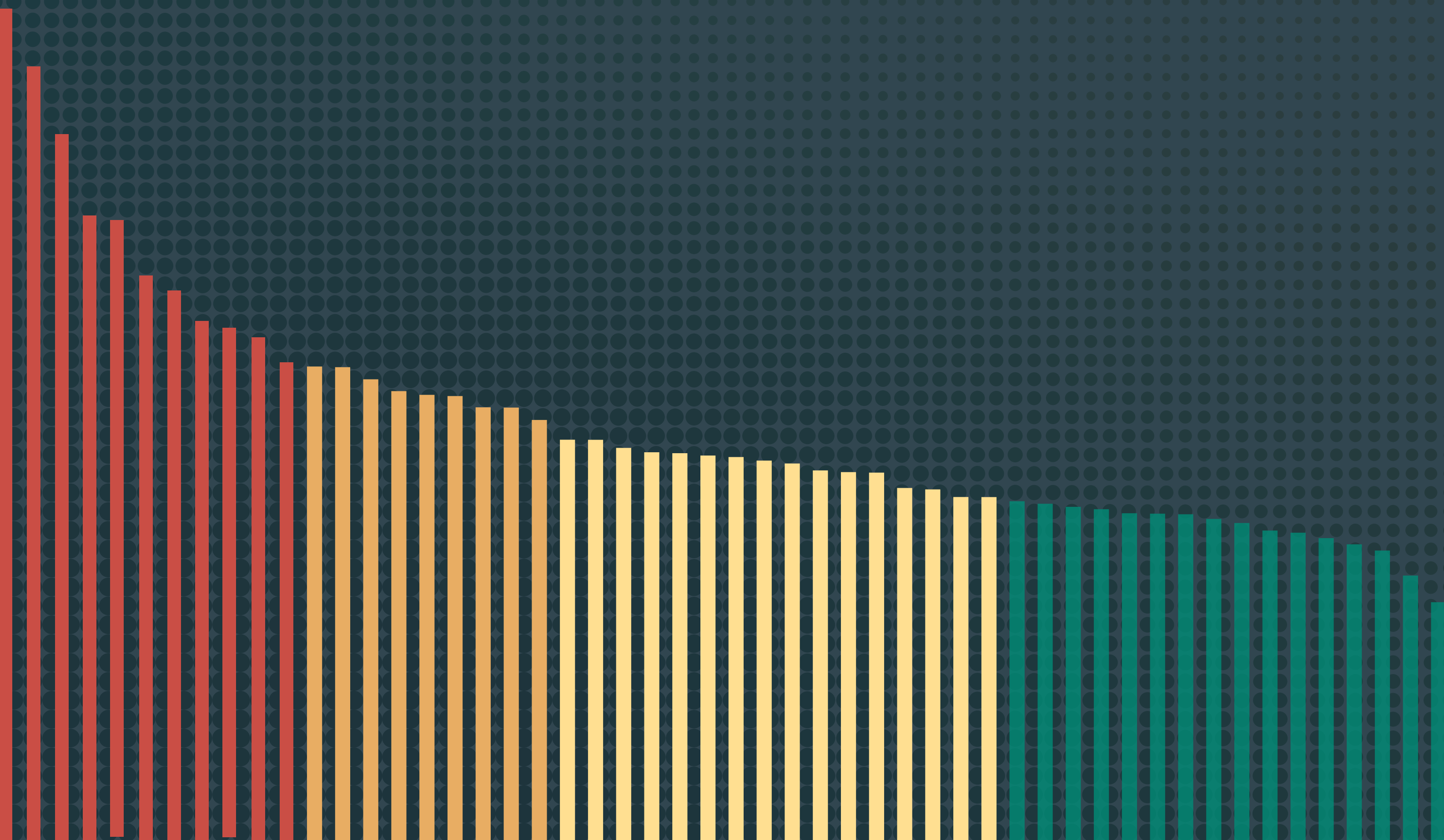
JUST ENERGY TRANSITION IN COAL DISTRICTS OF INDIA

Assessing differential vulnerability and pathways for intervention

Chinmayi Shalya, Ishita Kapoor, Sandeep Pai, Tikam Singh Banjara



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About Us

Swaniti Initiative (operating as Swaniti Global), founded in 2012, is a social enterprise that provides development solutions and technical assistance to improve the delivery of public services by leveraging research, data, and on-ground expertise. Swaniti works in areas of climate, public health, and livelihood. Swaniti's theory of change is that if people are provided with access to quality healthcare, education, employment, and social welfare programs, then everyone shall have an equal opportunity to thrive. Swaniti has worked across five countries and 11 Indian states to enable administrators to effectively implement programs within communities. Swaniti works across South and East Asia with local teams present within communities. We have 150+ team members across geographies and work in a decentralized model.

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List of Abbreviations

BT	Billion Tonnes
CCL	Central Coalfields Limited
CEEW	Council on Energy Environment and Water
CEPI	Comprehensive Environmental Pollution Index
CHC	Community Health Centre
CIL	Coal India Limited
COTRAVI	Coal Transitions Vulnerability Index
CPCB	Central Pollution Control Board
CSO	Civil Society Organisation
CSR	Corporate Social Responsibility
CTEI	Coal Transition Exposure Index
CTVI	Coal Transition Vulnerability Index
DMF	District Mineral Foundation
EPF	Employee Provident Fund
ETI	Energy Transition Index
GDP	Gross Domestic Product
GHG	Green House Gases
GoI	Government of India
GST	Goods and Services Tax
GW	Gigawatt
iFOREST	International Forum for Environment, Sustainability and Technology
IIPS	International Institute for Population Sciences
IPCC	Intergovernmental Panel on Climate Change
IPHS	Indian Public Health Standards
JJM	Jal Jeevan Mission
JPVL	Jaiprakash Power Ventures Limited
KM	Kilometer
MCL	Mahanadi Coalfields Limited
MDO	Mine Development and Operators

MLA	Member of Legislative Assembly
MoC	Ministry of Coal
MT	Million Tonnes
MTPA	Million Tonnes Per Annum
MW	Megawatt
NbS	Nature-based Solutions
NCL	Northern Coalfields Limited
ND-GAIN	Notre Dame Global Adaptation Initiative Country Index
NDC	Nationally Determined Contributions
NHFS	National Family Health Survey
NTPC	National Thermal Power Corporation
PMKKKY	Pradhan Mantri Khanij Kshetra Kalyan Yojana
PMKSY	Pradhan Mantri Krishi Sinchayee Yojana
PRI	Panchayati Raj Institution
PSU	Public Sector Undertaking
PWD	Public Works Department
RE	Renewable Energy
SDG	Sustainable Development Goal
SECL	South Eastern Coalfields Limited
TERI	The Energy Resources Institute
TPP	Thermal Power Plant
UNFCCC	United Nations Framework Convention on Climate Change
WRI	World Resources Institute

Executive Summary

The commitments made by various countries through their Nationally Determined Contributions (NDCs) to decarbonize and ramp up renewable energy (RE) deployment at scale has made weaning away from fossil fuels and emergence of diversified energy systems an impending reality.

India has also committed to a Net Zero target for 2070 and more interim targets of lowering GHG emissions and ensuring 50% of cumulative electric power capacity comes from non-fossil fuel sources by 2030. While the coal production in the country is on an upswing until the 2030s, its energy mix is already diversifying, shrinking the overall share of coal.

Need for vulnerability assessment

Even as India ramps up coal production, a spatial reality is emerging necessitating focus on regions where reserve exhaustion has occurred or is imminent in the near future. In a first, the Ministry of Coal (MoC), in 2024 acknowledged that India has 341 'abandoned/discontinued' coal mines, of which 147 will have to be closed.

In January 2025, the MoC amended its 'Guidelines for preparation of Mining Plan and Mine Closure Plan for Coal and Lignite Mines' to include the concept of 'just transformation' for local communities around coal mines to address 'the social, economic, and environmental challenges associated with mine closure activities' and allocate a proportion of the escrow fund for it.

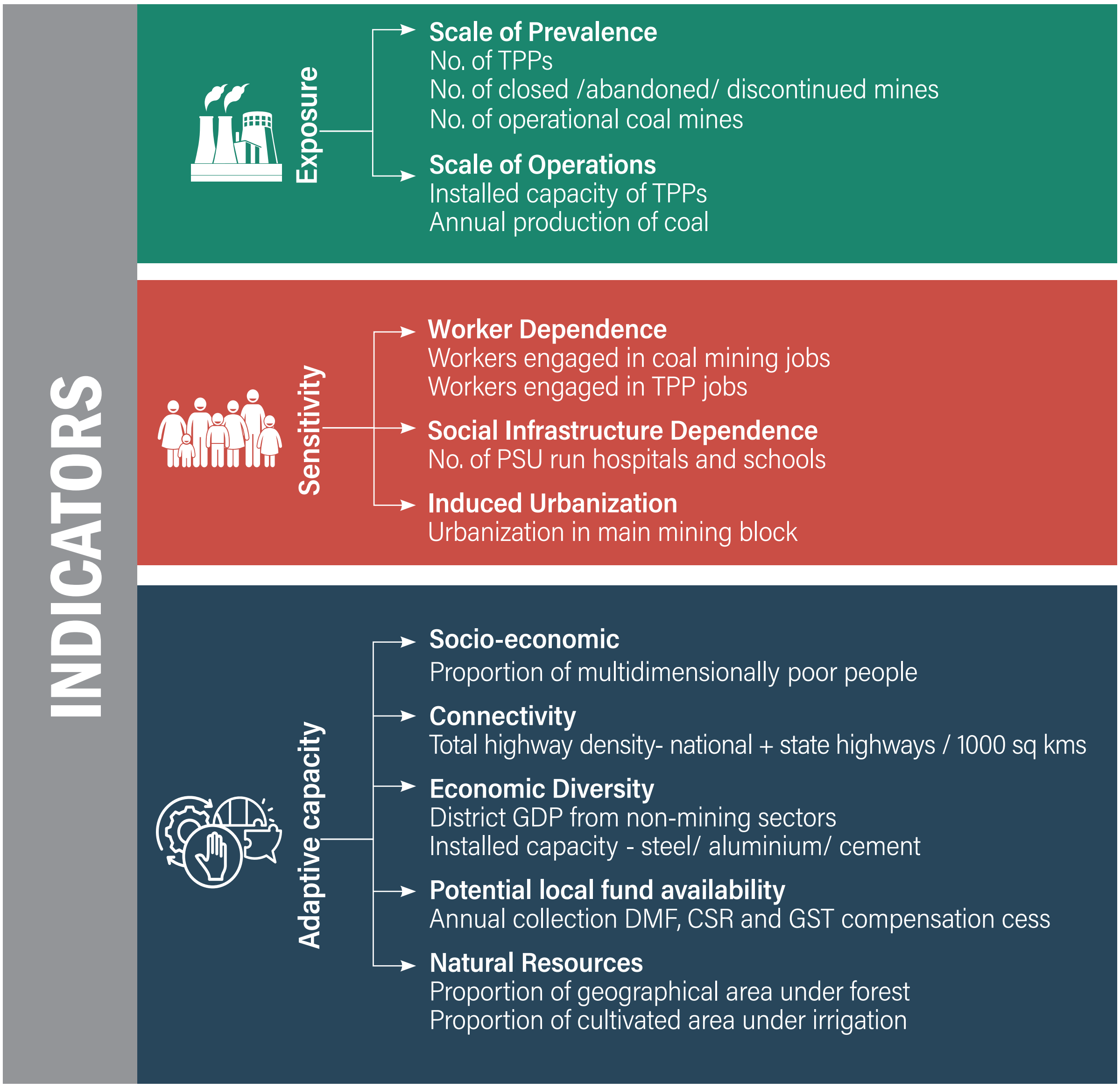
These two developments have finally mainstreamed the concern about ageing coal regions, planning for eventual reserve exhaustion in high producing regions and ensuring that the local coal dependent communities undergo the transition from the coal economy in a "just and equitable" manner.

To plan a comprehensive policy intervention in a timely, strategic and impactful manner, a comparative assessment of the sensitivities and coping capacity of coal-producing districts of India becomes necessary.

Coal Transition Vulnerability Index (CTVI)

We created a Coal Transition Vulnerability Index (CTVI) which is a tool to understand differential vulnerabilities of India's 52 coal districts. The CTVI draws from the Intergovernmental Panel on Climate Change (IPCC)'s concept of climate change vulnerability which has been adapted to a coal transition scenario. It provides a ranking of vulnerability to help understand which districts are and will be most vulnerable to coal transition. The vulnerability has been assessed on a set of indicators and weights arrived at through expert consultations.

Indicators under three pillars for district CTVI

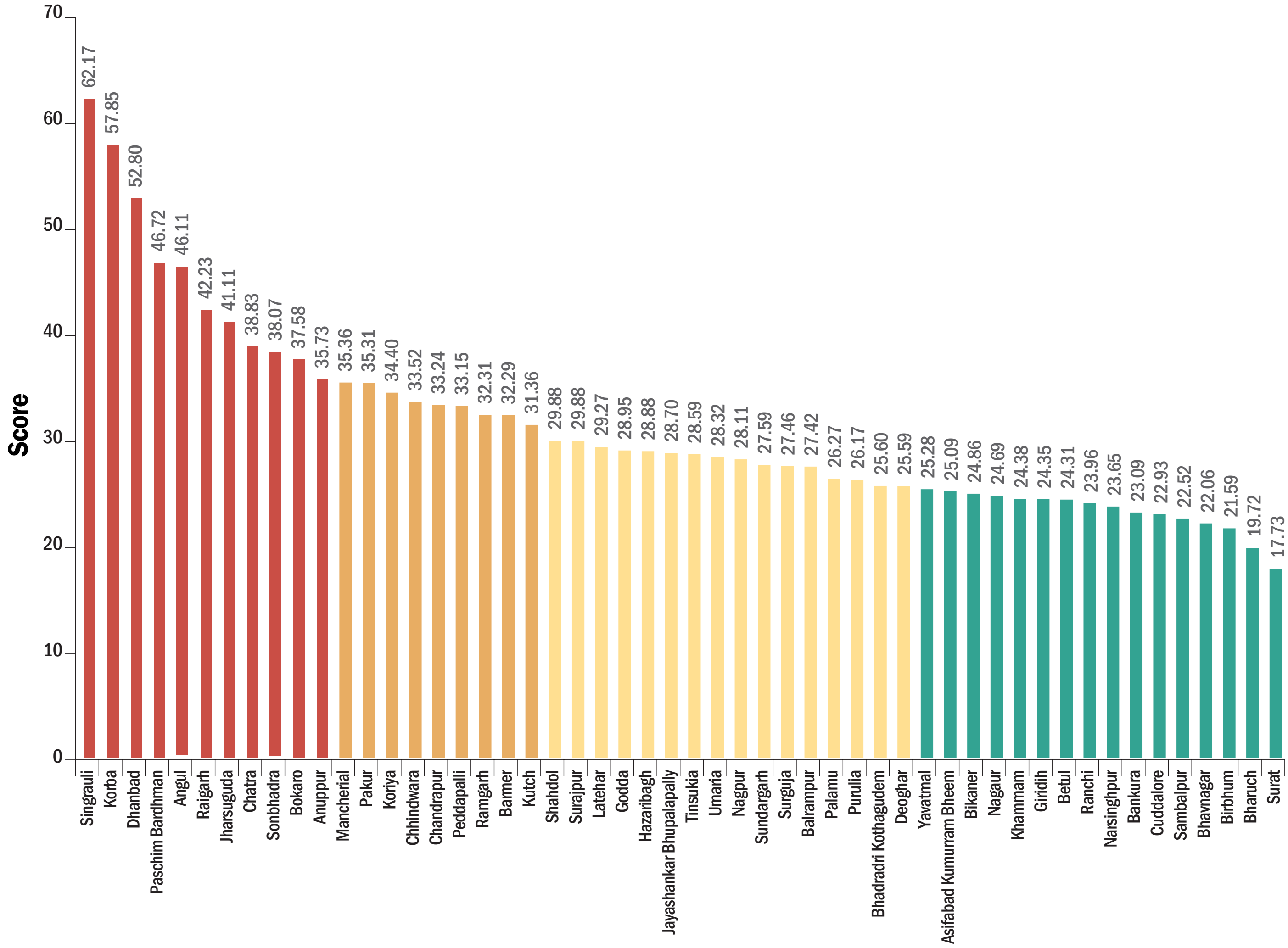


Key findings from the CTVI

Nearly 40% of coal districts fall in very high and high vulnerability categories

About 40% districts (20 out of 52 coal districts) are highly vulnerable to coal transition as per the index. These include districts which are big coal producers - Singrauli (Madhya Pradesh), Korba (Chhattisgarh), Dhanbad (Jharkhand), Angul (Odisha) etc. - and those with existing closed/ abandoned/ discontinued mine burden such as Ramgarh (Jharkhand), Koriya (Chhattisgarh), Chhindwara (Madhya Pradesh) etc.

District-wise CTVI scores and vulnerability level



Vulnerability characterized by high scale of coal production as well as existing burden of coal mines

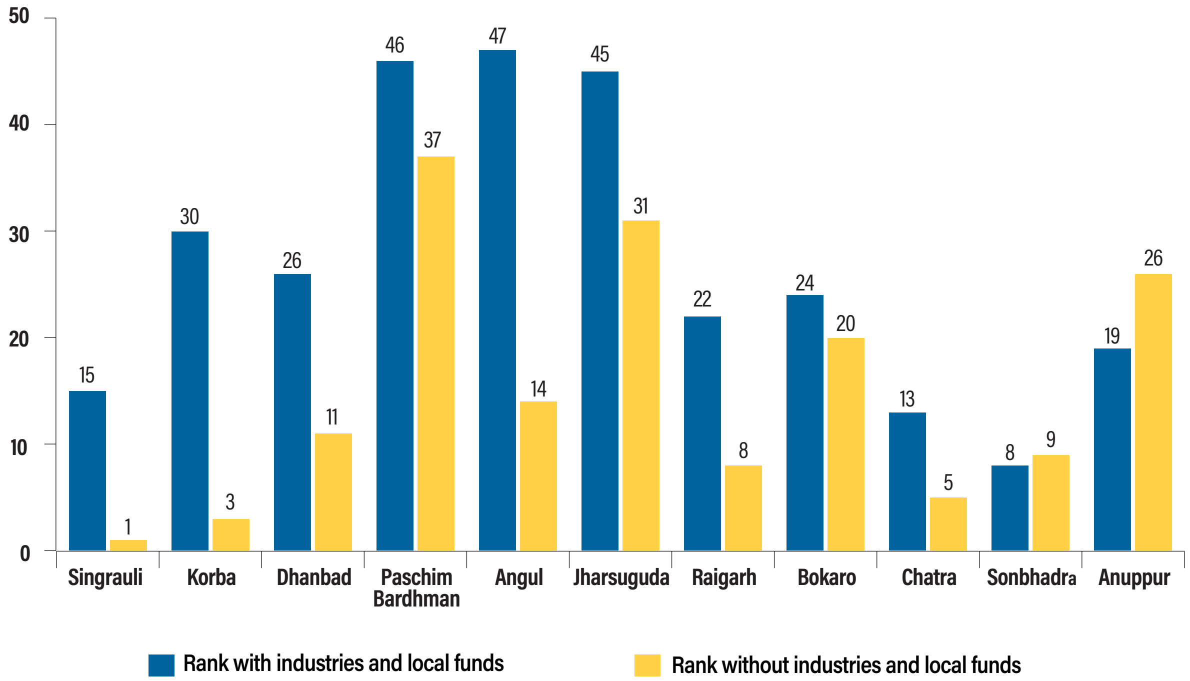
The index highlights transition vulnerability not only in districts with high coal production but also districts with a higher closed/ abandoned/ discontinued mines burden. The top most coal producing districts—Singrauli, Korba, Angul, Jharsuguda—are highly vulnerable to coal transition. These four districts make up about 40% of India's total coal and lignite production.

Additionally, these districts are with parallel realities of sizable production, higher number of coal mines and closed/ abandoned mines such as Bokaro, Ramgarh, Paschim Bardhaman and Dhanbad. Then there are districts with low production but a high number of closed/ abandoned mines such as Koriya, Chhindwara and Annupur. The local communities are already facing challenges due to coal closures in these districts.

Adaptive capacity a significant challenge; big coal districts have an edge if existing resources utilized well

Big coal producers exhibit high adaptive capacity, because CTVI indicators consider the presence of steel, aluminium, and cement industries, and availability of untied funds such as District Mineral Foundation (DMF), Corporate Social Responsibility (CSR) and GST compensation cess as available economic assets to build long-term resilience. This potential is contingent on effective utilization of the funds to build a non-coal economy and promoting fuel transition of coal-based industries. Should this not happen, the adaptive capacity of these districts would drastically reduce.

Adaptive capacity ranks of very high vulnerability districts with and without industries and local funds



12 districts are current transition epicentres, need immediate planning; 19 are future epicentres

Of the 52 coal and lignite districts, 31 have been identified as epicenters of coal transition. Of this, 19 are future epicentres where the impacts of coal transition would be felt after a decade or later, and 12 are current epicentres where the impact is already underway.

Future epicenters include districts producing 15MT of coal or more from the states of Odisha (Angul, Jharsuguda and Sundargarh), Chhattisgarh (Korba and Raigarh), Jharkhand (Chatra). Current epicenters include districts with at least 10 closed/abandoned mines, and/or more closed/abandoned mines than operational mines. Districts from Chhattisgarh (Koriya), Jharkhand (Ramgarh, Bokaro), Madhya Pradesh (Chhindwara, Anuppur), Maharashtra (Chandrapur), etc. fall in this category.

Hence, while big coal states might be looking at increased coal production in the coming years, some of their districts need just transition intervention immediately.

Recommendations for policymakers

For national-level policymakers

- Creating policy and guidelines for a just energy transition which is aligned with the national Net Zero 2070 target.
- Creating a cross-ministerial secretariat to build the policies for a just transition which would include Niti Aayog, along with relevant ministries including MoC, Ministry of Power, Ministry of New and Renewable Energy, and non-government experts.
- Building financing for just transition, locally and through international cooperation. Considering funneling of GST compensation cess to coal states for non-coal development.
- Initiating a ranking-based district coal transition program to align with Niti Aayog's Aspirational Districts Programme which targets converging various fund sources to improve adaptive capacity across socio-economic and resource potential indicators of coal districts and improve resilience to transition, and improve their overall capacity and ranking. The recently launched Aspirational DMF Program by the Ministry of Mines is one such initiative.
- Integrating just energy transition as a tenet of sustainable development goals for coal districts. As the adaptive capacities of most coal districts are poor and the local economy and social infrastructure needs to be improved.

For state-level policymakers

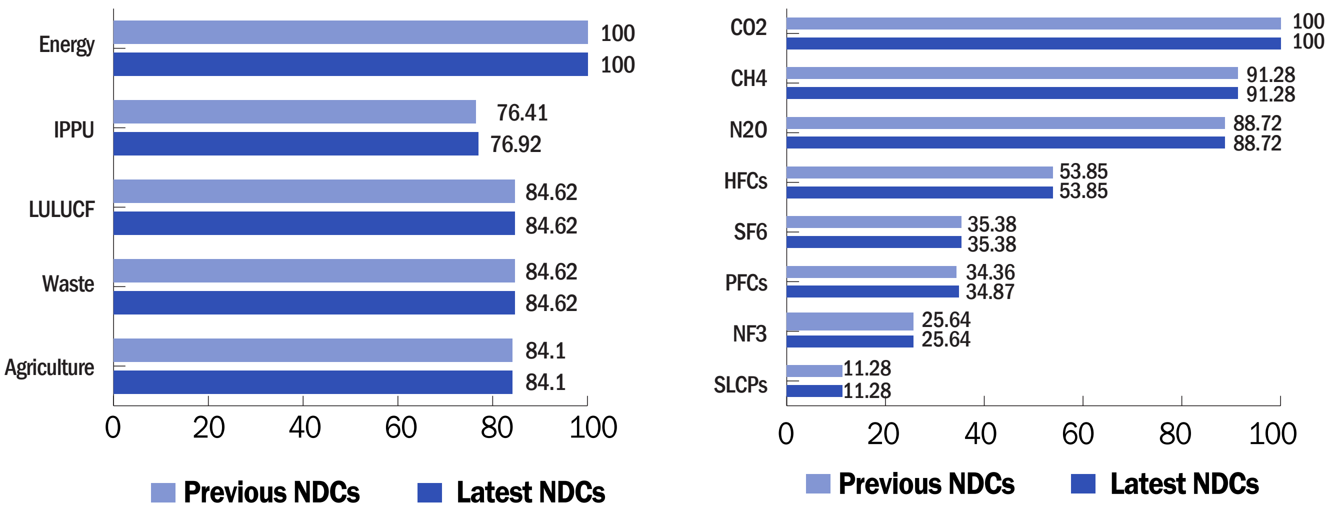
- Creating state and district-level institutions such as task forces or secretariats to plan and coordinate on a just coal transition.
- Improving long-term adaptive capacity for just transition in districts focussing on broader non-coal socio-economic measures.
- Aligning local untied funds such as DMF and CSR with just transition.
- Prioritizing current epicenters for immediate just transition planning and developing future transition epicenters to avoid large scale challenges.

CHAPTER 1

Introduction

The commitment by countries to limit the rise in global temperature to 1.5°C above pre-industrial levels and reduce the impacts of climate change will require collective efforts towards decarbonization.[1] As per the United Nations Framework Convention on Climate Change (UNFCCC), all countries have committed through their NDCs or Nationally Determined Contributions to ambitious renewable energy development and deployment, coupled with targets for reduction of greenhouse gases like carbon dioxide, nitrogen oxides, methane and hydrofluorocarbons.[2] In the long run, these commitments mean weaning away from fossil fuels and developing stable green energy systems. Therefore, even though this means that in the short and medium terms the use of fossil fuels might grow in absolute terms, it will be accompanied by increasingly diversified energy systems, as green technologies become more accessible and deployable at scale.

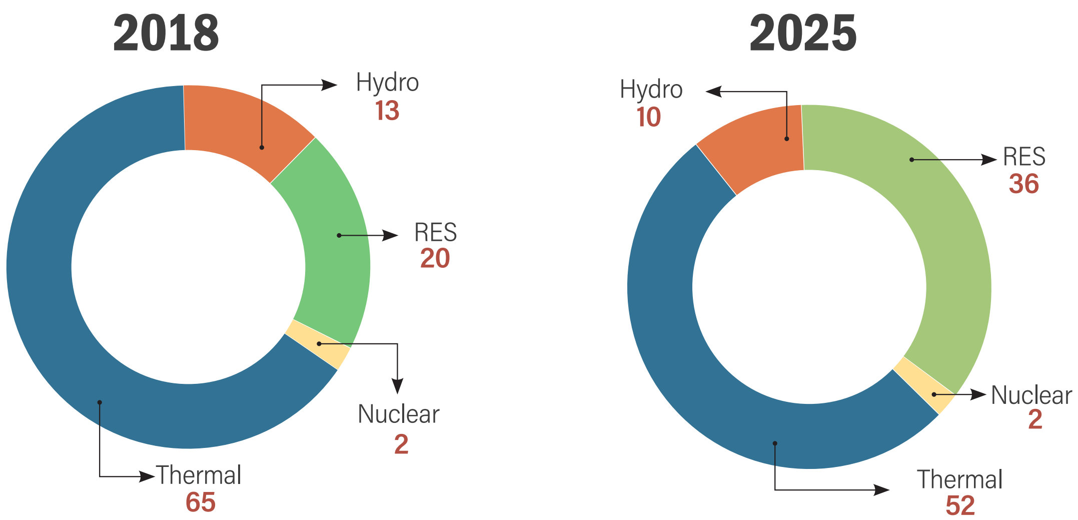
Figure 1.Sectors and greenhouse gases covered by countries in their NDCs



Source: United Nations Framework Convention on Climate Change, 2024

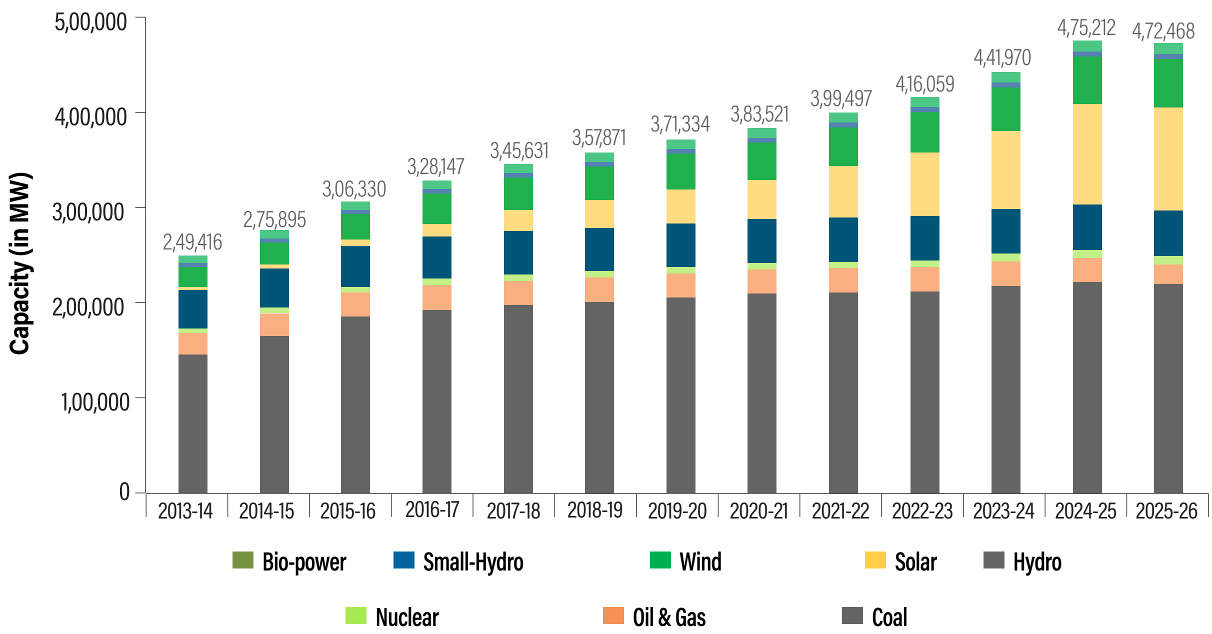
India too is moving towards targeted energy growth, driven by its NDCs and the target of Net Zero 2070. In the short term, it seeks to reduce its emissions intensity by 45% (compared to 2005 levels) and ensure 50% of the cumulative electric power capacity from non-fossil fuel sources by 2030.[3] Consequently, even as India aims to ramp up its coal production to a target of 1.5 billion tonnes (BT) by 2030[4], its overall energy mix is already diversifying and gradually shrinking the dominant role of coal (Figure 2). This is also visible in the year-on-year growth rate of renewable energy sources (Figure 3).

Figure 2. India's installed energy mix (2018 and 2025)



Source: National Power Portal, Ministry of Power, Government of India.

Figure 3. Source-wise energy capacity growth rate



Source: India Climate and Energy Dashboard, Niti Aayog, Government of India, 2025.

The gradual transition away from coal in India will be driven by two parallel trajectories. First, its coal growth story will be spatially concentrated. India will achieve its 1.5 BT production target but through large mining operations. Even today, India's coal mines are spread across 12 states and 52 districts, but 65% of its over 1 BT of production comes from only 75 coal mines,[5] with just four states—Odisha, Chhattisgarh, Jharkhand and Madhya Pradesh–cumulatively producing over 77% of the coal (Annexure I).

This means that a vast number of mining operations are currently, and will continue to remain, low producing, and in several cases even unprofitable.

Second, resource exhaustion in older coal regions will increase, leading to the closure of several coal mines. The Ministry of Coal (MoC), in 2024 acknowledged that India has 341 'abandoned/ discontinued' coal mines, of which 147 will have to be closed, while the rest will be merged with ongoing operations.[6]

To put it in the global context, the number of 'abandoned/discontinued' mines destined for closure in India is equivalent to the total number of the coal mines in Europe. This poses unique and significant socio-economic challenges for the coal-producing regions where these mines are located.

Acknowledging the potential impacts of coal mine closure, in January 2025, the MoC amended its 'Guidelines for preparation of Mining Plan and Mine Closure Plan for Coal and Lignite Mines' to include the concept of 'just transformation' for local communities around coal mines to address 'the social, economic, and environmental challenges associated with mine closure activities.' The guidelines describe "just transformation" as the "equitable process of transitioning from traditional coal/lignite mining" and "addressing the social, economic, and environmental challenges associated with mine closure activities".[7]

The guidelines place two unprecedented but crucial concerns at the heart of coal production in India:

- A significant number of coal mines will be formally closed in the immediate and near future;
- Considering the various targets and the dual reality of coal expansion and reserve exhaustion regionally, it is certain that socio-economic challenges pertaining to coal transition will hit home in several coal regions.

These realities necessitate action for non-coal dependent and local economic and social development.

Hence, the first step is to develop a holistic understanding of the coal transition burden on various districts and their current capacity to adapt and cope with this change. While the coal ecosystem is complex and usually intertwined with local socio-political and economic dynamics, a broad set of parameters can provide a comparative understanding of the differential vulnerability of coal districts in India.

This study aims to provide an assessment of coal-producing districts of India through a coal transition vulnerability index or CTVI, underscoring their differential vulnerability to coal transition, as per the current status of coal mines and production and their respective potential capacities to mitigate the impacts of transition.

Deriving from the climate vulnerability index, it provides data-based insights into the exposure, sensitivity and adaptive capacity of districts to energy transition, and a final ranking as to where they stand as compared to other such districts. It is designed to give national and state-level decision-makers a bird's eye view of the vulnerable districts and plan policy and intervention in a phased and long-term manner to create non-mining local economies and social well-being.

It also seeks to inform other stakeholders—industry, think tanks and civil society groups—to know which regions are vulnerable, and focus their efforts in welfare investments, research, and discourse building accordingly.

LITERATURE REVIEW AND EXISTING GAP

The vulnerability assessments have typically been done to assess climate change-related impacts and associated coping capacities. There are several indices which map out climate change vulnerability, the most prominent one being the climate vulnerability assessment by the Intergovernmental Panel on Climate Change (IPCC).[8] Others include the ND-GAIN index by the University of Notre Dame[9] and the Climate Risk Index by German Watch.[10]

In the Indian context too, climate vulnerability has been assessed at state and district levels by government and non-government institutions. These include the Climate Vulnerability Assessment by the Department of Science and Technology[11], Climate Vulnerability Index by the Council On Energy Environment and Water (CEEW)[12], and the Climate Resilient Cities by the World Resources Institute (WRI), India.[13]

Considering its inextricable link to climate action, energy transition vulnerability indices have also been attempted globally and nationally. The work so far has focussed on inter-country vulnerability evaluation in context of RE energy system developments (such as the ETI by the World Economic Forum[14], COTRAVI[15], CTEI by the International Energy Agency[16], and the Mining Vulnerability Index[17]).

In India, district-level studies have been conducted by think-tanks such as Swaniti Initiative, International Forum for Environment, Sustainability and Technology (iFOREST), The Energy Resources Institute (TERI) etc which have combined primary and secondary data to evaluate deep impacts of coal transition locally. Indexing has only been attempted so far at an inter-state level (Climate Policy Initiative)[18] and at the district-level by the University of Ahmedabad.[19] The district-level index looks at various parameters to determine exposure, sensitivity and adaptive capacities. However, this study deviates from the University of Ahmedabad's study in its method (refer 2.2.5) and the interpretation of indicators which have been determined after a series of discussions with a diverse set of stakeholders (refer 2.2.3).

This study combines publicly available secondary data with ground-level contexts and expert insights to create an index of district-level vulnerability and capacity to cope with a reserve exhaustion scenario. An attempt has also been made to further slice the vulnerability at the administrative block level, to indicate local capabilities and focus of intervention for state governments.

CHAPTER 2

Methodology

Although determined by national commitments, the impacts of decarbonization will be most keenly felt at the sub-national level where socio-economic ecosystems around coal mining have developed over the decades. Considering this, we have assessed the comparative vulnerability of all districts in India.

2.1 Research questions

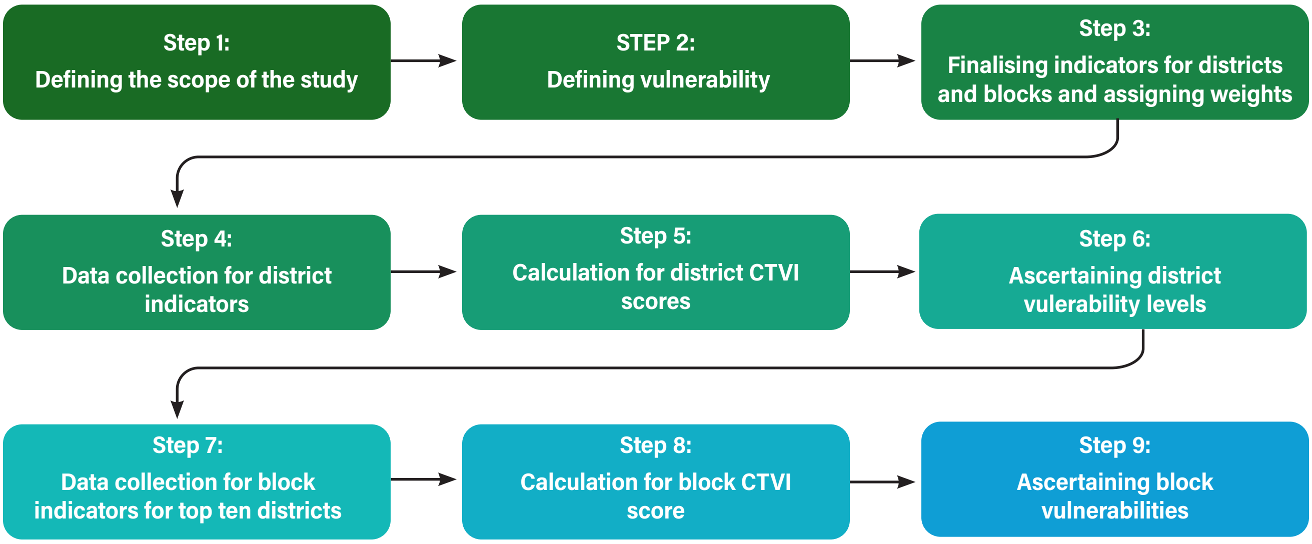
Through the study we seek to answer the following research questions:

1. Among all coal districts in India, which are the most vulnerable to coal transition in the current scenario?
2. Since mining is often a concentrated activity and a coal transition planning will require a targeted localized approach, which of the mining blocks[1] would be most vulnerable within the most vulnerable districts?
3. What can be the key strategies–nationally and sub-nationally–to assess vulnerability and build resilience of these districts towards coal transition?

2.2 Study approach and methodology

To address the research questions, we have developed a coal transition vulnerability index (CTVI) which provides a comparative vulnerability ranking between the districts across a broad and common set of indicators. The study approaches the index through critical datasets, combined with expert insights into the indicators, their relevance and intensity of vulnerability. A breakdown of the methodology has been provided in Figure 4.

Figure 4. Methodology



2.2.1 Defining the scope of the study

The scope of the study has been defined at two levels:

a. **Conceptual:** The assessment and creation of CTVI is strictly based on a set of key indicators for which secondary data is publicly available. It is conceived as an evaluation framework for practitioners to ascertain vulnerability in various geographies through relevant indicators based on the available data.

   The CTVI does not delve into site-specific assessments or primary data sets, which are typically ascertained through ground-level studies. Some of these are, however, established through case studies.

b. **Spatial and temporal:** The CTVI considers all 52 coal mining districts of India[2], spread across 12 states (Map 1). Transitioning away from coal is likely to have a distinct timeline and impact for each district, depending on the coal reserves and financial viability of the operations. The assessment and CTVI look at the vulnerability as of today, based on current operations and the existing burden on closed/ abandoned/ discontinued mines.

2.2.2 Defining vulnerability

To answer the research questions, the study adapts the Intergovernmental Panel on Climate Change (IPCC)'s concept of climate change vulnerability to a coal transition scenario to assess the impact on districts and on administrative blocks.

The IPCC defines climate change vulnerability as "the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements, including sensitivity or susceptibility to harm and lack of capacity to cope and adapt."[3]

The concept of vulnerability is a synthesis of three components or pillars–exposure, sensitivity and adaptive capacity–which determine the extent of impact in the context of resilience.

The IPCC's definitions are adapted to the coal transition scenario to denote "the susceptibility to the impact of the phase out of coal mines due to reserve exhaustion or financial infeasibility or climate change commitments, and the resilience to cope and adapt to the change." The three key pillars of vulnerability are defined accordingly, as follows:

- **Exposure,** in the context of coal transition, has been defined as exposure to the scale of coal mining and coal-based thermal power plant (TPP) operations. This includes the number of coal mines and the level of coal production, and the number of TPPs and their capacity to generate power, the closure or scaling down of which would impact local jobs, economy and access to social infrastructure.[4,5]

- **Sensitivity** has been defined to capture the susceptibility and impact of coal mining and coal-based TPP closure on local communities. This includes local workers dependent on these operations for jobs, associated urbanisation and social infrastructure dependence on coal companies, which will be impacted in the event of closure or reduction in operations.[6]

- **Adaptive capacity** has been defined to capture the social and economic resilience of the regions to withstand the transition process and adapt to new economic systems. This includes socio-economic well-being, diversity of local economy, potential revenue, fund sources, and local natural resource potential.[7]

Figure 5. Three pillars of coal transition vulnerability

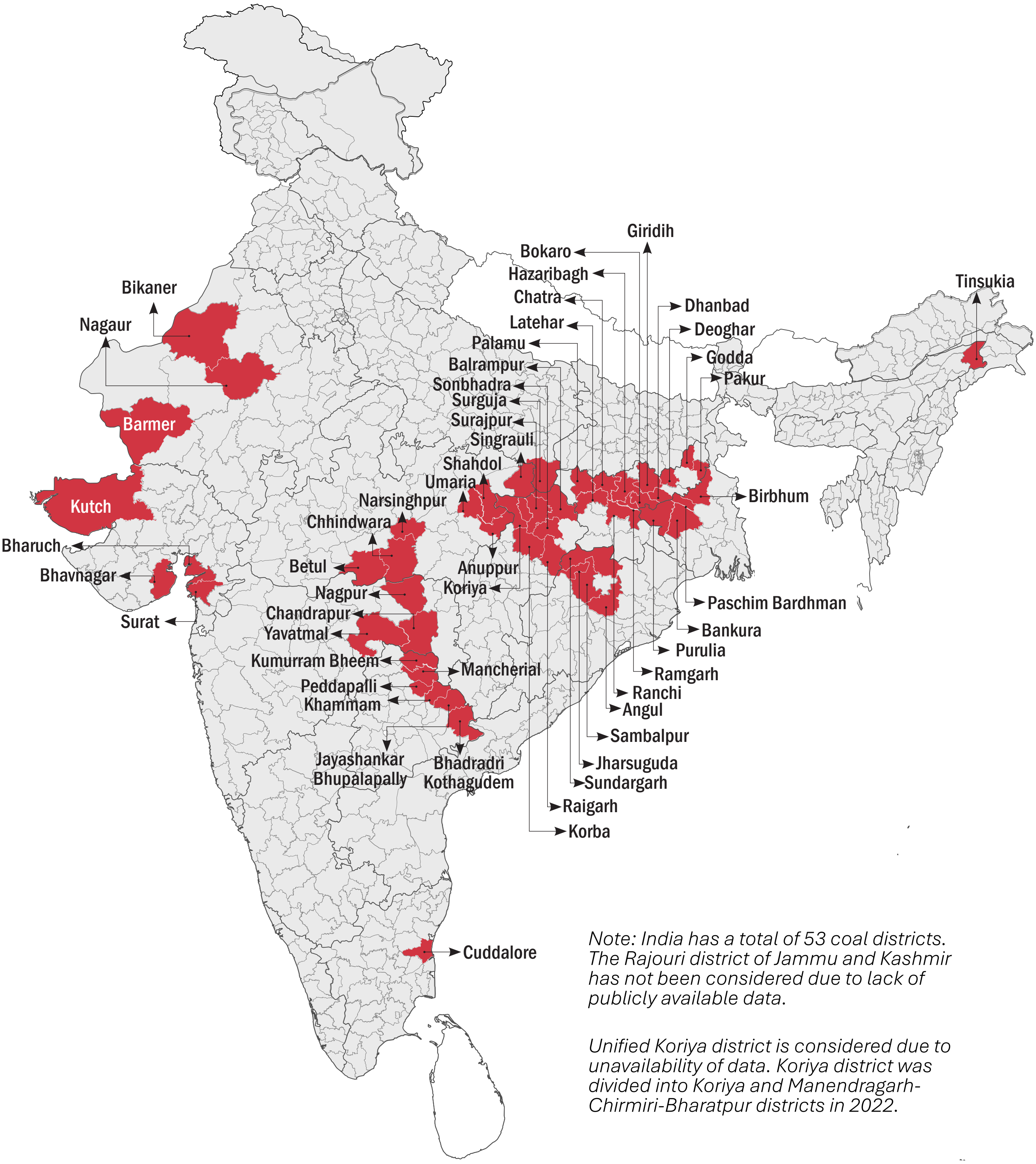
2.2.3 Indicators and weights

The indicators and weights assigned are determined through consultations with domain experts. We worked with 16 experts from leading think tanks, administrators from top coal-producing states of Odisha and Chhattisgarh, and industry experts from coal, coal-based power, and steel to finalize the set of indicators and their respective weightage.

The first round of discussions with each expert included detailed feedback and discussions on the adequacy and appropriateness of the indicators as prepared by our team. A final set of indicators was developed based on the experts' feedback.

After the indicators were discussed and finalized, we followed a weightage system based on participation[8], where we adopted the budget allocation method, wherein the experts were asked to assign differential weights to the indicators within a scale of 100, based on their perceived role and influence on districts and block vulnerability. A trend analysis of the expert weights was done before their finalization.

Map 1. Coal districts in India considered for the study



Note: India has a total of 53 coal districts. The Rajouri district of Jammu and Kashmir has not been considered due to lack of publicly available data.

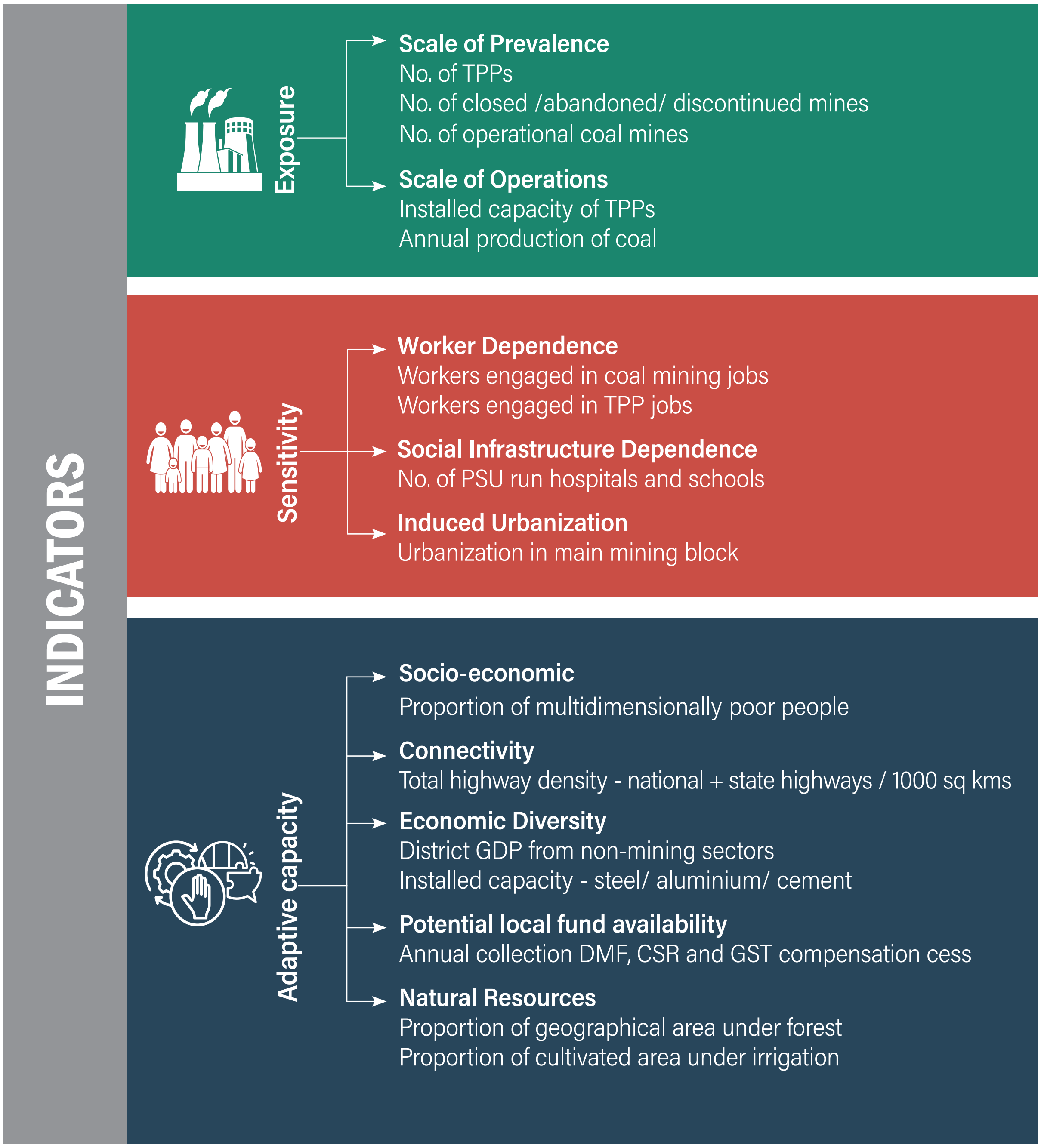
Unified Koriya district is considered due to unavailability of data. Koriya district was divided into Koriya and Manendragarh-Chirmiri-Bharatpur districts in 2022.

Finally, the overall vulnerability levels were finalized with the experts.

a. **Indicators:** Indicators are essential to the assessment of vulnerability, and are eventually aggregated to create the index.[9] We developed representative indicators under each pillar based on a literature review and series of iteration with domain experts. Figure 6 depicts the district-level indicators, and Table 1 elaborates on the rationale behind each indicator.

For block CTVI, the indicators for exposure and sensitivity remain the same. The adaptive capacity indicators are modified considering the fact that block-level data for the same parameters is not available in the public domain.

Figure 6. Indicators under three pillars for district CTVI



b. **Assigning weightage to pillars and indicators:** Among the pillars, adaptive capacity has been given the highest weightage of 40%, exposure is given 35%, and sensitivity 25%. This is because the capacity to adapt was perceived to be the biggest determinant of the district's vulnerability.

Most experts felt that sensitivity is a corollary to exposure. Hence, exposure was weighed higher than sensitivity.

Table 1. Rationale for indicators

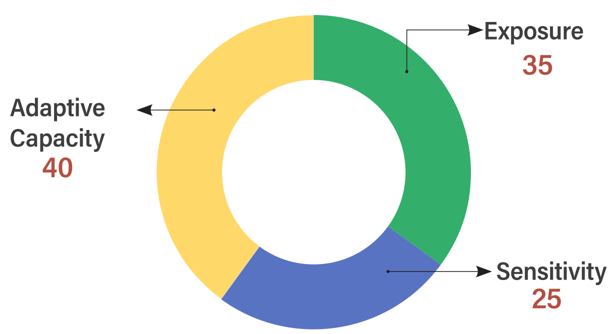
Indicator	Rationale	Relation to CTVI
EXPOSURE		
No. of coal mines in the district	To determine the extent of the operations. The presence of mines indicates local jobs and economic activity in the region, thereby exposing the communities to coal transition.	↑
Coal production (MT) in the district in 2024-25	To determine the scale of operations. High production would have a direct bearing on the number of jobs and a broader economic focus in the region.	↑
No. of closed/ abandoned/ discontinued coal mines	To determine the existing transition burden due to declining coal reserves, financial unviability, etc.	↑
No. of TPPs	To determine the presence of a coal industry ecosystem which may lead to higher dependence and a bigger transition impact.	↑
Installed capacity (MW) of TPPs	To determine the scale of operations of TPPs. Plants with higher capacity operations would create more jobs and socio-economic dependence.	↑
SENSITIVITY		
Working population engaged in coal mining jobs (%)	To determine local dependence on coal mining for livelihood. This includes departmental[10], contractual[11] and informal workers[12] (including truckers).	↑
Working population engaged in TPP jobs (%)	To determine local dependence on coal TPPs for livelihood. This includes departmental[13], contractual[14] and informal[15] workers (including truckers).	↑
Urban population in the main mining block (%)	To determine induced urbanization in the main block[16] due to coal mining activity. Such dependency indicates chances of reverse urbanization in a depletion or closure scenario.	↑
Number of company-run and/ or -funded hospitals and schools	To determine dependency on coal companies (particularly PSUs such as Coal India Limited (CIL)), for social infrastructure and access.[17,18]	↑
ADAPTIVE CAPACITY – DISTRICT		
Proportion of multidimensionally poor people (%)	To determine socio-economic resilience of the local population and access to social infrastructure and basic amenities.	↑
Total highway density—national + state/ 1000 sq km (Ratio)	To determine existing connectivity for future industrial access and mobility of goods (raw materials, finished products, etc.), services, and human resources.	↓
Steel, aluminium and cement – total installed capacity (MTPA)	To determine the presence of more diverse economic and livelihood avenues. These industries are likely to go through a fuel transition, but will not face closure.	↓
District GDP from the mining sector (%)	To determine the diversity of the local economy. A higher proportion of GDP from non-mining sectors would represent a more diverse economy.	↓
GST compensation cess, DMF and CSR: estimated annual collection at current production (crore rupees)	To determine local fund potential for building social and economic resilience since District Mineral Foundation (DMF)[19] and Corporate Social Responsibility (CSR)[20] are accrued/utilized at the district level. GST compensation cess[21], if funnelled back to the districts, can also be utilized for local resilience building.	↓
Geographical area under forest (%)	To determine natural resource potential for scalable Nature-based Solutions (NbS) and alternative livelihoods.	↓
Cultivated area under irrigation (%)	To determine the harnessed water potential for any infrastructural and industrial set-up.	↓
ADAPTIVE CAPACITY – BLOCK		

CHC to population ratio (ratio)	To determine the availability of public tertiary healthcare or the community health centers (CHC) to the population.[22]	↑
Literacy rate (%)	To determine the level of the literate population as an enabler of skill and job creation.	↓
Households with tap water connections under JJM (%)	To determine access to basic amenities and the efficiency of scheme implementation in coal mining areas.	↓
DMF projects sanctioned in high priority sectors (%)	To determine the efficiency of scheme implementation in coal mining areas.[23]	↓
Block's geographical area under forest cover (%)	To determine natural resource potential for scalable Nature-based Solutions (NbS) and alternative livelihoods.	↓
Block's geographical area under cultivation (%)	To determine natural resource potential for scalable Nature-based Solutions (NbS) and alternative livelihoods.	↓
Block's cultivated area under irrigation (%)	To determine the harnessed water potential for any infrastructural and industrial set-up.	↓

Within the pillars, coal mining indicators are ranked higher, as they form the base of the study and the impact area to be assessed. TPP-related indicators are ranked relatively lower, as their operations were perceived to be smaller, and overall worker dependence on them to be much lower than coal.

Among adaptive capacity indicators, the highest weightages are assigned to economic diversity through the proportion of non-mining GDP and local fund availability for economic diversification and socio-economic development. Similar weightages are assigned to indicators for connectivity and local resource potential, as they hold promise for non-coal development if leveraged well.

Figure 7. Weights assigned to pillars



2.2.4 Data collection for all indicators

Once the indicators for both the district and block levels were fixed, data was collected primarily from published government documents. The latest available data has been used (Annexure II), but for some indicators, estimations and calculations are used.

2.2.5 Calculation of scores for district CTVI

To arrive at an index score, secondary data against each of the indicators is collected and normalized using the min-max technique.[24] Once the data is normalized into scores from 0-100, the weighted average is taken to derive the district score under each pillar. All three pillars measure vulnerability in the same direction, i.e., higher score on exposure, sensitivity, or adaptive capacity would contribute to a higher score on CTVI. After this, the overall CTVI is derived for each district as the weighted geometric mean of its score under the three pillars. A higher final score indicates more vulnerability in the district.

$$Final\ Score = \sqrt[(w_1 + w_2 + w_3)]{Exposure^{w_1} + Sensitivity^{w_2} + Adpative\ Capacity^{w_3}}$$

Figure 8. Indicator weights for CTVI

2.2.6 Ascertaining levels of vulnerability

The CTVI scores, derived from the indicators, are clustered into four different levels of vulnerability based on their score, as depicted in Table 2. The levels are finalized based on expert consultations.

Table 2. Levels of vulnerability

Score	Vulnerability level
Above 35	Very High
31-35	High
26-30	Moderate
25 and below	Low

2.2.7 Calculation of scores for block CTVI

After ascertaining the vulnerability at the district level, we select the districts with "Very high" vulnerability for a further block level assessment. We calculate the scores for all the coal mining blocks in these districts and a final ranking was derived.

2.2.8 Evaluation of block CTVI

Based on the ranking and scores, a final comparative assessment of the blocks is done. The levels of vulnerability are not applied at the block level as these blocks are already part of the districts with "very high" vulnerability.

2.3 Limitations of the study

- **High-level understanding of coal transition:** This study provides a high-level, comparative analysis across districts and is unable to capture nuances related to gender, caste, other demographics, and variations in labor characteristics.

- **Current-state analysis:** The study is based on static data and presents a snapshot of the vulnerabilities of the districts in the present moment. The index doesn't aim to offer a dynamic picture, nor does it account for any factors that might indicate change or growth, which limits its ability to capture the timeline of the energy transition. While the index identifies regions that would be vulnerable to the transition, it does not give a definite period of time in which the transition will take place.

- **Reliance on publicly available secondary data:** The index uses publicly available, secondary data from existing literature and government portals. It utilizes the most up-to-date data available for the districts and blocks assessed here. Ideally, a primary data survey would have provided the most accurate data, but it was beyond the scope of this study.

CHAPTER 3

Results

3.1 Overall CTVI ranking and evaluation

Our results show that 20 out of 52 districts are highly vulnerable to any future coal transition (Figure 9), i.e., having high levels of exposure to coal mining and co-dependent sensitivities, which are compounded by low adaptive capacities. These 20 districts are spread across 10 states. The overall CTVI score shows that:

- Eleven of the 52 districts (21%) fall in the "very high" vulnerability category (Figure 9);
- Another nine districts fall in the "high" vulnerability category (Figure 9);
- The "very high" and "high" vulnerability categories include districts which are not only coal producers but also have coal-based TPP operations, and an existing burden of closed/ abandoned/ discontinued mines. This is compounded by their low adaptive capacity (Annexure VI);
- The "moderate" category comprises 16 districts with relatively low coal production but high number of closed/ abandoned/ discontinued mines, notwithstanding some exceptions (Annexure VI);
- Most of the lignite districts, and small coal-producing districts show "low" vulnerability levels, with sixteen districts falling in this category (Annexure VI).

The CTVI shows a wider range of scores for exposure and sensitivity, indicating high mining activities and dependency in some districts, and lower concentrations in others. The adaptive capacity however shows clustering of districts within a smaller range. This is due to the fact that the range of human development indicators, resource potential, and economic diversity is smaller. For instance, in exposure and sensitivity, big coal districts such as Singrauli and Chatra are distinctly identifiable in Figure 10, with barely any other districts overlapping in the same range. However, in adaptive capacity, these districts share space with others indicating similar socio-economic realities. There are a few exceptions for instance, while Sundargarh demonstrates high exposure, it can be clearly identified among others for its high adaptive capacity.

Figure 9. District-wise CTVI scores and vulnerability level

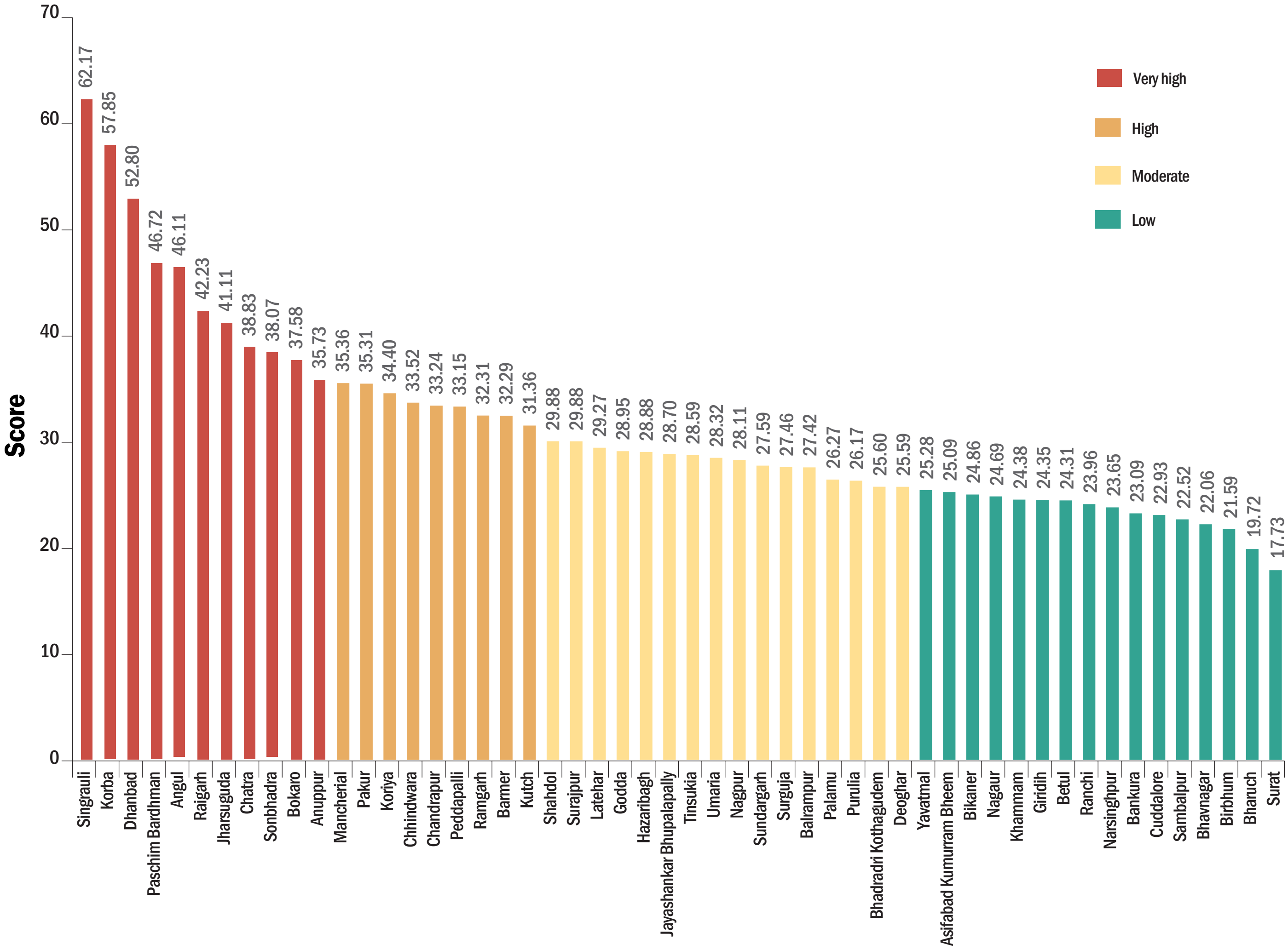
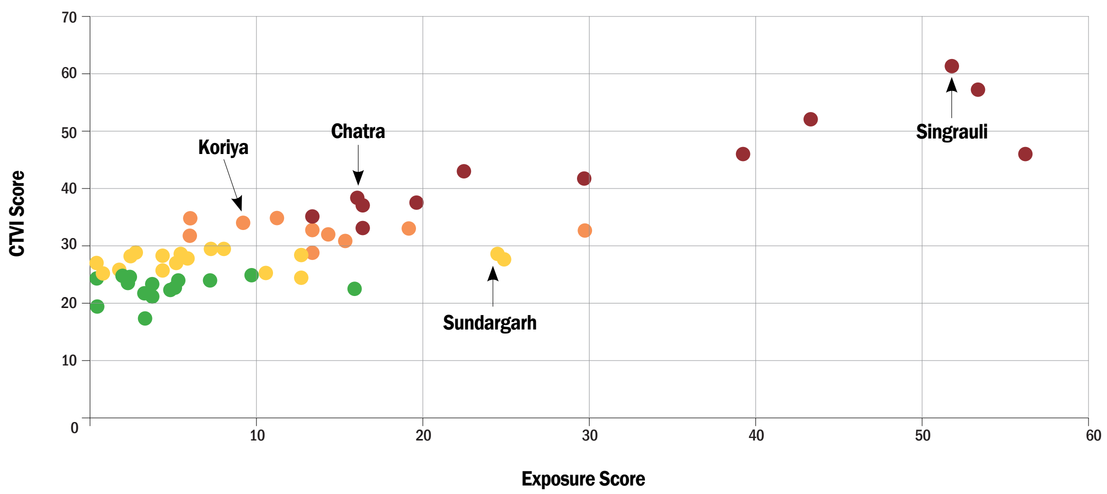
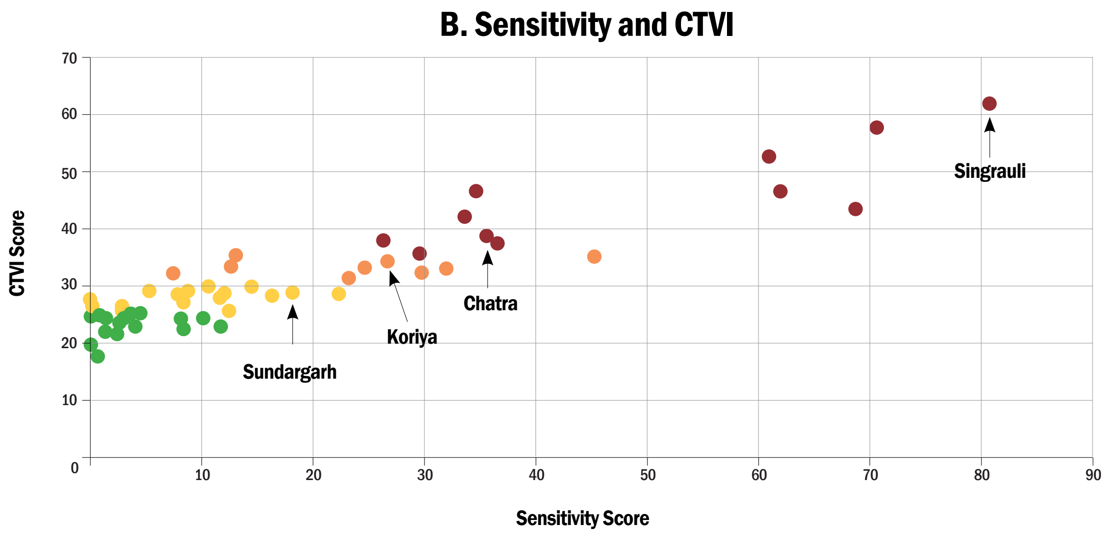
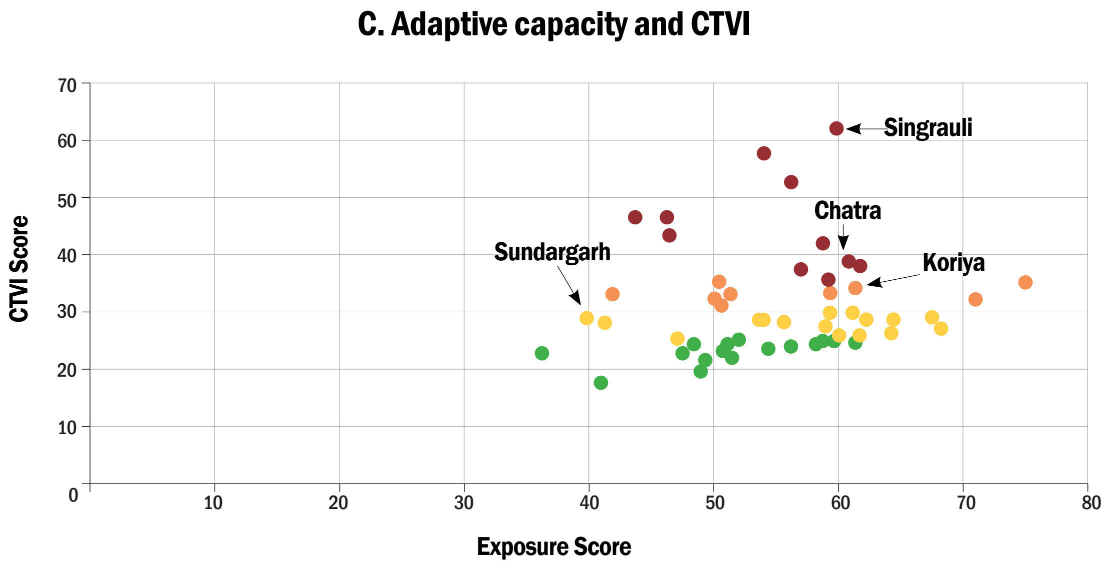


Figure 10. Correlation of district CTVI score with pillar scores

A. Exposure and CTVI







3.2 Assessment according to vulnerability levels

3.2.1 Very high vulnerability districts

The CTVI shows that 11 districts are highly vulnerable to coal transition in India (Table 3). These districts are either among the topmost coal-producing districts—such as Singrauli (143 MT), Korba (127 MT) and Angul (114 MT)—or (and) have a high number of operational coal mines, such as Paschimi Bardhman and Dhanbad. All of these have TPP operations of various scales. Overall, about 62% of India's total coal production and 48% of operational coal mines come from the "very high" vulnerable districts (Annexure VI).

Four of these districts—Paschimi Bardhman, Dhanbad, Anuppur and Bokaro—also have a high number of closed/ abandoned/ discontinued coal mines (Annexure VI).

In absolute numbers, the districts falling in this category produced 668 MT of India's 1,088 MT coal in 2024-25, and have 201 of the 423 operational mines and 148 of the 316 closed/ abandoned/ discontinued mines.[1]

Table 3. Districts with "very high" coal transition vulnerability

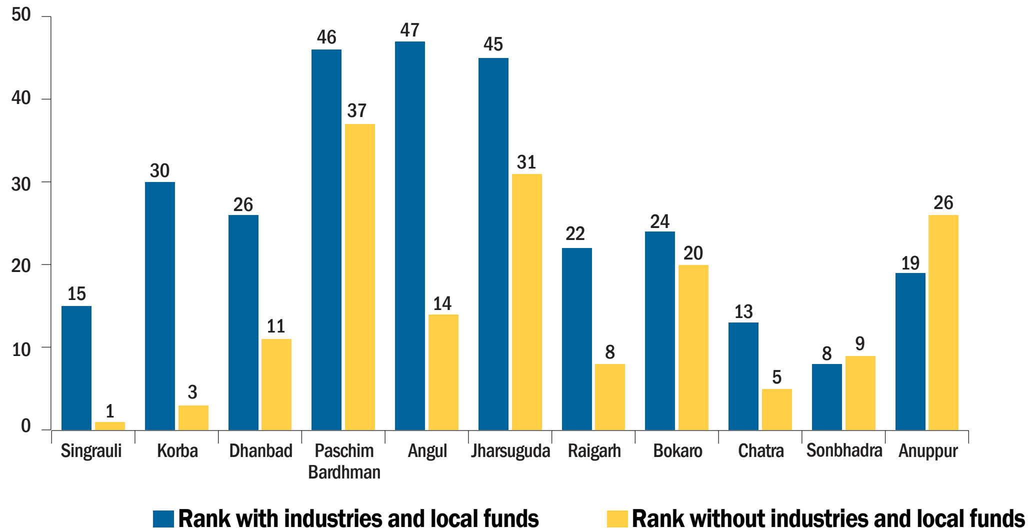
District	State	CTVI Rank	Score	Vulnerability Level
Singrauli	Madhya Pradesh	1	62.170	Very high
Korba	Chhattisgarh	2	57.846	Very high
Dhanbad	Jharkhand	3	52.799	Very high
Paschim Bardhman	West Bengal	4	46.716	Very high
Angul	Odisha	5	46.112	Very high
Raigarh	Chhattisgarh	6	42.229	Very high
Jharsuguda	Odisha	7	41.105	Very high
Chatra	Jharkhand	8	38.826	Very high
Sonbhadra	Uttar Pradesh	9	38.069	Very high
Bokaro	Jharkhand	10	37.584	Very high
Anuppur	Madhya Pradesh	11	35.726	Very high

The high exposure factors have led to high levels of local livelihood and social dependency. The big producing districts—Singrauli, Korba, Angul, Jharsuguda, Dhanbad, Paschim Bardhman, Chatra—have at least 10-15% workers engaged in coal mining and TPP jobs in a formal or informal manner.[2]

They also exhibit associated urbanization and induced economic development in the major mining blocks. For instance, districts like Korba, Dhanbad have nearly 66% and 74% urban population in their major mining blocks respectively. This urbanization is much higher than the districts' overall urbanization, which is 37% for Korba and 60% for Dhanbad.[3] In fact, the top coal-producing district in the country, Singrauli, is 90% rural, but its main mining block has about 26% urban population. This has been correlated with coal-mining activities in these districts, based on our ground interaction with locals and administrators.

Therefore, 10 of the 11 districts fall among the top 15 in exposure and sensitivity pillar rankings (Annexure III and IV). These districts, however, exhibit high adaptive capacity compared to others. This is largely because CTVI indicators consider the presence of steel, aluminium, and cement industries, and availability of untied funds such as DMF, CSR and GST compensation cess as available economic assets to build long-term resilience.

Figure 11. Adaptive capacity ranks of very high vulnerability districts with and without industries and local funds



Hence, better adaptive capacity is contingent on effective utilization of these resources to generate local non-mining livelihoods and improve the socio-economic well being of the local communities. Should these funds not be utilized well, or the local steel, cement and aluminum industries prove unable to sustain in these geographies, the adaptive capacity of these districts would drastically reduce (Figure 11). This is because the other adaptive capacity parameters of these districts fare poorly in terms of the proportion of multidimensionally poor people. In almost all districts, the proportion is higher than the India average of 14.96%.[4] In Singrauli and Sonbhadra, the proportion is as high as 30% (Annexure VI). GDP from the mining sector is also sizeable in disricts like Korba (58.4%), Singrauli (57%), Angul (30%), Chatra (26%) (Annexure VI).

3.2.2 High vulnerability districts

The CTVI assessment shows that 9 districts are in the high vulnerability category. This includes districts with rank 12 to 20. However, a closer look shows that there is no wide variability in the absolute scores within this category (Table 4).

Table 4. Districts with "high" coal transition vulnerability

District	State	CTVI Rank	Score	Vulnerability Level
Mancherial	Telangana	12	35.361	High
Pakur	Jharkhand	13	35.311	High
Koriya	Chhattisgarh	14	34.404	High
Chhindwara	Madhya Pradesh	15	33.519	High
Chandrapur	Maharashtra	16	33.241	High
Peddapalli	Telangana	17	33.150	High
Ramgarh	Jharkhand	18	32.307	High
Barmer	Rajasthan	19	32.288	High
Kutch	Gujarat	20	31.362	High

The category includes some high-producing districts such as Chandrapur (30.7 MT), Pakur (21 MT), and Peddapalli (21 MT). Of these, Chandrapur and Peddapalli also have TPP operations.

Mining and TPP operations have led to a relatively high worker dependency on coal mining and TPP industry. About 7%-10% of these districts' population is engaged in the coal and TPP industry in formal or informal jobs (Annexure VI). These districts, however, do not show much coal associated urbanization, largely due to newer mining operations (Pakur) or due to overall industrial development (Chandrapur, Peddapalli) in the district and in the state at large.

This category also includes districts which are currently low-producing but have a high number of closed/ abandoned/ discontinued mines, such as Koriya (14)[5], Chhindwara (44), Chandrapur (17), and Ramgarh (18). These districts show high urbanization in the main mining block, indicating that older mining operations have led to induced urban dependence which would be sensitive to coal transition.

Some of these districts (Koriya, Chhindwara and Ramgarh) also have a high proportion of multidimensionally poor population compared to the India average of 14.96% (Annexure VI), and a lower availability of local funds such as DMF and CSR due to low production, which reduces their overall adaptive capacity and enhances vulnerability.

The category also includes two lignite producing districts—Kutch and Barmer. Kutch has been propelled to a high rank due to its production levels and a very high TPP capacity (9 GW), while Barmer has one of the poorest adaptive capacity rankings (Annexure V). Ground verification, however, shows that these districts are likely to have only localized impacts of coal transition, which will largely be exacerbated due to very poor adaptive capacity, particularly connectivity challenges, low forest and cultivation potential, and limited availability of local funds.

3.2.3 Moderate vulnerability districts

The "moderate" category includes 16 districts with largely low production, lower number of operational mines, and minimal or no closed/ abandoned/ discontinued mines burden. Most of them, however, have poor adaptive capacity, indicating local challenges in addressing the impacts of coal transition.

Table 5. Districts with "moderate" coal transition vulnerability

District	State	CTVI Rank	Score	Vulnerability Level
Shahdol	Madhya Pradesh	21	29.884	Moderate
Surajpur	Chhattisgarh	22	29.877	Moderate
Latehar	Jharkhand	23	29.272	Moderate
Godda	Jharkhand	24	28.945	Moderate
Hazaribagh	Jharkhand	25	28.875	Moderate
Jayashankar Bhupalapally	Telangana	26	28.700	Moderate
Tinsukia	Assam	27	28.587	Moderate
Umaria	Madhya Pradesh	28	28.321	Moderate
Nagpur	Maharashtra	29	28.105	Moderate
Sundargarh	Odisha	30	27.587	Moderate
Surguja	Chhattisgarh	31	27.460	Moderate
Balrampur	Chhattisgarh	32	27.422	Moderate
Palamu	Jharkhand	33	26.273	Moderate
Purulia	West Bengal	34	26.167	Moderate
Bhadradri Kothagudem	Telangana	35	25.597	Moderate
Deoghar	Jharkhand	36	25.591	Moderate

Of the 16 districts in this category, 10 produced less than 10 MT of coal in 2024-25. The exceptions include Sundargarh (79.4 MT), Hazaribagh (32 MT), Nagpur (24.5 MT), Bhadradri Kothagudem (17 MT), Surguja (16.9 MT), and Godda (18 MT).

Only six of these districts—Shahdol, Umaria, Nagpur, Sundargarh, Bhadradri Kothagudem and Purulia—have TPP operations as well.

While the overall exposure and sensitivity levels in these districts are lower, poor adaptive capacity makes it imperative to plan for coal transition at the local level. For instance, 13 of the 16 districts have a higher proportion of multidimensionally poor people compared to the India average of 14.9%. All the districts (except Sundargarh) have low fund potential from coal and thereby significantly fewer untied resources for economic development and diversification.

The biggest exception in this category is Sundargarh district. Despite being the fourth largest coal producer with nearly 79 MT of production in 2024-25, the district falls in the moderate category due to lower sensitivity to the scale of production and high adaptive capacity defined by relatively better connectivity, economic diversity (through the presence of steel industry and the tertiary sector in parts of the district), sizeable DMF funds which come not only from coal, but also from iron ore mines, and a high natural resource potential.

Multiple factors contribute to low sensitivity. First, it is a new mining region, even within Odisha. It does not have any underground mining operations, which were the first kind to come up in Angul or Jharsuguda in Odisha and older regions like Dhanbad or Ramgarh district. Second, the district has only seven big open-cast mines, concentrated in only one block, Hemgir. The new mining operations, as per officials of Mahanadi Coalfields Limited (MCL), which is the PSU operating dominantly in the district, have ensured that methods are highly mechanized and less labor intensive.

The newer operations have also meant that induced urbanization in the region has not occurred yet. In contrast to Jharsuguda, where coal mines are located within a two to three kilometer radius from the municipality, Sundargarh's mines are connected by roads through forested areas.

However, a reassessment of the district's vulnerability would be required in the coming years, as it is slated to see a rise in coal production. Even with the current capacity of coal mines and the mineable reserves, coal would last in the district for another 30 years. Additionally, private coal mines of 23.26 MTPA are already in the offing, and several other coal blocks have been allotted.[6] These are likely to change the sensitivity parameters drastically.

3.2.4 Low Vulnerability districts

The "low" category includes most of the lignite districts as well as coal districts with much lower production compared to other categories. The only exceptions are Cuddalore (20 MT), Sambalpur (17 MT), Yavatmal (15MT), and Khammam (14.2 MT). Collectively, the 16 districts in this category account for eight percent of the total coal and lignite production of 2024-25. Another key distinct characteristic of these districts is a relatively less number of closed/ abandoned/ discontinued mines, which reduce the exposure drastically.

Table 6. Districts with "low" coal transition vulnerability

District	State	CTVI rank	Score	Vulnerability Level
Yavatmal	Maharashtra	37	25.283	Low
Asifabad Kumurram Bheem	Telangana	38	25.092	Low
Bikaner	Rajasthan	39	24.862	Low
Nagaur	Rajasthan	40	24.685	Low
Khammam	Telangana	41	24.382	Low
Giridih	Jharkhand	42	24.350	Low
Betul	Madhya Pradesh	43	24.306	Low
Ranchi	Jharkhand	44	23.959	Low
Narsinghpur	Madhya Pradesh	45	23.651	Low
Bankura	West Bengal	46	23.087	Low
Cuddalore	Tamil Nadu	47	22.927	Low
Sambalpur	Odisha	48	22.521	Low
Bhavnagar	Gujarat	49	22.057	Low
Birbhum	West Bengal	50	21.590	Low
Bharuch	Gujarat	51	19.720	Low
Surat	Gujarat	52	17.726	Low

Hence, worker dependency is much lower (Annexure VI), and no clear association can be established with local urbanization. Additionally, some of them have better adaptive capacities, particularly Khammam, Cuddalore, Sambalpur, Bharuch, Surat, etc. which are overall well connected and urbanized regions. This capacity is not contingent on coal-based industries (steel, aluminium, and cement) or revenue, but on other indicators such as better connectivity, urbanization, and the diversity of the local economy.

These districts are likely to have smaller localized impacts of coal transition in the future. However, they have the adaptive capacity to cope if planned well. The district with ongoing transition away from coal is Betul, where there are as many as four closed/ abandoned/ discontinued mines, the same in number to operational ones.

3.3 Block-level CTVI

3.3.1 Overview

Block-level CTVI is an attempt to establish the concentration of coal transition vulnerability within the various administrative blocks in a district. While the district will remain the unit for planning for a coal transition, a block-level vulnerability assessment shows that even among the various mining blocks, some have a heavier concentration of coal mining and TPPs than others. It is crucial to understand these nodes, as they would not only engage locals, but also attract workers from other parts of the district or state. From a planning perspective, these blocks would also need more focused industrial planning due to local economic conditioning, labor availability and land use conditions. The index considers the 31 coal mining blocks of the 11 districts in the "very high" vulnerable category as per the district CTVI (Table 7).

Table 7. Coal mining blocks considered for CTVI

State	District	Block	State	District	Block
Odisha	Angul	Talcher	**Jharkhand**	Bokaro	Bermo
		Kaniha			Gomia
		Chendipada			Chandankiyari
	Jharsuguda	Lakhanpur		Chatra	Tandwa
		Jharsuguda			
Chhattisgarh	Korba	Katghora		Dhanbad	Dhanbad
		Korba			Nirsa
		Podi-Uproda			Baghmara
		Pali	**West Bengal**	Paschim Bardhman	Pandabeswar
	Raigarh	Tamnar			Asansol Kulti Township
		Gharghoda			Andal
		Dharamjaigarh			Salanpur
Madhya Pradesh	Anuppur	Kotma			Jamuria
	Singrauli	Baidhan			Barabani
		Chitrangi			Faridpur-Durgapur
Uttar Pradesh	Sonbhadra	Dudhi			Raniganj

3.3.2 Results

The overall block CTVI scores establish the specific vulnerability points among the districts. The top 10 most vulnerable blocks, i.e., those with the highest score, run parallel to the 11 districts they were selected from. The scores indicates that not every mining block is as vulnerable as the other, even within a very highly vulnerable district.

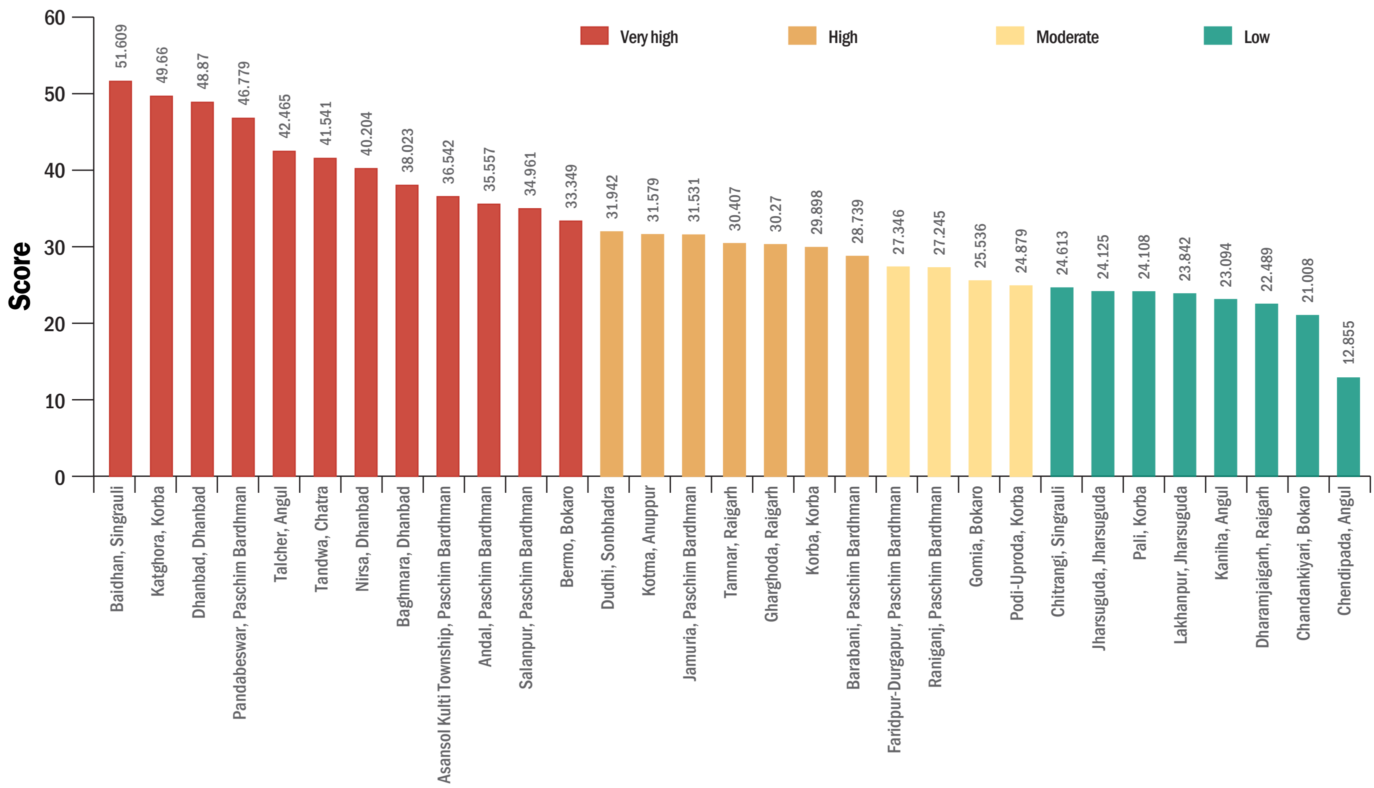
The overall findings suggest that most of the major mining blocks, i.e., those with a concentration of mines and high levels of production, rank higher or are more vulnerable. This is not only due to the high exposure and sensitivity, but also their adaptive capacity. Some of the natural resource potential for forests and agriculture is limited in these mining blocks (Annexure VIII). For instance, within Singrauli, the top coal-producing district of India, mining exists in Baidhan and Chitrangi blocks. Baidhan is ranked the most vulnerable block across districts, while Chitrangi has low vulnerability (Figure 12).

This is largely due to the fact that the concentration of operational mines, production and TPPs is in Baidhan, leading to high sensitivity in terms of worker dependence and associated urbanization (Annexure VIII). The adaptive capacity of the two blocks is also different. Chitrangi has better scheme implementation and higher natural resource potential in terms of forests and cultivation.

Similarly, in Angul, of the three mining blocks, Talcher, Kaniha and Chhendipada, Talcher ranks fifth on the CTVI, falling in the very high vulnerability category, whereas Kaniha and Chhendipada are in the low vulnerability category.

The results show that regional development for coal transition will needs to be done keeping the “very high” and “high” vulnerability blocks as the targets. A holistic planning approach will be required with due consideration to the overall potential and capacity of the district.

Figure 12. CTVI scores and levels of vulnerability of key mining blocks



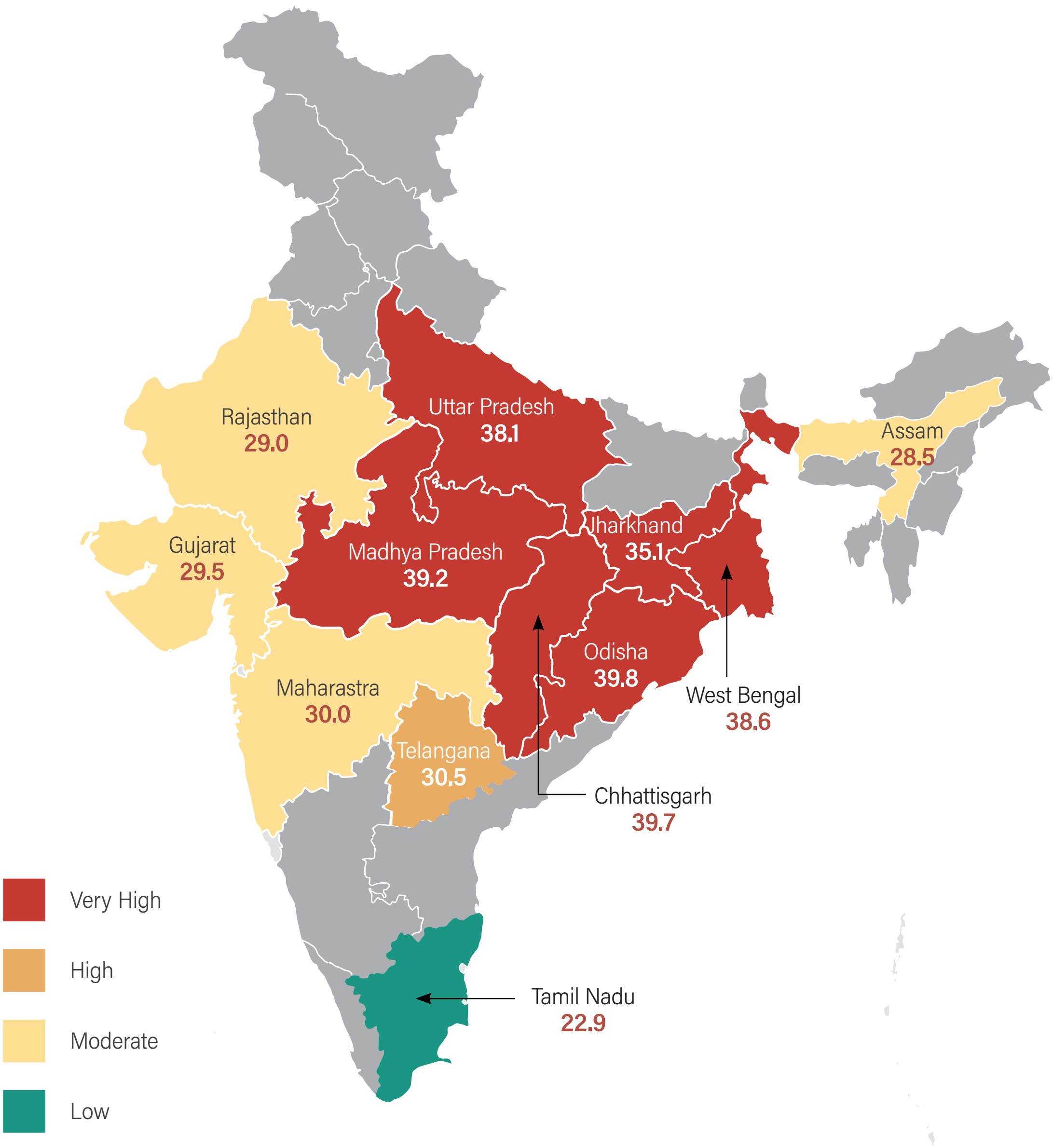
3.4 Aggregating CTVI for targeted policy action

Policy planning and action for coal transition at the district level will be driven by state and national government policies. While districts will face most of the social and economic impacts, planning for the transition, financial resource building, comprehensive local economic development, and job creation will be the prerogative of the state administration. Hence, it is crucial to understand the overall vulnerability of the states as determined by the composite vulnerability of the districts.

To understand this, and as a broad guidance for policy, we have drawn a weighted average of the district CTVI scores to determine an overall state-level vulnerability to coal transition.

The aggregated CTVI shows that the topmost coal-producing states—Odisha, Chhattisgarh, Jharkhand, Madhya Pradesh, West Bengal, and Uttar Pradesh—fall in the "very high vulnerability" category. These states account for 83% of India's total coal production[7], 74% of the operational coal mines, and 85% of the closed/ abandoned/ discontinued mines.

Map 2. Aggregated CTVI scores at the state level



Only one state—Telangana—falls in the "high vulnerability" category. It accounts for about 6.5% of India's coal production, 10% of the operational coal mines, and nearly 5% of the closed/ abandoned/ discontinued mines.

The "moderate vulnerability" states have relatively lower levels of coal production, and a much lower burden of closed/ abandoned/ discontinued mines, particularly in the case of Gujarat and Rajasthan. While there are significant TPP operations, the overall sensitivity is low due to lower worker engagement and no direct links to induced urbanization. States like Maharashtra and Gujarat also display better adaptive capacity. These account for 8% of India's coal production, 15.5% of operational mines and 10% of closed/ abandoned/ discontinued mines.

While all coal districts will undergo the transition sooner or later, the scale of impact is likely to vary as per their level of production and the number of mines located there. Knowing the stage of transition of districts within a state will be important for timely and targeted planning.

Considering this, we also determined the current and future epicenters for coal transition, i.e., those districts which are likely to have an impact of scale. This identification is strictly based on coal mining-related indicators. For this, we considered two inclusion criteria:

- Future epicenters, or districts with 15 MT of coal production and above;
- Current epicenters, or districts with at least 10 closed/ abandoned/ discontinued mines, and/or more closed/ abandoned/ discontinued mines than operational mines, irrespective of the total production.

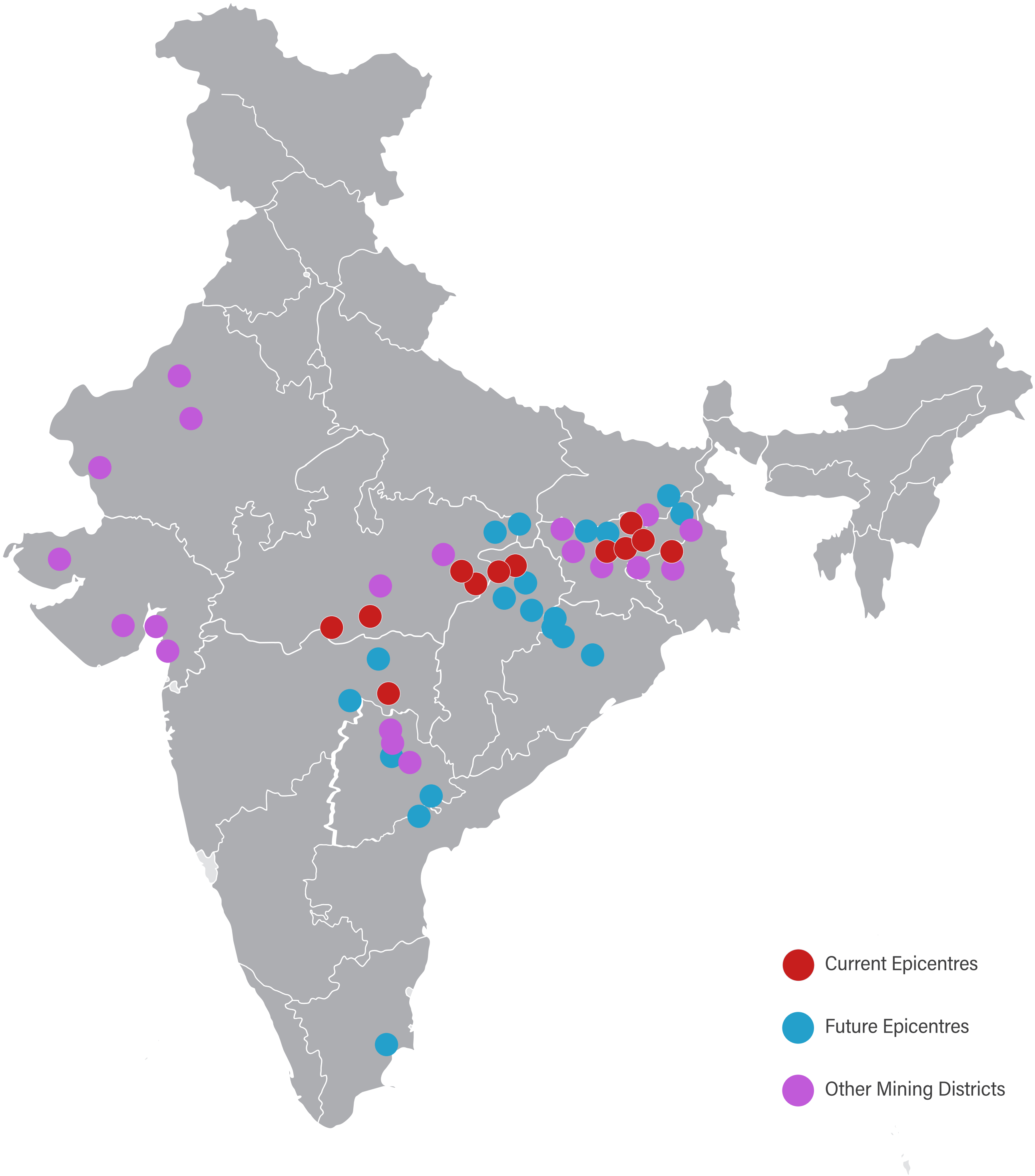
Of the 52 districts, 31 are or will be the epicenters of coal transition. Of these, 19 are future epicenters while 12 are current epicenters. The assessment also shows that realities of reserve exhaustion and growing coal production co-exist in big coal states. For instance, of the six coal-mining districts in Chhattisgarh, two are already undergoing a coal transition, while three will face it in the future. In Jharkhand, 8 of the 12 districts were identified as undergoing a transition of scale. Of these, four key districts are already in the midst of it while also producing significant coal, and four others will undergo transition in the future.

These would necessitate planning and intervention in the short, medium and long-term to ensure that the transition is just.

Table 8. Current and future coal transition epicenters

State	Current epicenters	Future epicenters
Odisha	Nil	Angul, Jharsuguda, Sundargarh, Sambalpur
Chhattisgarh	Koriya, Surajpur	Korba, Raigarh, Surguja
Jharkhand	Dhanbad, Bokaro, Ramgarh, Giridih	Chatra, Pakur, Godda, Hazaribagh
Madhya Pradesh	Anuppur, Chhindwara, Shahdol, Betul	Singrauli
Maharashtra	Chandrapur	Nagpur, Yavatmal
Telangana	Nil	Peddapalli, Khammam, Bhadradri Kothagudem
Tamil nadu	Nil	Cuddalore
Uttar Pradesh	Nil	Sonbhadra
West Bengal	Paschim Badhman	Nil

Map 3. Current and future coal transition epicenters



3.5. Ground-truthing the CTVI

To understand the CTVI scores and ranks better and add regional context to the findings, we conducted ground truthing of key districts.

These ground level case studies unpack the exposure, sensitivity and adaptive capacity of the chosen districts and substantiate the numbers through lived realities in the coal regions and the need and opportunity around coal transition. The districts have been chosen to represent the key trends emerging from the CTVI. These include districts with high transition vulnerability in the current scenario as well as futuristic scenario; significant production but parallel burden of closed/ abandoned/ discontinued coal mines; and, outliers defying high production conditions.

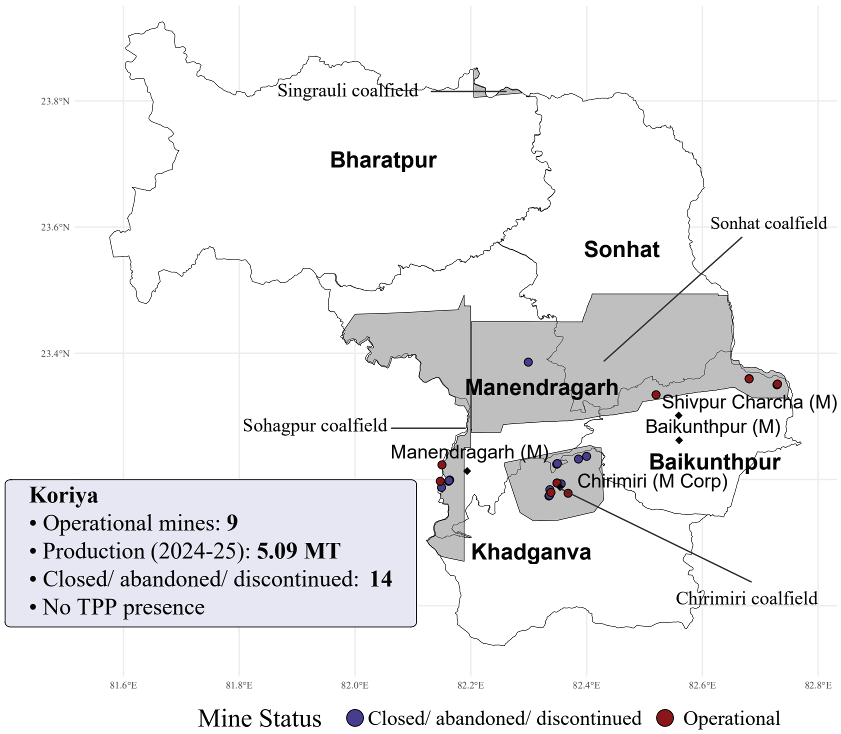
The district case studies predominantly ask the following key questions:

- Do the districts exhibit the same levels of vulnerability as established by the CTVI in terms of dependence, and adaptive capacity?
- Are there any planned developments, specifically expansion or reduction in scale of coal mining, which can alter or influence the current ranking in the near future?
- What are the key measures which can be undertaken to reduce the vulnerability of these districts?

3.5.1 Koriya, Chhattisgarh

Vulnerability level: High CURRENT COAL TRANSITION EPICENTRE			
CTVI rank	Exposure rank	Sensitivity rank	Adaptive capacity rank
14	24	14	10

Map 4. Coal mining in Koriya district



Note: Unified Koriya district is considered due to unavailability of data. Koriya district was divided into Koriya and Manendragarh-Chirmiri-Bharatpur districts in 2022.

One of the six coal producing districts of Chhattisgarh, Koriya faces high vulnerability not due to its current scale of operations, but because it is already staring in the face of coal transition. The district produced just over 5 MT of coal in 2024-25 accounting for only 2.5% of Chhattisgarh's total production.[8] This production came from nine mines operated by the South Eastern Coalfields Limited (SECL), an arm of the nationally owned Coal India Limited and the only company operating there.

The district, however, has 14 closed/ abandoned/ discontinued mines[9] and the impacts of the closure, make the district highly vulnerable and a current epicentre of transition. The region where closures have happened—Chirimiri area of Khadgawan block—bears testimony to a coal-induced ecosystem on the verge of decline.

Induced urbanization and poor adaptive capacity leading to high vulnerability

In Chirimiri, meeting various stakeholders associated with coal mining invariably involves a discussion on the declining economy of the area and talk down the memory lane on how the local municipality developed after the first coal mines were established.

Interviews with labour union representatives, civil society organizations and district officials reveal that as coal mining grew in the region in the early 1900s, it brought permanent employees and their families, created local contractual employment, which opened up avenues for small businesses as well. Most of the local shop owners in the municipal region recount that their fathers or grandfathers set up the business to cater to the officials working in the coal mines.

However, with several mine closures over the last 15 to 20 years, there is a pervasive concern about the declining economy and population. The impacts of the closures are visible in several local patches such as Gelhapani, Bartunga Hill, which have been emptied out after departmental employees left. The company housing in these places is vacant or encroached upon by locals in need of shelter, the local markets have been bolted shut, company hospital and other facilities lie unserviced and abandoned.

Closed SECL hospital covered in foliage

This setback is huge for a district which is otherwise predominantly rural (69%), and tribal (46%) and depends on agriculture and forests, as suggested by the interview and ground visits. Its GDP is the smallest among all coal districts in the country.

Coal mining may not last beyond a decade

The mineable reserves of the operational mines in Koriya are about 95 MT. Considering the current production capacity of 8.15 MTPA, the coal mines are likely to last only a span of 11 years. Labour union members stated that two closed projects - Anjan Hill and Bartunga coal mine - are proposed for revival as open cast operations by private mine development and operators (MDO), which might extend the full exhaustion timeline by a few years.

Interactions with local businesses and political workers indicate that the sustenance of local businesses is challenged as departmental staff was transferred or retired, and contractual workers were left with unsteady income avenues after the closures. The members of the legislative assembly (MLAs) in the past have raised this as an electoral concern and demanded economic packages and restarting of coal mines as measures for reprieve, state locals. The concern is also futuristic, as reserve exhaustion is likely to impact current mining as well.

District officials and business owners conjecture that Chirimiri might lose the municipality status and face reverse urbanization if closures continue and no attempts are made to revive the economy.

Economic revival though transition planning for low GHG industries and service sector

Most interviews with the locals underscore the need for the district to be developed as a whole, combining the natural resource potential with industrial development. However, a district level planning for economic revival will be essential to leverage them in a people-centric manner.

The district has about 66% area under forest, indicating an immense potential for forest based products and developing community driven value chains, as per locals. Since a large part of the district is also agrarian, local crops can be leveraged for food-based industries. Locals point out the potential for rice-based products and oil seeds.

The potential of the district lies in its scenic and hilly location and proximity to the Guru Ghasidas national park and tiger reserve. While development of eco tourism is a common suggestion from all stakeholders, setting up autonomous public educational institutions of repute which can bring people from other parts of the country into the district for higher education.

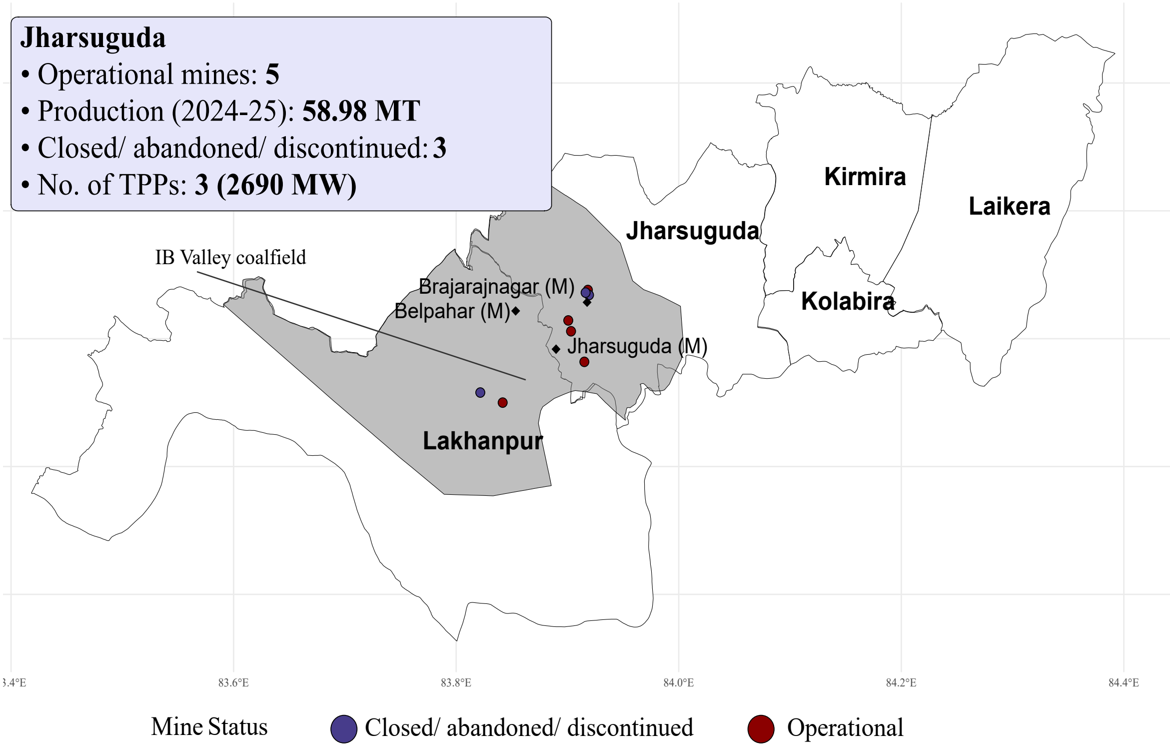
Abandoned coal company houses around Gelhapani, Chirimiri

Regions with old and dilapidated infrastructure can be revived in collaboration with SECL and MoC, for setting up required facilities for other economic avenues. Planning for Koriya can also serve as a learning ground for the state to be better prepared for future transition challenges in other districts, feel local stakeholders.

3.5.2 Jharsuguda, Odisha

Vulnerability level: Very High CURRENT COAL TRANSITION EPICENTRE			
CTVI rank	Exposure rank	Sensitivity rank	Adaptive capacity rank
7	10	5	45

Map 5. Coal mining in Jharsuguda district



The fifth largest coal producing district of India, and second in Odisha, Jharsuguda is among the growing coal and industrial regions. The district produced 59 MT of coal in 2024-25 from five mines which are operated by the Mahanadi Coalfields Limited (MCL), an arm of the nationally owned Coal India Limited. The production is slated to grow with two private mines to come up in the district.

Jharsuguda's vulnerability is defined not only by the worker dependence, but also by the growing induced urbanization in the mining blocks. Travel to the ground and interviews with a varied set of stakeholders point towards a slowly burgeoning urban economy to service coal mining and industrial workers and their households. To most in Jharsuguda, coal transition seems away by at least a couple of decades, but planning for safety nets and economic diversification must begin keeping reserves exhaustion and/or change in climato-economic priorities in view.

Heightened sensitivity due to worker dependence and induced urbanization

The district ranks fifth on the sensitivity pillar indicating high coal transition sensitivities, on two accounts - workers dependence of 14% on coal and high level of urbanization in major coal mining blocks (53%).

As per local interaction with district officials, and as also indicated by the data, Jharsuguda is among the smallest districts of Odisha in terms of geographical area, and population. In a smaller population, the proportion of coal mining and coal-based power workers, formal and informal, is significant (14%) and the coal economy dominates the district. Apart from coal mine workers, there is a thriving trucking industry which also brings money into the local markets, as per locals. Trucks loaded with coal are a dominant sight on the roads in the district, attesting to the fact that the mining industry supports almost 4,000 local trucking jobs.

The sensitivity to transition is further enhanced due to induced urbanization. Two municipalities - Brajrajnagar and Belpahar - have mushroomed around coal mining, as per trade union members and local business owners. Coal mines are located barely two to three kilometers - or about 10 minutes of car ride - from any part of these municipalities. The goods and services in these municipal regions are to service the coal mining, TPP workers, and truckers and their families, say members of the trade union and truck association.

Jharsuguda is among the most urbanized districts in Odisha overall, due to the industrialization induced by other coal based industries enhancing the sensitivity beyond just coal mining. About 20 kilometers away from coal mines, an industrial stretch comprising steel, sponge iron, cement, aluminium plants operated by companies such as Vedanta, UltraTech, Jindal and Aditya Birla etc. punctuate the highway. Locals feel that the industrial presence will sustain the economy despite coal in the long run, but municipalities around the mines will not be able to sustain unless other sectors are developed. Brajrajnagar and Belpahar areas could wear a different look when coal reserves begin to exhaust.

Over 20-year planning window

Coal transition in Jharsuguda is a futuristic idea for all stakeholders, as coal mining is only set to grow in the region in the near future. Even considering the current mining capacity per annum, the district is likely to exhaust the mineable reserves in the existing mines in just over 20 years. Additionally, two new privately owned coal mines are upcoming in the next four to five years.

This provides some scope for timely planning to build a diversified economy and build economic avenues around other regional strengths. To begin with, local funds such as DMF and CSR can be used towards planning for a transition. Since there are several industries, including private

Truck industry in Jharsuguda depends almost entirely on coal and employs a high number of informal workers as drivers and helpers players, the CSR potential of the district is also bigger than other non-industrial districts, say district officials.

Good connectivity, water resources can boost and nature-based economy

Among the topmost coal producing districts in India, Jharsuguda is the only one with a fully functional airport and direct air connectivity to major metro cities of Delhi, Mumbai and Kolkata. It is also well connected by roads to major industrial centres, including the coal-based and power district of neighbouring Chhattisgarh.

Within Odisha, it is the main node of connection to the industrial districts of Western Odisha, including Sundargarh and Sambalpur. Hence, to the local officials and civil society stakeholders, it exhibits the potential to be a crucial point of transit for business or leisure travellers.

Apart from industries, the district is also lined with several sites of religious significance, such as temples, scenic ghats by the river Ib, which cuts right through the district centre. The district is known for its proximity to other cultural and religious places such as Sambalpur where local textiles and temples, dam sites form major tourist attractions. Locals point out to the fact that the region can also boost Odisha's nature-based and religious tourism economy beyond popular locations such as Puri, which is on the eastern side of the state. Developing larger eco-resorts along the Ib or around the hillier regions of the districts would open Jharsuguda as a vacation destination for all income groups.

The district also has a significant forest area and a crop vibrancy. Civil society organizations in the district point out potential for seeds, forest based products, and crops such as ginger which are already grown for commercial purposes. These avenues, they feel, will also forefront women farmers and local entrepreneurs if developed holistically keeping branding and market linkages in view.

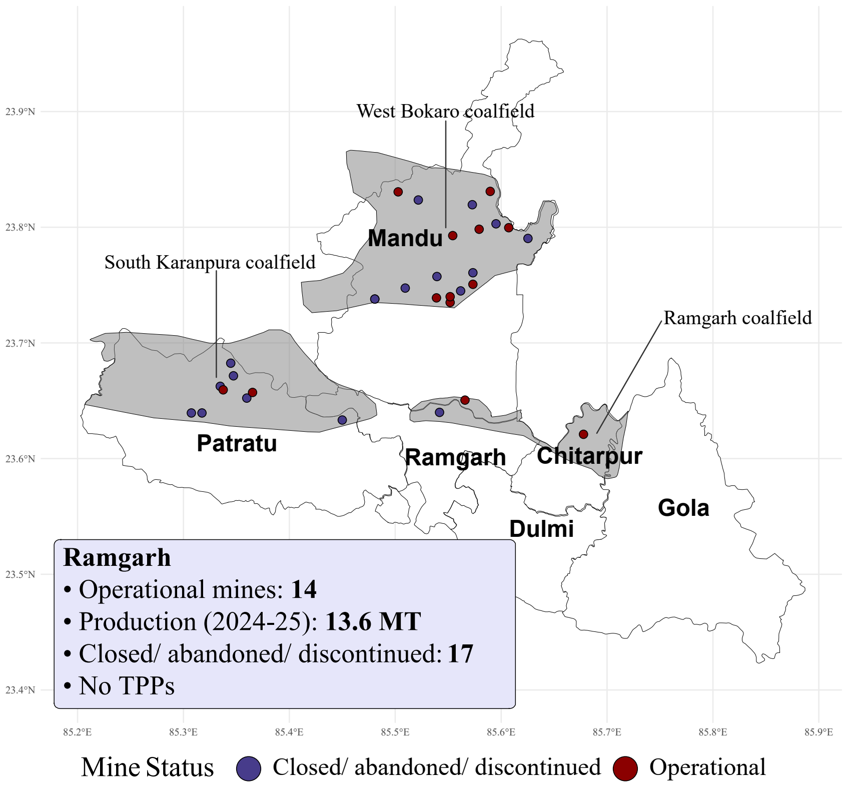
Locals insist that other industrial development must focus on low emission industries as the area has been trying to manage pollution issues and was earlier identified as a critically polluted industrial cluster by the Central Pollution Control Board (CPCB).

Old temples along ghats of rivers make are a site of architectural and religious significance

3.5.3 Ramgarh, Jharkhand

Vulnerability level: High CURRENT COAL TRANSITION EPICENTRE			
CTVI rank	Exposure rank	Sensitivity rank	Adaptive capacity rank
18	17	12	39

Map 6. Coal mining in Ramgarh district



Talking about coal in Jharkhand, would invariably bring up Ramgarh district along with Dhanbad, Bokaro and Hazaribagh, the quartet which forms a contiguous coal belt and the old coal regions of the state, dating back to nearly a century.

The district represents the need for coal transition planning. Its high vulnerability is defined by the scale of coal production (18 MT in 2024-25) compounded by a high number of closed/ abandoned/ discontinued mines (17). The high number of closed/ abandoned/ discontinued mines also make it the current epicenter for transition.

Old coal region with deep-rooted sensitivities to transition

While coal mining in Ramgarh is largely concentrated in two blocks - Mandu and Patratu, ground interactions with local civil society groups, panchayati raj institution (PRI) members, district administration, trade unions and local businesses suggest a deep running coal dependence around the mining areas, which go beyond formal and informal jobs in the coal mines. One of the most common sights in the coal regions of Jharkhand (and in Ramgarh) is of people carrying coal on bicycles procured from the fringes of coal mines, to be sold to local eateries. It is telling of livelihood and fuel dependence on coal in the region which defy traditional job categories.

Local interactions also suggest that nearly all the families within the three to five kilometers radius from coal mines depend on coal for income in some way. This includes jobs in the mines, in the truck industry or use of scavenged coal for self-use or selling in the local market.

The district's local enterprises also express heavy dependence on either coal as fuel or services provided to workers employed in coal mines. Coal mining is the biggest economic activity with a steady source of income, state stakeholders.

Ground interactions reveal that Ramgarh's sensitivities lie in the extended and induced dependence on coal. About 55% of the main mining blocks are also urbanized around coal mine operations spanning several decades. In addition, the contribution of Central Coalfields Limited (CCL), the CIL subsidiary operating in the district, to healthcare and education has substituted for deficits in public healthcare and educational facilities in the district, as per trade union and PRI members.

Pisciculture in Saunda mines

Closures creating localised impacts

Coal mine closures in the district are not new anymore. So far, 17 coal mines are already closed due to various reasons, including clearance matters and unprofitability. Locals say that the impacts on jobs have been felt due to the closure. However, the operational mines have cushioned the impacts as people moved to those mines. The impacts have largely been felt among the contractual and informal workers, which had to shift from one location to another.

Departmental workers were transferred within the company. Over the years, the district has been witnessing fluctuations in coal production. District officials say that while mining might continue for a decade more, the production might dwindle in the district. People are already aware that big mines are coming up in new coal regions in the state and no new significant expansions and mines are in the pipeline in the district.

Hence, state and district administrations, PRIs, trade union leaders are already engaging on the subject of just transition and non-coal livelihoods.

Strong case for mine repurposing, tourism and food industry hub

Currently, coal mining is the major economic activity supporting its ancillary activities like washery spares, fly-ash bricks, repair yards. Besides coal, there is little industrial presence in the district with one cement plant, stone quarries and food processing mills.

This is largely because Ramgarh has been more of a transit towards industrialised districts of Bokaro and Dhanbad which are located adjacent. However, the district enjoys certain advantages which can be leveraged to develop a non-coal economy. The district is just a one hour drive (50 kms) from the state capital. It has several scenic spots such as the Patratu valley, and religious places - Rajarappa temple - which attract local tourists. Archaeologically too, Ramgarh has sites with prehistoric relevance and middle Palaeolithic sites were discovered in the district, as per local administration.

These, if developed for economic regeneration, can become a full-day getaway for families from around the state and country, say locals.

The district is also among the first to begin reuse of coal mines land for other economic activities. The district has developed pisciculture in abandoned mine voids and engaged local fishermen for better income.

Additionally, local business owners and PRI members feel that the agrarian economy can be linked to food processing industries for livelihood generation. The connectivity and overall local resource availability in terms of water from Damodar river, crop diversity etc can be leveraged to build a significant industry around food which can benefit farmers and create more industrial livelihood for the youth.

Photo credit: Istock

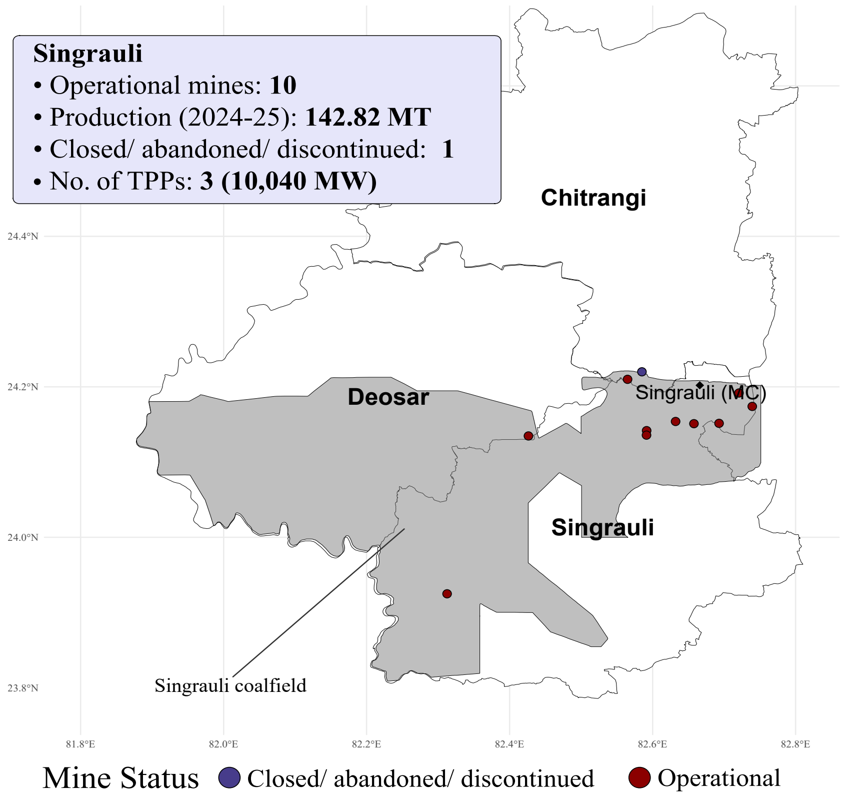
Coal pickers on cycles

3.5.4 Singrauli, Madhya Pradesh

Vulnerability level: Very High CURRENT COAL TRANSITION EPICENTRE			
CTVI rank	Exposure rank	Sensitivity rank	Adaptive capacity rank
1	3	1	15

Singrauli's coal transition vulnerability comes from its scale of coal mining and coal-based TPP operations, coupled with some of the poorest development indicators which define local resilience.

Map 7. Coal mining in Singrauli district



Ranking number one on the CTVI, Singrauli also ranks topmost in terms of sensitivity and 15th in adaptive capacity, preceded only by districts with low coal production and industrial presence, and hence lower fund potential.

Despite falling in the future epicentre category, the district's social-economic realities call for planning attention immediately. A visit to the district unpacked the numbers with reality on the ground, which in most cases looked more dire.

Coal mining and TPP hub of India

Singrauli is synonymous with coal mining and TPPs, being the largest producing district of both with a production of 143 MT coal in 2024-25 and over 10 GW TPP installed capacity. Beyond this, the district has negligible industrial presence and remains predominantly rural.

The mining and TPP ecosystem has resulted in a trucking and repair industry and services around the coal mining block which is the only urbanized region in the district. Coal dominates the landscape with elaborate open cast operations and TPPs. Public owned companies, Northern Coalfields Limited (NCL), an arm of CIL, National Thermal Power Corporation (NTPC), private operators such as Jaiprakash Power Ventures Limited (JVPL) and Sasan Power (Reliance Power Limited) etc. have sizeable presence in the region.

Even in residential or market areas, heaps of coal are a common sight since most households and eateries use it as fuel. Coal dust forms a black sheet over most sheds around shops or households.

Dust from truck movements, smoke from burning coal, emissions from TPPs are a common sight around the Waidhan area where the industry is clustered. Additionally, fly ash and other industrial effluents also cause contamination of water, as per locals. The ground realities reflect the recurrent concerns raised by the Central Pollution Control Board (CPCB), which categorises Singrauli among severely polluted areas based on the Comprehensive Environmental Pollution Index (CEPI) combining land, water and air quality parameters.[10]

Civil society groups, local businesses state that nearly 80% of households in the region would be directly or indirectly dependent on coal for some income, which includes income from repair shops etc. The small municipality in the block is a direct outcome of the service economy created due to the coal industry income. However, while livelihoods have been created due to industrial presence, several health ailments are also high in the region due to heavy pollution.

Stark case of resource curse

A CSO during a meeting described Singrauli as the "darkness under the lamp". Over 30% of Singrauli's population is multidimensionally poor (Annexure VI). Breaking the data through individual indicators actually amplifies reality. Only 31% households use clean fuel[11] and about 38% have tap water connections.[12] The incidence of stunting among children below the age of five years is nearly 38%.

On the ground, most houses are either kutcha or semi-pucca. Poverty is a common sight, with households scampering for income though various informal jobs. While industries have expanded, the benefits have not reached the locals or led to an overall improved well-being of

Children picking copper wires from mine blasting site in Singrauli the people, as per locals.

Future transition but immediate planning

Despite being a future transition epicentre, where effects of reserve exhaustion might start in the coming 10 years given the current mines' capacity and mineable reserves. Singrauli needs planning right away. In fact, there is a need for an overall development intervention in the district to build local resilience and improve human development indicators.

One of the biggest drawbacks for the district is the location. It is poorly connected and has only 77 square kilometers of highway connectivity, among the lowest in coal districts (Annexure VI). As per a state level administrator, even moving refuge from coal mines for recycling is a challenge as transportation costs make efforts unviable. The same challenge remains with bringing in other low or non-polluting industries.

District and coal company officials both concur that a 10 year period offers a short window for planning particularly when the task of developing the district is mammoth. They feel that a thorough assessment of the district is required to understand its potential, build necessary infrastructure, including connectivity, and train locals to be part of a more formal and remunerative workforce.

Nearly 53% of the district is under cultivation, and another 35% under forest, lending to an immense agro-forest potential.[13] The district has local agrarian and forest-based products potential as nearly 53%. There is also a significant water resource potential with Son river and its tributaries passing through the district. However, a comprehensive socio-economic rejuvenation plan would be required for the district, beyond the concerns of coal transition.

CHAPTER 4.

Conclusion

Coal transition will be an intrinsic part of India's Net Zero by 2070 target. This transition has already begun in several districts of India due to resource exhaustion, even as the country plans to ramp up production to 1.5 billion tonnes (BT) by 2030. Most studies on just transition away from coal in India have deep-dived into specific districts and unpacked the nuances of local impacts. However, there remains a gap in understanding the transition vulnerability of all coal-mining districts across a common set of parameters.

To provide a comparative picture of coal transition burden and resilience, we assessed all 52 coal districts of India across a set of commonly agreed parameters and created a vulnerability index as a high-level indicator for targeted and timely planning.

4.1 Key insights

- **Coal transition is not a futuristic idea:** The districts in "very high" and "high" vulnerability categories show a mix of three kinds of districts–the topmost coal producers, such as Singrauli (143 MT), Korba (127 MT), Angul (114 MT); high producers, producing over 20 MT of coal annually but also having high number of closed/ abandoned/ discontinued mines such as Dhanbad, Paschim Bardhman, Bokaro; and low-producing districts with a high number of closed/ abandoned/ discontinued coal mines such as Koriya, Anuppur, Ramgarh, etc. This mix shows that vulnerability is not just limited to current high-producing districts, but also includes several districts that are already undergoing coal transition and need transition support at the earliest.

- **The scale of transition in India is much higher compared to other countries:** The number of mines currently closed/ abandoned/ discontinued mines in India is already higher than the number of operational mines in the European Union (150)[1] and Australia (96)[2] combined. Even when comparing current mining operations, the scale of mining in India is almost 1.3 times the production (Australia – 467 MT[3] and European Union – 349 MT[4]) and nearly 1.7 times the operational mines in these two regions combined. Hence, major coal producers like India will face larger coal transition challenges than several global north countries. This will also percolate down to labor issues as India has much higher informality in labor compared to major coal regions in the global north. This makes targeted action more challenging, as no clear inventory of coal mining workers exists.

- **Most states have both future and current coal transition epicenters:** Most coal-producing states in India are home to both current and future epicenters of coal transition.

This underscores the need to initiate policy and planning to ensure a just transition in a timely and people-centric manner.

- **Differing coal transition vulnerability among districts:** The CTVI shows that while there are 53 coal-producing districts in India, they will face differing burdens of coal transition due to their scale of coal mining and TPP operations and associated sensitivity, and varied adaptive capacity and local resource potential. For instance, most lignite mining districts such as Cuddalore, Surat, Bhavnagar, Bikaner, and small coal districts such as Ranchi, Deogarh, Purulia don't exhibit low levels of vulnerability to coal transition due to smaller scales of operations and better adaptive capacity compared to big coal-producing districts. Districts with small concentrated operations are likely to experience hyper-local impacts, while big coal districts will face larger regional impacts.

- **High-producing coal districts are among the most vulnerable–but not always**: Most high-producing coal districts fall in the "very high" or "high" vulnerability category, indicating that high exposure and sensitivity are not significantly offset by adaptive capacity. This suggests that the scale of operations has created high levels of local dependence for livelihood, including induced urbanization, which cannot be mitigated by the current adaptive capacity.

- **Districts undergoing coal mine closures are also highly vulnerable:** The "very high" and "high" vulnerable districts include districts where coal production may be high (above 15 MT), but where several coal mine closures have simultaneously occurred (in districts like Bokaro, Ramgarh, Dhanbad, Paschim Bardhman). These also include old regions where closed/ abandoned/ discontinued coal mines are higher than operational ones (Anuppur, Koriya).

- **Differential vulnerability in mining blocks within the most vulnerable districts:** Even within highly vulnerable coal districts, it is the main coal mining blocks, i.e., where most of the coal mining and TPP operations are situated, that are most vulnerable to transition. By contrast, blocks with fewer mines may display low adaptive capacity but fare better on coal transition impacts due to limited current mining activity.

- **Adaptive capacity to play a dominant role in building resilience**: Adaptive capacity scores for districts range narrowly between 40 and 75. This suggests that while districts can be compared with each other, all of them would fall in the "very high" category if the vulnerability levels are to be extended to the pillars. For high producing big coal districts, the capacity is better due to the fund potential from DMF, CSR and GST compensation cess and availability of natural resources to harness for a low GHG economy. This means that adaptive capacity will play a very important role in off-setting the vulnerability of districts. Also, if the current resources (DMF funds, CSR investments) are not used efficiently, big coal districts will miss the opportunity towards building resilience through available local funds.

4.2 Recommendations

To ensure a 'just' transition away from coal planning and action at both the national and state levels will be required. In terms of intervention, building district-level adaptive capacities to improve social and human development indicators, and creating sustainable and diverse local economies, will be pivotal to absorbing the impacts. Keeping this in view, we make the following recommendations:

- **Creating policy and guidelines for a just energy transition:** India must develop a policy and broad guidelines for just energy transition to guide states and districts which face vulnerabilities. The guidelines must be aligned with the national Net Zero 2070 target. They can be developed at the national level through Niti Aayog–the Government of India (GoI) policy think tank–along with relevant ministries including Ministry of Coal, Ministry of Power, Ministry of New and Renewable Energy, and non-government experts. These must form the basis of state-level just transition policies.

- **Initiating a ranking-based coal transition program for the districts:** The model for Aspirational Districts Programme, the Niti Aayog led program to transform under-developed districts–can be replicated to develop a ranking-based program which can converge various fund sources to improve adaptive capacity across socio-economic and resource potential indicators of coal districts and improve resilience to transition, and improve their overall capacity and ranking.

- **Integrating just energy transition as a tenet of sustainable development goals for coal districts:** Energy transition at the district level is an issue of socio-economic resilience and well-being. Considering that the adaptive capacities of coal districts are already poor, the local economy and social infrastructure needs to be developed and improved, the transition goals must be tied to SDGs. Into its own national narrative, India must integrate just transition as the underlying focus to achieve SDGs. This will create a holistic developmental focus on what is currently perceived as a fallout of climate action.

- **Creating state- and district-level institutions to address coal transition challenges:** Every coal-dependent state should create task forces or dedicated secretariats comprising officials of relevant departments and experts at the state and district levels to plan the transition and coordinate on initiatives in alignment with the national guidelines and programs. As needs evolve, a dedicated office or planning centre must be developed for long-term and sustained implementation.

- **Improving long-term adaptive capacity for just transition in districts:** State governments must work with the districts to plan for adaptive capacity building which will focus on broader socio-economic measures to more specific transition related interventions such as skilling and reskilling of labor, economic diversification and local livelihoods based on regional strengths etc.

- **Aligning local untied funds with just transition initiatives:** State governments must align existing schemes with the just coal transition goals to build social infrastructure and economic avenues. Effective implementation of DMF and CSR is crucial, as their mandates align with the need for social infrastructure access and livelihood building. The Ministry of Mines has already acknowledged the reality of transition and asked for the creation of an endowment fund "for creating and sustaining livelihoods in areas where mining activity has stopped due to any reason including exhaustion of minerals."[5] GST compensation cess in coal states must be utilized for just transition investments.

- **Prioritizing current epicenters for immediate just transition planning:** State governments must start planning to ensure a just transition in current epicentres. These districts are either in the process of transition or have begun to face the aftermath and are in urgent need of support. Plans for current epicentres can also serve as a timely blueprint for planning a just transition in future and high-producing epicenters.

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Chapter 2

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5 Access to social infrastructure has been considered as an impact area as coal mining companies, which are mostly public sector undertakings (PSUs), contribute locally to health, sanitation, water, education and other facilities in the areas where they operate as part of their Corporate Social Responsibility (CSR) and other welfare measures.

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10 Departmental worker as defined under the Industrial Employment (Industrial Order) Central Rules, 1946, Wherein a worker has been employed on a permanent basis or for an unlimited period. In Coal India Limited (CIL), the largest coal company in India, departmental workers are entitled to benefits such as pension, employee provident fund (EPF), housing, and healthcare.

11 Contractual workers in India are defined under The Contract Labour (Regulation and Abolition) Act, 1970. The term refers to a workman who is hired by/through a contractor, with or without the knowledge of the principal employer. At CIL, contractual workers have a defined period of employment and are entitled to EPF and pension benefits. Hence, they are part of formally employed workers.

12 Defined by the Labour Bureau of India as those who do not have employment security or social security provided by the employer. In the context of the coal mining industry, several cleaning workers employed on short-term contracts, truck drivers, and helpers who are attached to agencies without a formal arrangement, are part of the informal workforce.

13 Ibid.

14 Ibid.

15 Ibid.

16 The index maps blocks with at least 5 MT production and 5 operational mines and 5 closed/ abandoned/ discontinued mines to classify as a major mining block. Districts without major mining blocks will be taken as a value of 0 to reflect no reverse urbanisation as there is no link between mining and urbanisation in that block. Additionally, the urbanisation in the districts of four states - Telangana, Maharashtra, Tamil Nadu and Gujarat - have been taken as zero as their urbanisation is reflective of larger industrial presence instead of coal mining.

17 India's coal PSUs, through decades of operation, have created social infrastructure such as healthcare centers and funded schools on which local communities depend due to inadequacies in the public social infrastructure and services. Any disruption in operations might affect the continuity of these services.

18 The assessment is limited to CIL-run healthcare facilities and CIL-funded schools, as district and block level data for other PSUs was not available in the requisite detail.

19 District Mineral Foundation are non-profit trusts established under India's Mines and Minerals (Development and Regulation) Amendment Act 2015 within each mining affected district. All mining companies are mandated to pay either 10% (if mines auctioned post-2015) or 30% (mines allocated pre-2015) of the royalty amount into DMFs. Its objective is "to work for the interest and benefit of persons, and areas affected by mining related operations".

20 India's Companies Act 2013 mandates companies to spend at least 2% of their net profits of the three immediately preceding financial years on Corporate Social Responsibility (CSR) activities with the aim of "integrating social, environmental and human development concerns in the entire value chain of corporate business". The amount has to be preferentially spent on the local areas and areas where the operates.

21 According to India's Goods and Services Tax (GST) Act 2017, there is a compensation Cess on coal at the rate of Rs 400 per tonne of domestic production. Earlier this cess was levied as a clean energy cess under the Finance Act 2010 at the same rate.

22 This ratio is compared to the guidelines provided under Indian Public Health Standards (IPHS) to understand if the CHC is serving above the stipulated norm of 1 CHC per 100,000 people.

23 The District Mineral Foundation (DMF) allocation and utilisation is based on the Pradhan Mantri Khanij Kshetra Kalyan Yojana (PMKKKY) that outlines certain high priority areas (like education, health, women and children among others) where at least 60% of the funds should be utilized.

24 The min-max technique is used to transform the indicators into unit-free data. This technique helps in comparing the various indicators with different measurement units (like MT, number, MW, Rupees) and range. It transforms the raw data into a score ranging from 0-100. As this index has two types of indicators – ones that increase the vulnerability (positive association to index) and others that reduce the vulnerability of the district (negative association to index) – two different formulae have been used here to calculate the scores.

$$\text{Positive Indicators} = (\text{Actual Value} - \text{Minimum}) / (\text{Maximum} - \text{Minimum})$$

$$\text{Negative Indicators} = (\text{Maximum} - \text{Actual Value}) / (\text{Maximum} - \text{Minimum})$$

Chapter 3

1 There are a total of 341 closed/ abandoned/ discontinued mines 2025 as published by the Ministry of Coal. However, there are multiple seams of the same mines that are considered as single closed/ abandoned/ discontinued mines in this study.

2 Ibid.

3 Census of India, 2011. Government of India.

4 NITI Aayog (Government of India). National Multidimensional Poverty Index: A Progress Review 2023 (Aug 2023). https://www.niti.gov.in/sites/default/files/2023-08/India-National-Multidimentional-Poverty-Index-2023.pdf

5 We have considered unified Koriya district due to unavailability of data. Koriya district was divided into Koriya and Manendragarh-Chirmiri-Bharatpur districts in 2022

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8 Ministry of Coal (Government of India). National Coal Portal Dashboard 2024–25. https://coaldashboard.cmpdi.co.in/dashboard.php

9 Ministry of Coal (Government of India). Lok Sabha Unstarred Question No. 4259: Operational Coal Mines (26 Mar 2025). https://sansad.in/getFile/loksabhaquestions/annex/184/AU4259_eH7g6j.pdf?source=pqals

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12 Department of Drinking Water & Sanitation, Ministry of Jal Shakti (Government of India). Jal Jeevan Mission (2025). https://jaljeevanmission.gov.in/

13 Office of the District Collector, Singrauli (Government of Madhya Pradesh). District Environment Plan — Singrauli (M.P.) (2021). https://www.mppcb.mp.gov.in/proc/Tech/DEP%20Singrauli.pdf

Chapter 4

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3 Idoine, N.E. et al. World Mineral Production 2019–23 (British Geological Survey, Nottingham, 2025). 97 pp. https://web.jrc.ec.europa.eu/visitors-centre-tools/coal-report/

4 European Commission, Eurostat. Coal production and consumption statistics (2025). https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Coal_production_and_consumption_statistics#Source_data_for_tables_and_graphs

5 Ministry of Mines (Government of India). Pradhan Mantri Khanij Kshetra Kalyan Yojana (PMKKKY): Revised Guidelines (Jan 2024). https://mines.gov.in/admin/storage/ckeditor/Annexure_I_PMKKKY_Guidelines_16_1712904663.pdf

Annexures

Annexure I: State-wise coal production in India

State	Production – 2024-25 (MT)	No. of coal and lignite mines
Assam	0.2	1
Chhattisgarh	204.2	47
Gujarat	13.30	10
Jharkhand	208.39	111
Madhya Pradesh	158.5	52
Maharashtra	70.8	48
Odisha	269.7	25
Rajasthan	9.934	7
Tamil Nadu	21.96	3
Telangana	71.45	43
Uttar Pradesh	24.03	3
West Bengal	35.42	73
Grand Total	**1087.9**	**423**

Annexure II: Data Sources

Indicator	Data Source
EXPOSURE	
No. of coal mines in the district (No.)	National Coal Portal, Ministry of Coal, Government of India, 2024-25 https://coaldashboard.cmpdi.co.in/dashboard.php
Coal production from the district in the last reference year (MT)	National Coal Portal, Ministry of Coal, Government of India, 2024-25 https://coaldashboard.cmpdi.co.in/dashboard.php
No. of closed/ abandoned/ discontinued (No.)	March 2025. Lok Sabha Unstarred Question no. 4259 on Operational Coal Mines. https://sansad.in/getFile/loksabhaquestions/annex/184/AU4259_eH7g6j.pdf?source=pqals
No. of TPPs (No.)	Central Electricity Authority, 2023. List of Power Stations in India. https://cea.nic.in/wp-content/uploads/pdm/2023/05/List_of_Power_Stations_31.03.2023.pdf
Installed capacity of TPPs (MW)	Central Electricity Authority, 2023. List of Power Stations in India. https://cea.nic.in/wp-content/uploads/pdm/2023/05/List_of_Power_Stations_31.03.2023.pdf
SENSITIVITY	
Proportion of district's working population engaged in coal mining jobs (%)	As per Coal India Limited (CIL), 2025. For mines owned by other companies (state power utilities, private companies) an estimate has been done based on workers per MT coal production as derived from the CIL data. District working population: Census 2011, projected for 2021 by the International Institute for Population Sciences. https://www.iipsindia.ac.in/sites/default/files/FULL_REPORT_WITH_FINAL_TABLES.pdf

Proportion of district's working population engaged in TPP jobs (%)	As per National Thermal Power Corporation (NTPC), 2024. For TPPs operated by other companies (state power utilities, private companies) an estimate has been done based on workers per MW of installed capacity as derived from NTPC data. District working population: Census 2011, projected for 2021 by the International Institute for Population Sciences. https://www.iipsindia.ac.in/sites/default/files/FULL_REPORT_WITH_FINAL_TABLES.pdf
Proportion of urban population in the major mining block of the district (%)	District Census Handbooks 2011, projected for 2021 through decadal growth rate, assuming that the demographic proportions have remained the same. https://censusindia.gov.in/census.website/data/handbooks https://www.iipsindia.ac.in/sites/default/files/FULL_REPORT_WITH_FINAL_TABLES.pdf
Number of company run/funded hospitals and schools in the district (No.)	Coal India Limited, 2018. Details of Medical Facilities in CIL and its subsidiaries.
ADAPTIVE CAPACITY	
Proportion of multidimensionally poor people (%)	NITI Aayog, 2023. National Multidimensional Poverty Index 2023. https://www.niti.gov.in/sites/default/files/2023-08/India-National-Multidimentional-Poverty-Index-2023.pdf
Total highway density: national + state/ 1000 sq km (ratio)	Individual state PWD websites; BharatMaps portal (Data as of March 2025) https://bharatmaps.gov.in/BharatMaps/Home/Map
Steel, Aluminium and Cement: Total installed capacity (MTPA)	Steel data – Data as on March 2025. Global Energy Monitor https://globalenergymonitor.org/ Aluminium data – Indian Bureau of Mines, 2022. Indian Minerals Yearbook 2022. https://ibm.gov.in/writereaddata/files/170989607765eaf18dc09eaAluminium_Alumina_2022.pdf Cement data – Indian Bureau of Mines, 2022. Indian Minerals Yearbook 2022. https://ibm.gov.in/writereaddata/files/1697613517652f86cd47a4fCement_2022.pdf
District GDP from non-mining sectors (%)	Data collected from various State Directorate of Economics and Statistics.
GST compensation cess, DMF and CSR: Total collection (crore rupees)	DMF data – Estimated annual DMF collection based on total DMF collection from National DMF Portal, Ministry of Mines, as on March 2025. https://dmfindia.mines.gov.in/state_dmf GST compensation cess data – Estimated at the rate of Rs 400 per tonne as per the government guidelines. https://icmai.in/TaxationPortal/upload/IDT/Article_GST/GST_COMPENSATION_CESS.pdf CSR data – Pai and Zerriffi, 2021. A novel dataset for analysing sub-national socioeconomic developments in the Indian coal industry https://iopscience.iop.org/article/10.1088/2633-1357/abdbbb An annual average of all three was taken.
Proportion of district's geographical area under forest (%)	PMKSY, District Irrigation Plans (2016-2020). Data taken from individual district irrigation plans.
Proportion of cultivated area irrigated (%)	PMKSY, District Irrigation Plans (2016-2020). Data taken from individual district irrigation plans.

CHC to population ratio (ratio)	Estimated based on the stipulated norm of 1 CHC to 1,00,000 people by IPHS. Data taken from individual state health portals.
Literacy rate (%)	District Census Handbooks 2011, projected for 2021 through decadal growth rate, assuming that the demographic proportions have remained the same. https://censusindia.gov.in/census.website/data/handbooks https://www.iipsindia.ac.in/sites/default/files/FULL_REPORT_WITH_FI-NAL_TABLES.pdf
Proportion of households provided with tap water connections (%)	Data as of May, 2025. Jal Jeevan Mission, Tap Water Supply in Households. https://ejalshakti.gov.in/jjmreport/JJMIndia.aspx
Proportion DMF projects sanctioned in high priority (%)	Calculated based on all projects sanctioned under DMF, Ministry of Mines, as on March 2025. https://dmfindia.mines.gov.in/DMF_state_wise_project_detalis

Annexure III: Ranking and scores for exposure

District	State	Rank	Score
Paschim Bardhman	West Bengal	1	55.965
Korba	Chhattisgarh	2	53.119
Singrauli	Madhya Pradesh	3	51.545
Dhanbad	Jharkhand	4	43.127
Angul	Odisha	5	39.042
Chandrapur	Maharashtra	6	29.559
Raigarh	Chhattisgarh	7	29.553
Nagpur	Maharashtra	8	24.725
Sundargarh	Odisha	9	24.340
Jharsuguda	Odisha	10	21.966
Sonbhadra	Uttar Pradesh	11	19.512
Chhindwara	Madhya Pradesh	12	19.031
Bokaro	Jharkhand	13	16.264
Chatra	Jharkhand	14	15.978
Cuddalore	Tamil Nadu	15	15.792
Kutch	Gujarat	16	15.226
Ramgarh	Jharkhand	17	13.904
Anuppur	Madhya Pradesh	18	13.283
Peddapalli	Telangana	19	13.279
Hazaribagh	Jharkhand	20	12.572
Mancherial	Telangana	21	11.157
Bhadradri Kothagudem	Telangana	22	10.492
Yavatmal	Maharashtra	23	9.630
Koriya	Chhattisgarh	24	9.093
Shahdol	Madhya Pradesh	25	7.965
Surajpur	Chhattisgarh	26	7.201
Khammam	Telangana	27	7.171
Pakur	Jharkhand	28	5.951
Barmer	Rajasthan	29	5.928
Umaria	Madhya Pradesh	30	5.737
Godda	Jharkhand	31	5.361

Betul	Madhya Pradesh	32	5.268
Surguja	Chhattisgarh	33	5.119
Bankura	West Bengal	34	5.054
Sambalpur	Odisha	35	4.833
Purulia	West Bengal	36	4.308
Jayashankar Bhupalapally	Telangana	37	4.286
Narsinghpur	Madhya Pradesh	38	3.655
Birbhum	West Bengal	39	3.615
Surat	Gujarat	40	3.254
Bhavnagar	Gujarat	41	3.213
Latehar	Jharkhand	42	2.680
Tinsukia	Assam	43	2.416
Bikaner	Rajasthan	44	2.342
Ranchi	Jharkhand	45	2.264
Giridih	Jharkhand	46	2.192
Asifabad Kumurram Bheem	Telangana	47	1.924
Palamu	Jharkhand	48	1.729
Deoghar	Jharkhand	49	0.719
Bharuch	Gujarat	50	0.379
Nagaur	Rajasthan	51	0.353
Balrampur	Chhattisgarh	52	0.336

Annexure IV: Ranking and scores for sensitivity

District	State	Rank	Score
Singrauli	Madhya Pradesh	1	80.807
Korba	Chhattisgarh	2	70.669
Dhanbad	Jharkhand	3	60.975
Angul	Odisha	4	59.882
Jharsuguda	Odisha	5	59.315
Mancherial	Telangana	6	45.240
Bokaro	Jharkhand	7	36.475
Chatra	Jharkhand	8	35.570
Paschim Bardhman	West Bengal	9	34.637
Raigarh	Chhattisgarh	10	33.585
Peddapalli	Telangana	11	31.915
Ramgarh	Jharkhand	12	29.588
Anuppur	Madhya Pradesh	13	29.544
Koriya	Chhattisgarh	14	26.664
Sonbhadra	Uttar Pradesh	15	26.299
Chandrapur	Maharashtra	16	24.642
Kutch	Gujarat	17	23.169
Jayashankar Bhupalapally	Telangana	18	22.290
Umaria	Madhya Pradesh	19	16.252
Surajpur	Chhattisgarh	20	14.406
Pakur	Jharkhand	21	12.984
Chhindwara	Madhya Pradesh	22	12.623

Sundargarh	Odisha	23	12.417
Bhadradri Kothagudem	Telangana	24	12.384
Hazaribagh	Jharkhand	25	12.064
Nagpur	Maharashtra	26	11.647
Cuddalore	Tamil Nadu	27	11.642
Shahdol	Madhya Pradesh	28	10.524
Khammam	Telangana	29	10.126
Godda	Jharkhand	30	8.604
Surguja	Chhattisgarh	31	8.345
Betul	Madhya Pradesh	32	8.105
Tinsukia	Assam	33	7.830
Barmer	Rajasthan	34	7.382
Sambalpur	Odisha	35	7.310
Latehar	Jharkhand	36	5.183
Yavatmal	Maharashtra	37	4.497
Bankura	West Bengal	38	3.987
Asifabad Kumurram Bheem	Telangana	39	3.624
Purulia	West Bengal	40	2.813
Deoghar	Jharkhand	41	2.762
Ranchi	Jharkhand	42	2.752
Narsinghpur	Madhya Pradesh	43	2.669
Birbhum	West Bengal	44	2.388
Giridih	Jharkhand	45	1.362
Bhavnagar	Gujarat	46	1.290
Bikaner	Rajasthan	47	0.782
Surat	Gujarat	48	0.645
Palamu	Jharkhand	49	0.082
Nagaur	Rajasthan	50	0.055
Bharuch	Gujarat	51	0.027
Balrampur	Chhattisgarh	52	0.000

Annexure V: Ranking and scores for adaptive capacity

District	State	Rank	Score
Pakur	Jharkhand	1	74.957
Barmer	Rajasthan	2	70.920
Balrampur	Chhattisgarh	3	68.262
Latehar	Jharkhand	4	67.597
Tinsukia	Assam	5	64.461
Palamu	Jharkhand	6	64.119
Godda	Jharkhand	7	62.296
Sonbhadra	Uttar Pradesh	8	61.663
Deoghar	Jharkhand	9	61.622
Koriya	Chhattisgarh	10	61.391
Nagaur	Rajasthan	11	61.369
Shahdol	Madhya Pradesh	12	61.164

Chatra	Jharkhand	13	60.854
Purulia	West Bengal	14	59.890
Singrauli	Madhya Pradesh	15	59.820
Bikaner	Rajasthan	16	59.618
Surajpur	Chhattisgarh	17	59.390
Chhindwara	Madhya Pradesh	18	59.256
Anuppur	Madhya Pradesh	19	59.228
Surguja	Chhattisgarh	20	58.957
Asifabad Kumurram Bheem	Telangana	21	58.782
Raigarh	Chhattisgarh	22	58.722
Giridih	Jharkhand	23	58.106
Bokaro	Jharkhand	24	56.932
Ranchi	Jharkhand	25	56.196
Dhanbad	Jharkhand	26	56.152
Umaria	Madhya Pradesh	27	55.627
Narsinghpur	Madhya Pradesh	28	54.262
Jayashankar Bhupalapa-lly	Telangana	29	54.070
Korba	Chhattisgarh	30	53.968
Hazaribagh	Jharkhand	31	53.648
Yavatmal	Maharashtra	32	51.970
Bhavnagar	Gujarat	33	51.525
Peddapalli	Telangana	34	51.310
Betul	Madhya Pradesh	35	51.090
Bankura	West Bengal	36	50.804
Kutch	Gujarat	37	50.602
Mancherial	Telangana	38	50.366
Ramgarh	Jharkhand	39	50.108
Birbhum	West Bengal	40	49.319
Bharuch	Gujarat	41	48.952
Khammam	Telangana	42	48.352
Sambalpur	Odisha	43	47.507
Bhadradri Kothagudem	Telangana	44	47.072
Jharsuguda	Odisha	45	46.470
Paschim Bardhman	West Bengal	46	46.173
Angul	Odisha	47	43.692
Chandrapur	Maharashtra	48	41.838
Nagpur	Maharashtra	49	41.349
Surat	Gujarat	50	41.065
Sundargarh	Odisha	51	39.909
Cuddalore	Tamil Nadu	52	36.222

Annexure VI: District-wise data on key indicators for exposure, sensitivity and adaptive capacity

District	State	Operation-al mines, 2025	Coal production (MT) 2025	Closed/ abandoned/ discontinued mines, 2025	No. of TPPs	Installed capacity (MW)	District workers engaged in coal mines & TPPs (%)
VERY HIGH							
Singrauli	Madhya Pradesh	10	142.8	1	3	10,040	19.2
Korba	Chhattisgarh	13	126.8	6	13	6,598	15.5
Dhanbad	Jharkhand	52	44.2	33	2	1,590	11.5
Paschim Bardhman	West Bengal	65	32.4	68	2	1,012	10.6
Angul	Odisha	11	114.1	5	2	4,200	12.7
Raigarh	Chhattisgarh	13	49.7	4	6	6,800	8.0
Jharsuguda	Odisha	5	58.9	3	3	2,690	12.0
Chatra	Jharkhand	4	52.0	2	1	660	11.4
Sonbhadra	Uttar Pradesh	3	24.0	0	4	8,830	3.7
Bokaro	Jharkhand	13	16.9	12	3	1,420	3.3
Anuppur	Madhya Pradesh	12	6.0	14	2	1,410	4.2
HIGH							
Mancherial	Telangana	16	9.0	4	1	1,200	14.5
Pakur	Jharkhand	2	21.9	0	0	0	4.7
Koriya	Chhatisgarh	9	5.1	14	0	0	5.3
Chhindwara	Madhya Pradesh	11	1.6	44	0	0	1.6
Chandrapur	Maharashtra	22	30.7	17	5	4,780	5.8
Peddapalli	Telangana	9	21.2	2	2	2,663	9.7
Ramgarh	Jharkhand	14	13.6	18	0	0	4.0
Barmer	Rajasthan	4	7.0	0	2	1,330	0.6
Kutch	Gujarat	3	5.3	0	4	9,020	3.7
MODERATE							
Shahdol	Madhya Pradesh	8	4.7	12	0	0	1.1
Surajpur	Chhatisgarh	9	5.6	8	0	0	3.3
Latehar	Jharkhand	3	5.4	1	0	0	1.7
Godda	Jharkhand	2	18.0	1	0	0	2.5
Hazaribagh	Jharkhand	11	32.1	3	0	0	3.2
Jayashankar Bhupalapally	Telangana	7	6.2	1	0	0	8.1
Tinsukia	Assam	1	0.2	6	0	0	0.4
Umaria	Madhya Pradesh	6	1.8	3	1	1,340	2.1
Nagpur	Maharashtra	15	24.5	5	6	6,966	2.0
Sundargarh	Odisha	7	79.4	1	1	1,600	2.8
Surguja	Chhatisgarh	3	16.9	0	0	0	3.0
Balrampur	Chhatisgarh	0	0.0	1	0	0	0.0
Palamu	Jharkhand	3	0.0	2	0	0	0.0
Purulia	West Bengal	2	0.1	1	2	1,700	0.4
Bhadradri Kothagudem	Telangana	8	17.1	5	1	1,080	3.5
Deoghar	Jharkhand	1	1.5	0	0	0	0.6

Social infra-structure by coal companies (No.)	Urban population in major mining block (%)	Multidimensionally poor people (%)	total highway density—national + state/ 1000 sq kms	Steel, Aluminium and cement—total capacity	District GDP from non-mining sectors (%)	GST compensation cess, DMF and CSR—total collection (Rs. crore)	Area under forest (%)	Area under irrigation (%)
13	26	31	24	2.4	43	6,330	42.2	21.6
6	66	18	50	0.6	42	5,624	66.0	6.4
21	74	17	58	3.0	90	2,293	9.3	6.4
7	0	11	45	14.5	94	1,307	3.5	79.0
12	19	14	68	6.5	69	5,163	45.0	15.4
1	6	19	51	5.8	81	2,084	12.2	20.5
4	53	7	63	4.5	95	2,565	9.8	24.5
2	10	37	39	0.0	73	2,247	59.9	26.8
5	25	31	34	0.9	80	1,157	47.9	31.7
9	98	15	65	8.3	90	807	18.5	10.0
5	52	20	112	0.0	87	308	21.7	3.7
HIGH								
0	0	4	45	5.3	86	409	41.3	39.5
0	0	50	60	0.0	77	926	11.5	27.2
5	45	20	57	0.0	66	267	60.0	35.1
3	32	14	37	0.0	100	89	25.0	7.2
5	0	6	69	23.9	93	1,613	35.1	21.0
0	0	2	31	1.5	81	935	11.6	78.6
13	55	18	125	0.3	86	644	28.9	44.6
0	23	21	19	0.0	84	313	1.2	14.9
0	0	11	59	8.1	97	309	15.7	46.0
MODERATE								
1	34	24	29	0.0	93	216	36.4	23.4
3	18	22	61	0.0	90	251	47.2	4.7
1	0	42	72	0.0	85	252	40.8	11.8
3	0	36	82	0.0	96	792	17.7	16.2
5	2	26	94	0.0	93	1,366	32.4	20.0
0	0	6	15	0.0	77	272	49.3	64.1
2	28	18	85	0.0	85	17	10.8	4.0
1	25	23	59	0.0	91	86	52.6	31.4
5	0	1	125	2.5	99	1,164	14.7	29.1
3	0	15	49	4.1	86	4,227	45.1	35.4
0	0	24	41	0.0	90	699	38.7	25.6
0	0	32	57	0.0	90	19	19.3	9.5
0	0	32	57	0.0	94	14	33.5	14.3
0	0	27	78	3.2	100	7	12.0	22.2
0	0	4	29	0.0	80	1,057	58.7	61.6
2	0	37	92	0.0	99	83	7.0	41.6

LOW							
Yavatmal	Maharashtra	11	15.6	6	0	0	1.4
Asifabad Kumurram Bheem	Telangana	1	3.8	2	0	0	1.3
Bikaner	Rajasthan	2	2.9	0	1	250	0.2
Nagaur	Rajasthan	1	0.0	0	0	0	0.0
Khammam	Telangana	2	14.3	1	1	1, 800	2.2
Giridih	Jharkhand	2	0.6	4	0	0	0.1
Betul	Madhya Pradesh	4	1.4	4	1	1,330	1.6
Ranchi	Jharkhand	4	2.2	1	0	0	0.2
Narsinghpur	Madhya Pradesh	1	0.3	0	2	1,690	0.4
Bankura	West Bengal	4	1.4	0	1	2,340	0.7
Cuddalore	Tamil Nadu	3	22.0	0	6	4,840	2.4
Sambalpur	Odisha	2	17.2	0	0	0	1.4
Bhavnagar	Gujarat	3	3.9	0	1	500	0.3
Birbhum	West Bengal	2	1.6	2	1	1,050	0.5
Bharuch	Gujarat	1	0.1	0	0	0	0.0
Surat	Gujarat	3	4.0	0	1	500	0.2

	LOW								
	1	0	10	100	0.0	94	757	19.5	14.0
	0	0	17	12	0.0	96	170	44.3	16.8
	0	0	18	30	0.0	97	130	1.0	55.2
	0	0	13	44	0.6	96	22	1.5	23.6
	0	0	3	60	0.0	97	593	14.3	49.0
	2	0	30	93	0.6	99	30	32.1	15.7
	3	0	21	52	0.0	98	74	54.8	46.2
	4	0	16	56	0.0	99	129	25.4	20.0
	0	0	15	58	0.0	99	18	37.7	19.6
	0	0	18	80	1.9	100	56	18.5	58.6
	0	0	4	142	0.0	100	998	0.5	86.9
	2	12	10	56	5.4	97	951	33.1	35.5
	0	0	12	65	0.0	97	155	2.4	73.3
	0	0	18	139	0.0	100	66	3.5	51.4
	0	0	12	131	0.0	97	19	5.4	48.2
	0	0	5	152	19.3	97	177	8.8	34.7

Annexure VII: Ranks and scores for block-level CTVI

State	District	Blocks	Rank	Score
Madhya Pradesh	Singrauli	Baidhan	1	51.609
Chhattisgarh	Korba	Katghora	2	49.660
Jharkhand	Dhanbad	Dhanbad	3	48.870
West Bengal	Paschim Burdwan	Pandabeswar	4	46.779
Odisha	Angul	Talcher	5	42.465
Jharkhand	Chatra	Tandwa	6	41.541
Jharkhand	Dhanbad	Nirsa	7	40.204
Jharkhand	Dhanbad	Baghmara	8	38.023
West Bengal	Paschim Burdwan	Asansol Kulti Township	9	36.542
West Bengal	Paschim Burdwan	Andal	10	35.557
West Bengal	Paschim Burdwan	Salanpur	11	34.961
Jharkhand	Bokaro	Bermo	12	33.349
Uttar Pradesh	Sonbhadra	Dudhi	13	31.942
Madhya Pradesh	Anuppur	Kotma	14	31.579
West Bengal	Paschim Burdwan	Jamuria	15	31.531
Chhattisgarh	Raigarh	Tamnar	16	30.407
Chhattisgarh	Raigarh	Gharghoda	17	30.270
Chhattisgarh	Korba	Korba	18	29.898
West Bengal	Paschim Burdwan	Barabani	19	28.739
West Bengal	Paschim Burdwan	Faridpur-Durgapur	20	27.346
West Bengal	Paschim Burdwan	Raniganj	21	27.245
Jharkhand	Bokaro	Gumia	22	25.536
Chhattisgarh	Korba	Podi-uproda	23	24.879
Madhya Pradesh	Singrauli	Chitrangi	24	24.613
Odisha	Jharsuguda	Jharsuguda	25	24.125
Chhattisgarh	Korba	Pali	26	24.108
Odisha	Jharsuguda	Lakhanpur	27	23.842
Odisha	Angul	Kaniha	28	23.094
Chhattisgarh	Raigarh	Dharamjaigarh	29	22.489
Jharkhand	Bokaro	Chandankiyari	30	21.008
Odisha	Angul	Chendipada	31	12.855

Annexure VIII—Block-wise data on key indicators for exposure, sensitivity and adaptive capacity

Block	District	State	Operational mines, 2025	Coal production (MT) 2025	Closed/ abandoned/ discontinued mines, 2025	No. of TPPs	Installed capacity (MW)	Block workers engaged in coal mines & TPPs (%)
Baidhan	**Singrauli**	Madhya Pradesh	9	137.4	0	2	8,720	89.8
Katghora	**Korba**	Chhattisgarh	4	119.8	5	7	4,435	8.0
Dhanbad	**Dhanbad**	Jharkhand	30	27.0	25	0	0	5.7
Pandabeswar	**Paschim Bardhman**	West Bengal	11	16.2	13	0	0	1.2
Talcher	**Angul**	Odisha	8	97.1	5	1	3,000	76.95
Tandwa	**Chatra**	Jharkhand	4	52.0	2	1	660	61.3
Nirsa	**Dhanbad**	Jharkhand	15	8.0	6	1	1,050	34.4
Baghmara	**Dhanbad**	Jharkhand	7	9.2	2	1	540	0.6
Asansol Kulti Township	**Paschim Bardhman**	West Bengal	1	0.0	17	1	12	2.6
Andal	**Paschim Bardhman**	West Bengal	12	1.0	2	1	1,000	32.1
Salanpur	**Paschim Bardhman**	West Bengal	12	4.8	8	0	0	97.2
Bermo	**Bokaro**	Jharkhand	11	15.7	9	0	0	21.3
Dudhi	**Sonbhadra**	Uttar Pradesh	3	24.0	0	4	8,830	16.4
Kotma	**Anuppur**	Madhya Pradesh	12	6.0	10	0	0	15.3
Jamuria	**Paschim Bardhman**	West Bengal	10	2.3	7	0	0	45.8
Tamnar	**Raigarh**	Chhattisgarh	6	10.6	2	1	2,400	1.9
Gharghoda	**Raigarh**	Chhattisgarh	6	33.2	0	0	0	3.6
Korba	**Korba**	Chhattisgarh	5	5.5	1	3	1,700	79.3
Barabani	**Paschim Bardhman**	West Bengal	6	1.1	6	0	0	30.7
Farid-pur-Durgapur	**Paschim Bardhman**	West Bengal	4	2.6	3	0	0	10.3
Raniganj	**Paschim Bardhman**	West Bengal	9	4.4	12	0	0	11.1
Gomia	**Bokaro**	Jharkhand	1	0.9	3	1	420	0.0
Podi-Uproda	**Korba**	Chhattisgarh	3	1.6	0	0	0	6.4
Chitrangi	**Singrauli**	Madhya Pradesh	1	5.5	1	0	0	2.6
Jharsuguda	**Jharsuguda**	Odisha	4	19.0	3	1	600	12.3
Pali	**Korba**	Chhattisgarh	1	0.0	0	3	463	9.2
Lakhanpur	**Jharsuguda**	Odisha	1	40.0	0	0	0	15.6
Kaniha	**Angul**	Odisha	1	10.9	0	1	1,200	32.7
Dharamjaigarh	**Raigarh**	Chhattisgarh	1	6.0	2	0	0	14.4
Chandankiyari	**Bokaro**	Jharkhand	1	0.3	0	0	0	23.6
Chendipada	**Angul**	Odisha	2	6.2	0	0	0	2.7

** Data for sanctioned DMF projects was not found for West Bengal Districts, and hence, has been taken as 0.

Social infrastructure by coal companies (No.)	Urban population in major mining block (%)	CHC to Population ratio (Ratio)	Literacy rate (%)	Households provided with tap water connections under Jal Jeevan Mission (%)	DMF projects sanctioned in high priority (%) **	Area under forest (%)	Area under cultivation (%)	Area under irrigation (%)
12	42.6	1.5	54.1	33.3	68.2	25.6	26.8	35.0
4	39.1	0.5	67.4	76.5	66.5	21.7	41.2	3.2
16	97.3	0.3	69.3	97.3	64.9	2.4	4.7	9.3
1	0.0	3.5	64.1	49.6	0.0	0.5	16.9	11.8
12	46.5	1.4	73.5	90.8	70.4	14.7	52.9	9.5
2	10.3	1.3	51.8	22.6	84.1	43.6	18.7	24.1
1	38.6	3.8	60.0	35.7	97.3	2.3	7.0	3.8
4	33.4	3.3	64.3	23.1	76.7	7.4	7.6	2.1
2	0.0	5.0	71.7	100.0	0.0	0.0	0.0	0.0
0	0.0	3.5	68.6	54.8	0.0	0.5	16.9	11.8
1	0.0	5.0	70.5	68.1	0.0	0.0	45.6	9.8
3	97.8	0.5	68.7	83.6	79.8	31.4	20.2	10.0
5	25.4	1.6	54.2	87.5	70.8	58.4	23.0	4.8
3	51.8	0.3	64.0	87.1	11.5	28.1	45.2	2.2
2	0.0	1.2	61.7	42.1	0.0	0.0	46.7	10.2
0	0.0	1.0	63.8	70.7	27.3	5.3	56.6	4.0
0	11.9	0.7	57.2	75.3	83.9	10.3	44.4	4.6
2	73.9	0.7	45.0	75.4	76.7	79.7	10.4	4.8
0	0.0	5.0	60.5	91.6	0.0	8.4	45.0	21.4
1	0.0	5.0	75.5	75.3	0.0	6.6	33.2	21.4
0	0.0	1.1	66.7	82.3	0.0	0.0	15.5	76.9
5	43.4	0.6	55.5	66.6	87.3	47.3	11.7	10.0
0	0.0	1.9	48.2	52.7	59.8	74.5	13.5	1.2
1	1.9	1.7	45.3	35.0	73.2	39.8	34.7	14.7
3	70.8	0.4	72.1	80.0	82.5	13.5	47.6	13.7
0	2.8	2.0	58.3	69.8	46.8	62.7	20.7	4.2
1	26.9	1.4	70.7	93.4	61.2	9.7	24.4	33.1
0	6.5	1.4	70.0	93.4	80.9	39.2	37.1	20.3
1	6.9	1.0	53.1	84.2	43.2	34.4	36.8	6.4
0	5.1	0.6	53.6	33.5	88.0	3.0	53.0	10.0
0	0.0	0.8	64.7	99.8	95.5	37.2	46.1	20.5

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