
Jharkhand	Latehar				1-10 MT	
Madhya Pradesh	Shahdol				1-10 MT	
Chhattisgarh	Surajpur				1-10 MT	
Bihar	Patna	Less than 1 MT		1000-5000 MW		Less than 5 years
Maharashtra	Wardha	1-10 MT		Less than 1000 MW		5-15 years
West Bengal	Birbhum	Less than 1 MT		1000-5000 MW	Less than 1 MT	15-25 years
Uttar Pradesh	Allahabad			1000-5000 MW		5-15 years
Maharashtra	Amravati			1000-5000 MW		5-15 years
Rajasthan	Baran			1000-5000 MW		5-15 years
Tamil Nadu	Cuddalore			1000-5000 MW		5-15 years
Maharashtra	Gondia			1000-5000 MW		5-15 years
Maharashtra	Jalgaon			1000-5000 MW		5-15 years
Gujarat	Jamnagar			1000-5000 MW		5-15 years
Haryana	Jhajjar			1000-5000 MW		5-15 years
Rajasthan	Jhalawar			1000-5000 MW		5-15 years
Madhya Pradesh	Khandwa			1000-5000 MW		5-15 years
Punjab	Mansa			1000-5000 MW		5-15 years
Maharashtra	Mumbai			1000-5000 MW		5-15 years
Punjab	Rajpura			1000-5000 MW		5-15 years
Maharashtra	Ratnagiri			1000-5000 MW		5-15 years
Uttar Pradesh	Shahjahanpur			1000-5000 MW		5-15 years
Karnataka	Udupi			1000-5000 MW		5-15 years
Telangana	Warangal			1000-5000 MW		5-15 years
Chhattisgarh	Bilaspur	Less than 1 MT	More than 1 lakh tonne but < 1 MT	1000-5000 MW		5-15 years
Andhra Pradesh	Chittoor	1-10 MT				
Punjab	Fatehgarh Sahib	1-10 MT				
Maharashtra	Jalna	1-10 MT				
Punjab	Ludhiana	1-10 MT				
Maharashtra	Pune	1-10 MT				
Odisha	Rourkela	1-10 MT				
Odisha	Jajpur	More than 10 MT	Less than 1 lakh tonne			
Andhra Pradesh	Nellore	Less than 1 MT		More than 5000 MW		5-15 years
Madhya Pradesh	Umaria			1000-5000 MW	Less than 1 MT	More than 25 years
Jharkhand	Saraikela	1-10 MT	More than 1 lakh tonne but < 1 MT	Less than 1000 MW		5-15 years
Karnataka	Bijapur			1000-5000 MW		Less than 5 years
Uttar Pradesh	Lalitpur			1000-5000 MW		Less than 5 years
West Bengal	Purulia	Less than 1 MT	More than 1 lakh tonne but < 1 MT	1000-5000 MW	Less than 1 MT	5-15 years
Jharkhand	Giridih	1-10 MT	More than 1 lakh tonne but < 1 MT		Less than 1 MT	
Odisha	Sambalpur	1-10 MT	More than 1 lakh tonne but < 1 MT		Less than 1 MT	
Jharkhand	Hazaribagh	Less than 1 MT	More than 1 lakh tonne but < 1 MT		10-20 MT	
Jharkhand	Ramgarh	Less than 1 MT	More than 1 lakh tonne but < 1 MT		10-20 MT	
Jharkhand	Singhbhum	More than 10 MT	More than 1 lakh tonne but < 1 MT	Less than 1000 MW		15-25 years
Jharkhand	Godda				10-20 MT	
Telangana	Peddapalli				10-20 MT	
Chhattisgarh	Surguja				10-20 MT	

States	Districts new	Steel	Sponge Iron	Power	Coal	Age
Maharashtra	Yavatmal				10-20 MT	
Jharkhand	Dhanbad	Less than 1 MT	Less than 1 lakh tonne	1000-5000 MW	More than 20 MT	5-15 years
Chhattisgarh	Durg	More than 10 MT	More than 1 lakh tonne but < 1 MT	Less than 1000 MW		5-15 years
West Bengal	Burdwan	More than 10 MT	More than 1 MT	Less than 1000 MW		More than 25 years
Uttar Pradesh	Balrampur		Less than 1 lakh tonne	Less than 1000 MW	1-10 MT	5-15 years
Chhattisgarh	Janjgir-Champa			More than 5000 MW		5-15 years
Tamil Nadu	Salem	1-10 MT	More than 1 lakh tonne but < 1 MT	1000-5000 MW		15-25 years
Gujarat	Surat	More than 10 MT				
Andhra Pradesh	Anantapur	1-10 MT	More than 1 lakh tonne but < 1 MT			
Odisha	Keonjhar	1-10 MT	More than 1 lakh tonne but < 1 MT			
Karnataka	Koppal	1-10 MT	More than 1 lakh tonne but < 1 MT			
Goa	South Goa	1-10 MT	More than 1 lakh tonne but < 1 MT			
West Bengal	West Medinipur	1-10 MT	More than 1 lakh tonne but < 1 MT			
West Bengal	Bankura	1-10 MT	More than 1 lakh tonne but < 1 MT	1000-5000 MW	Less than 1 MT	15-25 years
Madhya Pradesh	Betul			1000-5000 MW	1-10 MT	More than 25 years
Telangana	Karimnagar			1000-5000 MW	1-10 MT	More than 25 years
Telangana	Bhadradri Kothagudem				More than 20 MT	
Jharkhand	Chatra				More than 20 MT	
West Bengal	Paschim Bardhaman				More than 20 MT	
Andhra Pradesh	Vishakhapatnam	More than 10 MT		1000-5000 MW		5-15 years
Maharashtra	Nagpur	Less than 1 MT		More than 5000 MW	More than 20 MT	15-25 years
Maharashtra	Chandrapur	Less than 1 MT	More than 1 lakh tonne but < 1 MT	1000-5000 MW	More than 20 MT	15-25 years
Gujarat	Kutch	1-10 MT		More than 5000 MW		5-15 years
Odisha	Dhenkanal	More than 10 MT	More than 1 lakh tonne but < 1 MT	1000-5000 MW		5-15 years
Chhattisgarh	Raipur	More than 10 MT	More than 1 lakh tonne but < 1 MT	1000-5000 MW		5-15 years
Madhya Pradesh	Anuppur			1000-5000 MW	1-10 MT	5-15 years
Maharashtra	Raigad	More than 10 MT	More than 1 lakh tonne but < 1 MT			
Odisha	Angul	More than 10 MT	Less than 1 lakh tonne	1000-5000 MW	More than 20 MT	15-25 years
Karnataka	Bellary	More than 10 MT	More than 1 MT	1000-5000 MW		5-15 years
Uttar Pradesh	Sonbhadra			More than 5000 MW	More than 20 MT	More than 25 years
Odisha	Jharsuguda	1-10 MT	More than 1 lakh tonne but < 1 MT	1000-5000 MW	More than 20 MT	15-25 years
Chhattisgarh	Korba			More than 5000 MW	More than 20 MT	15-25 years
Madhya Pradesh	Singrauli			More than 5000 MW	More than 20 MT	15-25 years
Jharkhand	Bokaro	More than 10 MT		1000-5000 MW	10-20 MT	More than 25 years
Telangana	Mancherial			1000-5000 MW	10-20 MT	Less than 5 years
Odisha	Sundergarh	1-10 MT	More than 1 MT		More than 20 MT	
Chhattisgarh	Raigarh	More than 10 MT	More than 1 MT	1000-5000 MW	10-20 MT	5-15 years

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