Energy for Sustainable Development 61 (2021) xxx

Contents lists available at ScienceDirect

Energy for Sustainable Development

The political economy of coal in India – Evidence from expert interviews

Lorenzo Montrone [a,b,*], Nils Ohlendorf [a,b], Rohit Chandra [c]

[a] Technische Universität Berlin, Department Economics of Climate Change, Str. des 17. Juni 145, 10623 Berlin, Germany
[b] Mercator Research Institute on Global Commons and Climate Change, Torgauer Str. 12-15, 10829 Berlin, Germany
[c] Indian Institute of Technology Delhi, School of Public Policy, IIT Campus, Hauz Khas, 110016 New Delhi, Delhi, India

ARTICLE INFO

Article history:
Received 14 December 2020
Revised 25 January 2021
Accepted 15 February 2021
Available online xxxx

Keywords:
India
Political economy
Power sector
Coal
Expert interviews

ABSTRACT

Indian coal power capacity has doubled in the last ten years, and its coal pipeline is the second largest on the globe. This paper analyzes the political economy determinants of India's reliance on coal in the power sector. We base our analysis on a novel theoretical framework to assess how actors having different objectives shape coal investment decisions in India. Our results are based on the analysis of 28 semi-structured expert interviews conducted in Delhi. We find that India's substantial expansion of coal power can be explained by the following factors. First, the power sector was liberalized to ensure sufficient supply. This resulted in large industry conglomerates investing in coal and securing long-term profits as renewable energy support was ineffective. Second, the planned public investments in new coal capacity are motivated by securing the long term availability of electricity. Third, the reliance on coal in Eastern India for jobs, and the presence of local vested interests, are major barriers to a transformation away from coal. Fourth, pollution regulations that would limit coal use are ineffective because of the strong political influence of coal-proponents.

Introduction

To remain well below 2 °C, as agreed in the Paris Agreement, carbon-emitting coal-fired power generation needs to be phased-out by 2050 (IPCC, 2019; Luderer et al., 2018). However, instead of being gradually decreased, the global coal capacity is planned to increase by another 25% in the upcoming years (Shearer et al., 2020). If these additional plants are built, they could become stranded before the end of their economic lifetime. Given that two thirds of India's coal-fired power plants were built in the last 10 years and that India has the second largest coal pipeline, more than half of these plants risk being stranded after 2030 if India were to pursue policies in line with the Paris Agreement (Malik et al., 2020).

Why does India rely on coal in the power sector? Economic and technological reasons alone cannot explain the large pipeline and the existing plants. The price of renewable energy (RE)[1] in India has reduced dramatically (Creutzig et al., 2017), and recent RE projects are cheaper than many existing coal power plants (Somananthan & Chakravarty, 2019). In addition, the health effects caused by local air pollution arising from power generation based on coal are substantial; coal combustion was responsible for almost 170,000 deaths in 2015 in India (GBD MAPS, 2018). In previous energy transitions, political factors were often as important as economic and technological factors in explaining power sector development (Biber et al., 2017; Geels et al., 2017). In this context, we analyze the political economy of the Indian power sector with a specific focus on coal.

Our study contributes to the existing literature on the political economy of energy in India. A large body of literature focuses on the uptake of REs (Isoaho, Goritz, & Schulz, 2017; Krishna, Sagar, & Spratt, 2015; Ramamurthi, 2016; S. Shidore, Busby, 2019b; Tagotra, 2017; Tongia, 2007). International pressure has been found to be an important enabler for RE investment (S. Shidore, Busby, 2019b). The largest barrier to REs is financial distress of the electricity distribution sector (S. Shidore, Busby, 2019b; Tongia, 2007), caused by the use of low electricity tariffs as a tool for political patronage (Mahadevan, 2019; Min & Golden, 2014). Electoral opportunism and strong vested interests in the sector are major difficulties that hinder power sector reforms removing these barriers (Cheng et al., 2020; Dubash, Kale, & Bharvirkar, 2018). Only a few studies have investigated the political drivers of coal in the power sector. Tongia and Gross (2019) find that coal mining is central to India's political economy because it is an essential revenue source for the central government, the state governments, and state-owned enterprises, such as Indian Railways, the largest employer in the country (Kamboj & Tongia, 2018). Worrall, Whitley, Garg, Krishnaswamy and Beaton (2018) identified all the government policies incentivizing the use of coal in the power sector. We contribute to this literature by providing, to our knowledge, the first comprehensive and theory-guided analysis which focuses explicitly on the determinants of the past and planned focus on coal capacity in the power sector. By doing so, we

* Corresponding author at: Torgauer Str. 12-15, 10829 Berlin, Germany.
E-mail address: montrone@mcc-berlin.net (L. Montrone).

[1] With RE we imply wind and solar power, unless specified differently.

https://doi.org/10.1016/j.esd.2021.02.003
0973-0826/

also contribute to a growing literature focusing on the political economy of coal in other countries (e.g., Brauers & Oei, 2020; Dorband et al., 2020).

We conducted semi-structured interviews with 28 energy experts and policymakers in Delhi. We systematically coded the interviews to classify actors, objectives, and contextual factors that influence coal-related policies. We cluster our results around three overarching objectives: providing sufficient and cheap electricity supply, promoting domestic industries and personal interests, and mitigating air pollution and climate change. The analysis is conceptually based on a novel political economy framework (Jakob et al., 2020). In general, the framework assumes that political and societal actors try to influence energy related policies. All actors are guided by multiple objectives, while a variety of contextual factors determine the relevance of objectives and the influence of actors.

Our analysis shows that India's reliance on coal is driven by direct government intervention in the power sector to secure long-term electricity supply. Public sector undertakings (PSUs)[2] along the coal supply chain are used to create regional employment and prosperity and strong vested interests also exist. Environmental concerns are more important now than in the past, but not significant enough to overcome powerful incumbents in polluting sectors such as coal generation.

The remainder of the paper is structured as follows. Section 2 describes the historical and projected development of the Indian power sector. Section 3 describes our research design, while Section 4 extensively describes our findings. We discuss broader implications for an Indian energy transition and conclude in Section 5.

India's power sector

Structure of the power sector

The Indian power sector is governed by several ministries, associated PSUs, and government agencies. Fig. 1 shows the organization of the Indian power sector and how it relates to coal mining, transport, and manufacturing of power plants.

The central government approves most energy policies. Within the central government, the Prime Minister Office (PMO) has a special role, as it decides the most important policy issues. Subordinate to the PMO are multiple specific ministries, which regulate different segments of the sector, but require the PMO's approval for changes in regulations.

The Ministry of Coal is responsible for regulating the production, supply, distribution, and pricing of coal, and implements its regulations directly through the quasi-monopolist PSU Coal India Limited (CIL). Coal in India is transported via railways that are managed by the Ministry of Railways and operated by the PSU Indian Railways. Bharat Heavy Electricals Limited (BHEL), an engineering and manufacturing PSU of the Ministry of Heavy Industries, manufactures products for the power sector such as turbines and boilers for thermal power plants and transmission lines. The Ministry of Power is in charge of the planning, policy formulation, and enactment of legislation concerning thermal and hydropower generation, transmission, and distribution. Furthermore, through the PSU National Thermal Power Corporation Limited (NTPCL), it controls 16% of the power capacity of the country. The Ministry of New and Renewable Energies regulates wind, small hydro, biogas, and solar power. Since 2014, it has been headed by the same minister as the Ministry of Power. Finally, the Ministry of Environment, Forestry, and Climate Change (MoEFCC) enacts environmental regulations and approves environmental clearances for power projects and new mines. However, these regulations are often not binding or weakly enforced by other ministries and PSUs (Stuligross, 1999).

Governmental agencies support the ministries in managing the power sector. The Central Electricity Authority (CEA) is a statutory organization that advises the Ministry of Power on development plans for the electricity system. Every five years, the CEA releases the National Electricity Plan, which outlines the development of the power sector in the medium-term. The Central Electricity Regulatory Commission (CERC), another key regulator, defines the guidelines for the Power Purchase Agreements (PPAs) between power generation companies and distribution companies (DISCOMs). NITI Aayog is a policy think tank that was established by Prime Minister Modi in 2014 to advise the Prime Minister Office and facilitate cross-ministerial cooperation. Since then, it has been heavily involved in power sector management, for example by drafting the National Energy Policy in 2019, which includes scenarios of long-term development pathways for the power sector.

Apart from the central government, state governments also influence the power sector. The central government is required to consult with state governments on policies concerning the power sector because electricity is listed as a concurrent subject[3] in the constitution. The state governments and the central government are jointly responsible for fostering electrification. State governments are also financially involved in electricity generation, as they are often major shareholders of local power plants. Besides power generation, they also have the greatest influence on electricity distribution as they own most DISCOMs. These buy electricity from generation companies and sell it to consumers. Usually, each local DISCOM signs long-term PPAs with electricity generators for 20–25 years, specifying the amount and price of electricity to be procured. These contracts generally guarantee a contribution towards fixed costs of power plants, even if electricity is not purchased. PPAs also regulate those who bears the financial burden of changes in costs, e.g., changes in global coal prices.

The judicial branch of the government also influences the development of the power sector. The Supreme Court takes up appeals primarily against verdicts of lower ranked judicial institutions. Among these, the National Green Tribunal (NGT) is of particular relevance in the power sector, as it handles environmental issues.

Historical development of the power sector

In recent decades, India's power sector has been through a number of reforms that have led to the liberalization and rapid expansion of total installed capacity. Fig. 2 shows a timeline of the additions to annual capacity by power source since 1965 and the most important events and policies in the power sector.

Between India's independence in 1947 and the year 2003, the power sector was centrally managed via a system of five-year plans. These plans were developed by a planning commission,[4] which regularly set new targets for power capacity. However, until the early 2000s, the grid expanded faster than the installed capacity and the excess electricity demand led to frequent power shortages. This demand-supply mismatch was driven by delays of centrally planned generation projects, while regional governments expanded the grid access despite the insufficient capacity. It was believed that liberalizing the power sector would solve these supply shortages. However, the first attempt to liberalize the power sector with the Independent Power Producers policy in 1992 failed to provide the necessary guarantees to attract private investment (Dubash, Kale, & Bharvirkar, 2018; Sreenivas et al., 2018).[5]

[2] Public sector undertakings is the official classification of state-owned enterprises in India.

[3] In the Indian constitution, the legislative section is divided into three lists: Union List, State List and Concurrent List. Items in the Concurrent List are required to be considered by both the union and state government.

[4] This planning commission was dissolved in 2015 and substituted by NITI Aayog.

[5] The only purchasers of electricity at the time were State Electricity Boards (SEBs) and their financial situation was disastrous. Political interference in tariff setting lead to SEBs selling electricity at non-cost recovery prices (Min & Golden, 2014). Widespread theft and transmission losses exacerbated the financial burden of SEBs. This financial situation made them an unreliable payer and thus increased the risk for private investors entering contractual obligations. Therefore, private investors demanded counter guarantees from the central government to isolate them from the risk of not being paid (D'Sa et al., 1999). For a detailed analysis of the reform process see, e.g., Dubash et al. (2018); Lal (2006); Singh (2010).

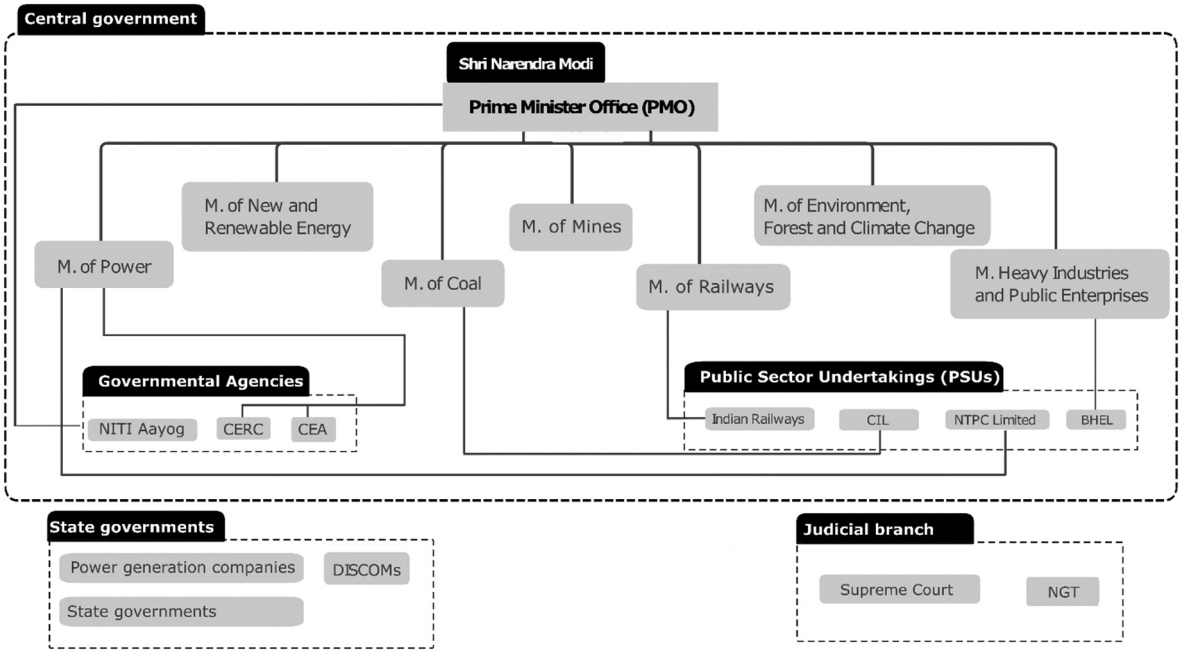

Fig. 1. *Power sector governance structure.* Acronyms: CERC = Central Electricity Regulatory Commission, CEA = Central Electricity Authority, CIL = Coal India Limited, NTPCL = National Thermal Power Corporation, BHEL = Bharat Heavy Electricals Limited, DISCOMs = Distribution Companies, NGT = National Green Tribual. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

The Electricity Act in 2003 more successfully liberalized the Indian power sector. This cornerstone legislation mandated the unbundling of distribution and generation, the creation of a regulatory agency that overlooked the determination of tariffs (i.e., CERC), introduced competitive bidding for power projects, and effectively liberalized the import of coal by private actors. Since then, prices for PPAs have been determined via reverse auctions (Sreenivas et al., 2018). However, NTPCL was exempted from this provision until 2011 and was allowed to bilaterally negotiate tariffs with DISCOMs. The principles of the Electricity Act were implemented by the National Electricity Policy of 2005, and the National Tariff Policy of 2006. The liberalization led to a sharp increase in mostly private investments in power capacity additions (see Fig. 2). Between 2003 and 2011, 40 GW of privately financed coal capacity was commissioned (Sreenivas et al., 2018) and in 2019, 46% of the total installed power capacity was privately owned (CEA, 2020). This market share is highly concentrated within a few companies: Adani, Tata, Reliance, and Jindal Group account for almost 70% of the coal-fired power plants that were contracted between 2006 and 2011 (Gadag, Chitnis, & Dixit, 2011). Some DISCOMs, especially in large cities, are also privately owned by Tata Power and Adani Transmission, both operating in Mumbai and Delhi.

Coal thereby maintained and further strengthened its role as the largest source of electricity in India. In 2010, coal-fired power capacity accounted for 65% of the installed capacity mix, hydropower 22%, natural gas 8%. Nuclear power played only a relatively marginal role (3%) (WEPP, 2017). In 2020, there is 228 GW of operating coal-fired power capacity (Shearer et al., 2020), generating 74% of total electricity. Coal-fired power plants are installed in almost every Indian state (see Fig. 3). However, in Eastern India, there is an especially high concentration of installed coal capacity relative to population and regional GDP. The Eastern states of Jharkhand, Odisha, Chhattisgarh, West Bengal together host 80% of the total coal reserves in India (MOSPI, 2019) and are often

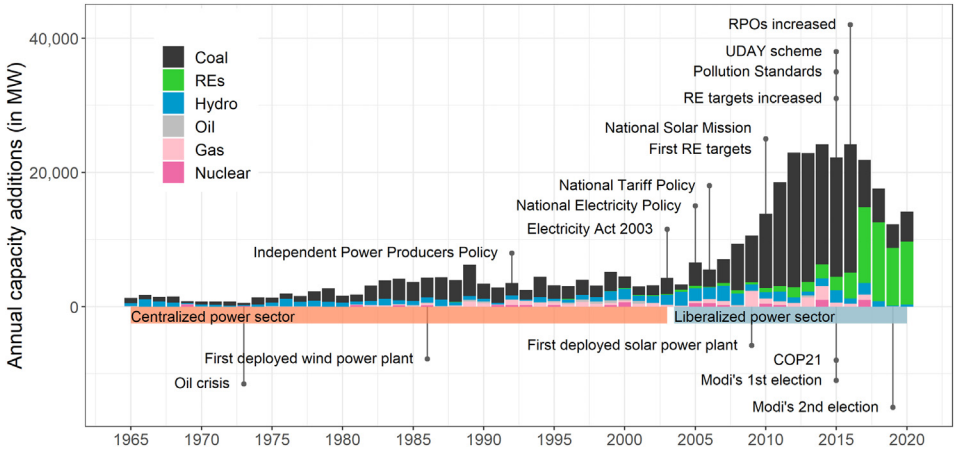

Fig. 2. *Annual capacity additions by source (including a timeline of relevant events).* Sources: Own elaboration based on WEPP (2017) until 2016 and CEA (2020) until 2020. Acronym: RPOs = Renewable purchase obligations, UDAY = Ujjwal DISCOM Assurance Yojana.

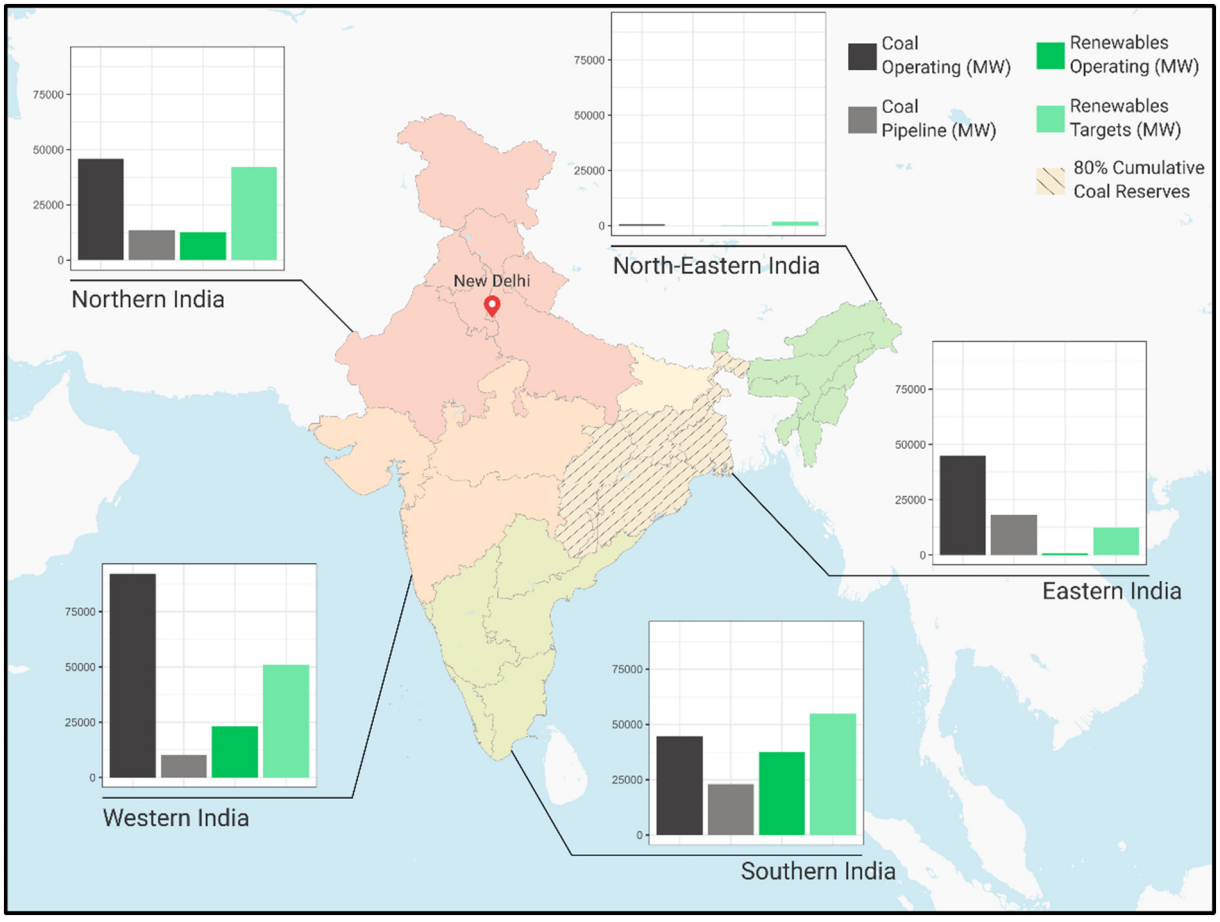

Fig. 3. *Geographical distribution of coal and RE capacity in MW (existing and planned)*. Sources: Own elaboration. Total installed capacity by region of REs (wind and solar) as of September 2020 is taken from MNRE (MNRE, 2020). Tentative state-wise breakdown of RE targets for 2022 (which differ from the actual pipeline) are taken from MNRE (MNRE, 2015). The coal pipeline refers to plants that are announced, permitted, or already under construction. Both pipeline and operating coal capacity are taken from Shearer et al. (Shearer et al., 2020). The dashed pattern indicates the states, which host 80% of India's known coal reserves. The geographical clustering follows CEA definitions and is in line with the electricity grid clusters.

referred to as the Indian "Coal Belt". Known coal reserves in India amount to a total of 319.04 billion tons of mostly low calorific coal, potentially allowing continuous extraction at current rates for another 500 years (own calculation). However, India also depends on high calorific imported cooking coal. Despite abundant natural resources, the regions in Eastern India are among the poorest of the country in terms of per capita income.

Since 2010, RE capacity has substantially increased, but remains low compared to the total installed coal capacity. The deployment of wind power started in 1995, while the first solar plant was built in 2009. In 2010, Prime Minister Manmohan Singh inaugurated the National Solar Mission, an initiative to promote the use of solar power. This Mission set the first target of 20 GW of REs (including small hydro and biomass) by 2022, thereby laying the ground for their further development. This target has since been increased by the current Prime Minister Modi; after his first election in 2015, just before COP21, he announced an increase of the RE target to 175 GW by 2022.[6] In the same year, the Ministry for Environment, Forestry, and Climate Change released more ambitious pollution regulations for thermal power plants, and Renewable Purchase Obligations (RPOs), increased from 3% in 2006 to 8%. Finally, the PMO adopted the UDAY scheme, a program to improve the financial situation of DISCOMs by limiting the level of debt they could contract. Jointly, these policies gave a boost to the RE deployment, especially in the solar sector. In 2020, wind and solar capacity make up respectively 10% (38 GW) and 9.5% (36 GW) of the total installed capacity (CEA, 2020).[7]

Since 2016, the power sector has officially been in a state of oversupply, caused by the sharp increase of annual capacity additions after 2010. In 2019, coal-fired power plants operated at plant load factors (PLFs) of an average of 56% (CEA, 2020). The overcapacity led to plummeting new coal-based capacity additions, while DISCOMs refrained from providing new long-term PPAs. The Standing Committee on Energy (Standing Committee on Energy, 2018), a committee consisting of Members of Parliament, estimates that there are 40 GW of recently deployed coal-fired power plants that have become non-performing assets.

Despite the oversupply, the quality of electricity for Indian households remains low, with frequent load shedding, brown-outs, and electricity being available only at limited times in some villages (Pelz & Urpelainen, 2020). This is explained by the large budget deficits of DISCOMs, which lack the financial capacity to buy the necessary power to serve all consumers. The dire financial situation of DISCOMs results from a long history of politically set low electricity tariffs, allowing theft and unmetered consumption (Dubash, Kale, & Bharvirkar, 2018). Hence, some DISCOMs are reluctant to sell electricity

[6] Distributed as follows across technologies: 100 GW from solar, 60 GW from wind, 10 GW from bio-power and 5 GW from small hydro-power.

[7] The geographical distribution of RE capacity is not homogeneous (Figure 3). The majority is concentrated in Western and Southern India, which both have favorable wind and solar conditions. REs are envisaged to increase from roughly 10% in 2020 to 35% of total installed capacity in 2022. Currently planned RE investments are also mostly concentrated in Southern, Western and Northern India (Figure 3).

or provide a grid connection to consumers eligible for subsidized tariffs; they prefer industrial consumers, who pay higher tariffs to compensate partially for the lower tariffs of domestic and agricultural consumers.

Coal is projected to remain the largest source of electricity until 2050, despite a constantly increasing share of REs. The National Electricity Plan of 2018 estimates that the share of coal in power generation will decline from 72% of generation in 2019 to 48% in 2030 (CEA, 2018). However, the total coal-based electricity generation is expected to increase by roughly 60% from 805 GWh to 1300 GWh, as the National Electricity Plan assumes an average annual electricity demand growth of 4.5%.

Methodology

We base our analysis on a novel actor-centered political economy framework developed by Jakob et al. (2020) (see Fig. A.1 for a visualization). The framework is guided by the idea that the energy policies that are implemented, are those which best comply with the objectives of the most influential actors. In the framework, each actor has a specific set of objectives, which are represented, by different degrees, in the policy outcomes according to the actor's influence on policy formulation processes. Political actors have a direct influence on the policy formulation process (e.g. by writing or adopting legislation or regulations). Societal actors, in contrast, are not formally able to design policies but can influence political actors. Finally, contextual factors determine i) the importance of each objective for each actor ii) the influence of each societal actor on each political actor, and iii) the influence of each actor on the policy outcomes. Contextual factors comprise economic, environmental, and institutional aspects. This framework can easily and transparently be applied empirically and allows comparison across countries. For example, Dorband et al. (Dorband et al., 2020) applied the same framework to study the political economy of coal in Vietnam and (Ordonez et al., under review) for Indonesia.

Our main data sources are semi-structured expert interviews that we complement with extensive desk research. In total, two authors conducted 28 semi-structured expert interviews in October and November 2018. While conducting our interviews, we followed ethical principles in line with the Charter of Fundamental Rights of the European Union and the European Code of Conduct for Research Integrity. Before starting an interview, we explained the project, clarified that the responses would only be used for academic purposes and that the interviewee's identity would remain anonymous. We furthermore asked for the informed consent to record and later transcribe the interviews. Three cases restrained from allowing to record. The interviewers furthermore took structured notes during each interview, including their impression of the interviewee's statements. The structured notes were cross-checked between the two interviewers and discussed.

The sample selection followed a snowballing process (O'Reilly & Parker, 2013). First, we identified a set of relevant institutions that we categorized as political and societal actors in our theoretical framework. This identification was based on initial desk research of policy documents and scientific publications. For example, we assessed which institutions authored or commented on important policy documents, such as the National Electricity Plan, which was authored by CEA, and received comments from a long list of public and private institutions. We used the personal network of the authors and publicly available contacts of employees to find relevant experts[8] within these institutions and contacted them via email. Second, at the end of each interview, we asked for recommendations of further energy experts (Cohen & Arieli, 2011). We thereby iteratively extended our initial list of institutions. We repeated this procedure until the recommendations became repetitive and the new information obtained from each new interview became minimal, following the principle of thematic saturation (O'Reilly & Parker, 2013).

The final sample of 28 interviews includes at least one representative of most key actors in the Indian power sector.[9] We interviewed twelve experts from national societal actors (NSA) including research institutions, journalists, and non-governmental organizations, ten experts from national political actors (NPA) including ministries and regulatory agencies, three experts from public-owned enterprises (PEA), two experts from international societal actors (ISA), and one expert from a privately owned enterprise (PrEA). Table A. 1 contains a list of institutions covered. In the remainder of the paper, each interviewee is referenced by the type of actor plus a random number that has been assigned to each interview (e.g.: NSA1). This ensures that the referenced claims cannot be linked to a specific institution.

Our semi-structured interviews followed an interview guideline that consisted of three parts. The first part asks which are the most important power sector policies. The second part determines which actors are relevant for each decision-making process and why. The third part aims to identify relevant contextual factors and contains follow-up questions adapted to the specific expertise of each interviewee. We also used the third section to triangulate previously obtained information (the detailed interview guideline is available upon request).

We used the theoretical framework from Jakob et al. (2020) to guide our analysis. While coding our interview material, we identified whether a passage of the interview referenced to i) societal objectives ii) political objectives iii) societal actors iv) or political actors. For example, we classify as political actors all national and state level administrations, which officially adopt policies (e.g., all the ministries and the PMO) or actively participate in the policy formulation with the role of advising agencies (e.g. NITI Ayog, the CEA and CERC). Societal actors, on the other hand, comprise private and public companies like NTPC or Adani, but also NGOs and other citizen groups that can affect policies via influencing political actors.

Each passage has a second- and third-tier code to identify specific information about each coded actor and objective. For example, a societal actor could receive the second-tier code “Civil society” and the third-tier code “Farmers”. These second and third-tier coding categories emerged from the data analysis resembling the open coding approach (Holton, 2007). Each passage could receive multiple codes. In total, 87 different coding categories emerged (47 actors, 40 objectives). The list of codes and their classification into societal and political actors (objectives) is shown in Table A. 2 in the Appendix. After coding all passages, we qualitatively assessed the influence of each political actor on the policy formulation process, the role of each societal actor on each political actor, and the role of objectives and contextual factors on the respective influence.

By analyzing the coded data through multiple iterations between the authors, we clustered our results under three main overarching objectives, namely i) provide sufficient and affordable electricity supply, ii) promote domestic industries and personal interests, and iii) mitigate air pollution and climate change (see Table A. 2 for the clustering). These objectives reflect the energy trilemma and are commonly identified in the energy transition literature as important (e.g., Jenkins (2014); Schmidt, Schmid, & Sewerin (2019)).

Each result section describes in detail how objectives and actors interact and how these can be used to explain India's reliance on coal in the power sector. Given the qualitative nature of the analysis, we do not explicitly refer to all coded actors and objectives in all instances, but try to discuss the most important relationships. Thereby we aim to fulfill the highest standard of objectivity and reproducibility by following a state of the art guideline for expert interview analysis (Bogner et al., 2009). Whenever possible, we have tried to triangulate claims across

[8] We define an expert following the established definition of Bogner et al. (2009), as an individual that has “technical, process and interpretative knowledge that refers to a specific field of action, by virtue of the fact that the expert acts in a relevant way (for example in a particular organizational field or the experts' own professional area)”.

[9] We focued our analysis at the level of the Central government. For a detailed analysis at the State and district level analysis see e.g. Bhushan et al. (2020)

interviews. However, we acknowledge that the outcomes may contain subjective elements, as they necessarily partially depend on the authors' judgment.

Results

The next sections describe the main overarching objectives in the power sector, namely i) to provide sufficient and affordable electricity, ii) to promote domestic energy industries and personal interests, and iii) to mitigate pollution and climate change.

Provide sufficient and affordable electricity supply

Ensuring a sufficient and affordable electricity supply was frequently mentioned as a major objective in the power sector (ISA2, NSA3, NSA4, NSA5, NSA6, NSA9, NSA10, NPA2, NPA6, NPA8, NPA9). As a domestically abundant and cheap resource, the Indian government perceives coal as the most favorable option to ensure a reliable electricity supply. The government has thus created a policy environment in the power sector favoring coal that largely remains today and, after the power sector liberalization, has attracted profit-driven private investors. Incentives for REs remained ineffective until 2016, largely due to the bad and unresolved financial situation of the DISCOMs. While private coal investments plummeted in the late 2010s, public coal investments remained to ensure uninterrupted availability of electricity in the future.

Sufficient supply

To satisfy the rapidly growing electricity demand and to ensure energy security, the Indian government has been incentivizing the use of coal since independence (NSA5, NSA11). Until the early 1990s, India's economic policy focused on centrally managed rapid industrialization, which required substantial investments in power infrastructure. During this period, the oil crisis of 1973 exacerbated the need for domestic energy sources (NSA11), while modern renewable energies were not yet an established alternative. The lack of alternatives made large scale coal-fired power plants, and to a lesser extent,[10] hydropower plants an obligated choice for the government (NSA2).

To implement these projects, the central government used PSUs and finance from other publicly owned institutions, such as the Power Finance Corporation and the Rural Electrification Corporation (Worrall, Whitley, Garg, Krishnaswamy, & Beaton, 2018). The central government also implemented policies to incentivize private investments in the sector; most importantly, they encouraged long-term PPAs with a guaranteed payment of fixed costs (see Section 2), minimizing their investment risk (ISA2, NSA9, NPA10, NPA2). In addition, land and water resources have been allotted at concessional rates for thermal power projects, and return on equity remained unclaimed by the public financial institution (Worrall, Whitley, Garg, Krishnaswamy, & Beaton, 2018). Finally, income from power generation projects was subject to 100% tax breaks until April 2017 (Garg et al., 2017).

Private profits

Since liberalization, coal-fired power capacity has been the technology of choice for private investors, because the policy environment has been ensuring high profits and low interest rates (ISA2). Furthermore, many private conglomerates that entered the electricity generation market after liberalization were able to complement previous business activities along the coal supply chain. For example, Adani, India's largest port developer, became the largest private power producer in the country (2014). Tata and Reliance both owned DISCOMs in Mumbai and Delhi, which allowed them to negotiate convenient PPAs for their sister companies after liberalization (Sreenivas et al., 2018). Some of these private conglomerates also invested in domestic mining. Large power projects acquired mining rights on nearby reserves to privately mine the coal necessary for power production. Furthermore, Adani acquired mines in Indonesia and Australia to import coal to India.[11] The private investors in the coal sector increased efficiency, which was reflected by reduced power shortages and increased coal production. However, the involvement of private actors was not free of controversies: Between 2005 and 2009, more than 100 blocks (more than 20,000 MT of coal) were allotted to private actors at zero cost except for royalties (NPA2, PEA2, NSA10). This process of allotting the blocks was later canceled by the supreme court following a corruption scandal known as "Coalgate". These investment incentives created carbon-intensive lock-ins and powerful incumbents. PPAs, ensuring the payment of fixed costs to thermal power plants, restricted the uptake of REs, despite their dramatic cost reduction (ISA2, NSA9, NPA2). Furthermore, the incumbents oppose policies that would remove subsidies or impose additional costs for coal-fired power generation (NSA3). For example, with the large fiscal reform of 2015, the tax burden for coal and coal-fired power was reduced, while the burden on solar and wind increased (NSA3). Some independent power producers lobbied to renegotiate even more favorable terms for their PPAs (The Wire, 2018). Lobbying is often successful due to the strong leverage of private conglomerates over the current government lead by the Bharatiya Janata Party (BJP) (ISA1, NSA3, NSA5, NSA6). Adani and Tata even have direct personal relationships with the prime minister and allegedly contributed to financing his campaign (ISA2, NSA4, NSA5).

However, the rapidly falling costs of REs have lead private energy incumbents to increase their investment in RE (NSA3). After the large increase in coal-based power capacity between 2005 and 2015, some existing coal-fired power projects struggle to remain profitable, and private developers have difficulties obtaining loans for new projects (NSA7). These factors have contributed to a significant decrease in private coal investment. The large conglomerates in the power sector are now competing for higher market shares in RE markets (Chawla et al., 2018). Despite this, the policy environment still favors coal and 11 GW of private coal capacity is in the pipeline and will possibly come online if electricity demand rises (PrEA1).

Low electricity prices

DISCOMs incur large losses because of the political will to maintain low electricity tariffs for consumers (Dubash, Kale, & Bharvirkar, 2018). Local politicians, in exchange for political support, often promise to reduce electricity prices and to provide reliable grid connections (Dubash, Kale, & Bharvirkar, 2018). They fulfill those promises by setting electricity tariffs at subsidized rates and by allowing theft and unmetered billing (Mahadevan, 2019; Min and Golden, 2014). These electricity tariffs set by politicians impose heavy financial losses on DISCOMs. Consequently, most DISCOMs do not recover their costs, and have to be regularly bailed out by the central government.

Our interviews confirm the finding from other studies (e.g., Tongia, 2007) that policy incentives for REs remain less effective because of the dire financial situation of DISCOMs (NSA11, NSA5, NSA3). In 2006, the National Tariff Policy introduced a feed-in tariff, which guaranteed a return on investment of 15% on RE projects and required DISCOMs to partly procure power from RE sources (i.e., RPOs). However, DISCOMs have been reluctant to increase their share of REs as they

[10] Large scale coal and hydro projects were both pursued by the government. However, coal has historically been more successful, as India built 60 GW of coal, but only 20 GW of hydropower between 1972 and 2000 (own calculation based on PLATTS 2017). Strong social resistance against large hydropower dams and the subsequent reluctance of international financial institutions, such as the World Bank, to support these projects explain the comparative advantage of coal (Khagram, 2004).

[11] Imported coal from Indonesia and Australia is competitive with domestic coal imported from the Eastern regions due to the high domestic freight transport tariffs (see Section 4.2). The entrance of imported coal in the Indian power market created a new source of competition for the Eastern mines and a new source of profits for private companies.

fear their financial problems will worsen because of the higher RE tariffs and because of the required grid investments for the RE integration (NSA3). To maintain low consumer prices, state governments often "*turned a blind eye*" towards the DISCOMs' lack of compliance (NSA3). The lack of enforcement of RPOs increased the risk of RE investments generating higher capital costs (NSA3), being the largest cost component of RE investments (Hirth & Steckel, 2016).

Since 2016, the financial problems of DISCOMs have been addressed more successfully by the government. The UDAY scheme improved their financial situation,[12] and the government has become more strict on the enforcement of RPOs (NSA3).

Long term security of supply

The Ministry of Power considers coal-fired power capacity necessary to ensure the security of supply and is skeptical about the potential of REs to satisfy the fast-growing energy demand (NPA4, NPA6, NPA8, NSA9). Coal-fired power capacity is regarded as a reliable technology for baseload capacity (NPA4, NPA6), and as the only technology able to meet the peak demand in the evening (10–11 pm) (CEA, 2019) (OI1). Given the large number of financially stressed assets in the power sector (see Section 2.2), private actors are reluctant to embark on new coal projects until PLFs begin to rise again (PrEA1). While the relative share of public investment in coal-fired power plants has declined since liberalization, the coal pipeline in 2020 is 83% publicly owned (own calculation based on Shearer et al. (2020)).

For the central government, NTPCL has been instrumental in ensuring energy security since liberalization. The government protected the dominant position of NTPCL during liberalization, despite the acceleration of private investment (NPA2).[13] For example, NTPCL was absolved by the Tariff Policy of 2006 from competitive bidding until 2011 (NPA2). In this period, NTPCL signed PPAs for more than 50 GW (Sreenivas et al., 2018). Public support for coal to ensure energy security via publicly-owned power plants emerges as the main driver of Indian coal investments in the future.

Promote domestic energy industries and personal interests

The energy sector has often been used to promote economic growth and job creation (NPA2, NPA3 NSA5), two primary objectives of the national government (ISA2, NSA3, NSA5, NSA11, NPA8). Indian PSUs satisfy those primary objectives and several more; CIL and Indian railways are large employers and contribute to regional development and re-distribution goals (Chandra, 2018). Similarly, BHEL and NTPCL are large coal incumbents that manufacture and operate coal-fired power plants and thereby play a strategic role in providing the country's energy security. Lastly, over time, vested interests along the whole coal supply chain have emerged.

Regional development and jobs

The relatively poor coal mining regions in the East strongly benefitted from, and still depend on, the coal industry (NSA10, NPA2, PEA2, NSA5). The central government used CIL to foster investment, create employment, and redistribute wealth in the coal mining regions (Chandra, 2018). In addition, CIL has built houses, public infrastructure, and provides healthcare services, contributing to the well-being of the entire region (Chandra, 2018). When large-scale coal mining began, formerly remote villages became business centers (PEA2). Coal mining also generated employment in further sectors, such as road construction, transport, hotels, domestic servants, and vegetable sellers (PEA2) (Pai and Carr-Wilson, 2018). Policy-makers build on continued coal production to improve their chances of re-election. For example, state-level parties put pressure on the central government to invest in large coal mining projects operated by CIL in their constituency (NSA5, PEA2, ISA1, NSA4). The Ministry of Coal has often been assigned to Eastern Indian politicians, who have been major political figures in their states (e.g., Shibu Soren and Mamata Banerjee). Coal interests exist at multiple governance levels: locally, providing jobs; directly, as small amounts of coal maintain livelihoods; and at the state and the central level, through the allocation of coal mining rights.

The relevance of coal for economic development was not confined to the Eastern states, since the fast growing Western regions were historically the main consumers of coal. Western regions put pressure on the central government to facilitate the diffusion of cheap coal over the national territory, which often created regional tensions. For example, the freight equalization policy, enacted between 1953 and 1993, ensured the same price of coal irrespectively of the location of the demand. As a consequence, businesses decided to set up industrial clusters near the coastal trade hubs in the West, far away from the Eastern coal mines (Toman, Chakravorty, & Gupta, 2003). Many mining intensive districts in the Eastern states thus remained extractive economies, dependent mostly on CIL to provide employment opportunities (Bhushan et al., 2020).

Job opportunities

Though historically important, labor unions in the coal sector currently have a limited influence on the BJP-lead government. Nationwide, coal strikes have often been threatened, and sometimes carried out. However, a shrinking formal labor force has reduced union's bargaining power, leading them to compromises and taking deals rather than being able to resist major policy changes in the sector. Informal employment, as well as contracted labor in the mining sector, have been constantly increasing (NPA8). Today, only 30% of mining employees are estimated to be formally employed (Bhushan et al., 2020). In addition, due to its profitability Coal India's has been able to offer many financial benefits to existing employees, and buy-in the major opponents to increasing privatization and subcontracting in the industry.

Yet, coal miners remain an important group of voters due to their large number and geographical concentration (NSA7). In the Ramgarh district of Jharkhand, for example, a household survey found that 59% of people in the sample derived their income from coal-related activities (Bhushan et al., 2020). Such high levels of dependence might as well be common in many coal districts across India. Thus, whether new jobs from the RE sector can replace coal related jobs remain an important concern of the government (NPA3, NSA3, PEA2).

Jobs in the RE sector do not, to date, geographically overlap with coal jobs. Coal jobs are concentrated in Eastern India, while solar and wind jobs are concentrated in the West and the South (see Fig. 3, Section 2.2). Given that Eastern Regions have thus far not benefitted from new RE related jobs, they persist in politically supporting coal (NSA10, NSA12, PEA2, NSA5). Developing adequate RE capacity to absorb coal related jobs might even be technologically and economically unfeasible due to the low suitability of the Eastern region from wind and solar (Pai et al., 2020).

In addition, the total number of jobs in India may decrease by transitioning to REs. While thermal power plants are manufactured domestically, 80% of solar cells are imported from China and Malaysia (NSA3, Energy, 2020). To protect and stimulate the domestic solar industry, in 2018 the Government of India introduced an import duty of 25% on foreign solar cells (Ministry of Finance, 2018). However, with its legal time span of only two years, the import duty is considered ineffective in fostering a domestic market and triggering large-scale investments (Dutt, Aggarwal, & Chawla, 2019). Besides, it has adverse climate impacts by reducing the competitiveness of solar power relative to coal (NSA3, Buckley and Garg, 2019).

[12] The Central Government changed course to increase its power over the state governments (NSA2, NPA6). It essentially reduced the ability of the state governments to use electricity subsidies before elections (see Section 2.2). Additionally, the Central Government proposes switching to a system of centrally managed direct transfers, rather than the electricity subsidies managed by the states.

[13] More details on the strategic role of other PSUs are presented in Section 4.2.

Revenues

Indian Railways heavily relies on revenues from coal transport to ensure profitability (NSA12) and to cross-subsidize passenger fares. It does this by overpricing freight transport, of which coal constitutes 44% (Kamboj and Tongia, 2018).

The increasing share of REs in the Western regions in the last decade, however, has put pressure on the Indian Railways business model. Coal power plants in Western regions, being far from coal-mines,[14] are beginning to be less competitive than the increasingly cheaper REs.[15] This has reduced coal demand, which has further decreased the coal revenues from freight transport. In response, Indian Railways set higher freight tariffs, making the remote coal-fired power plants even less competitive. This reinforcing feedback loop has led to a doubling of freight tariffs between 2012 and 2017 (NSA12).

Despite Indian Railways' partial dependency on coal revenues, we find no evidence that the company or the ministry of Railways exerts any pressure to delay an energy transition away from coal. In fact, Indian Railways seems to be actively seeking strategies to reduce its dependency on coal (NSA1, NPA4).

Coal is also an important source of revenue for the central government, which uses coal income to fund various regional development projects (IISD, n.d.). The "Clean Energy Cess", a tax on coal, was introduced in 2010 at USD 0.80 per ton of coal and raised to USD 3.20 per ton in 2015 (Garg et al., 2017). Unlike carbon taxes that are designed to reduce the use of a pollutant, the "Clean Energy Cess" was primarily established to raise revenues, assuming a low elasticity of coal demand (NSA4).

Energy independence and personal interests

The electrical equipment and manufacturing company BHEL strategically contributes to India's energy independence and is also a large employer. Coal-related business activities contributed to more than 80% of BHEL's annual revenues in 2017–18 (BHEL, 2018). Decreased orders for coal-fired power plants would thus threaten BHEL's main source of revenues (ISA2). From a strategic perspective, there are concerns that shutting down the domestic turbine production could increase India's dependence on other countries and international companies, as turbines for potential coal-fired power plants in the future would then need to be imported. One interviewee thus speculated that pressure from BHEL, in combination with concerns over energy security, might explain why the National Electricity Plan suggests a stable flow of 3–5 GW of new annual coal capacity (ISA2). In addition, BHEL provided legal and technical support to facilitate the approval of the environmental clearances for several proposed coal-fired power plants that ordered BHEL turbines.[16]

Lastly, the presence of large public monopolies along the coal supply chain (i.e. CIL) has created multiple opportunities to extract rents. Local and national politicians have participated in businesses benefitting from coal, e.g. machinery suppliers, transport, or ash treatment (NPA2, PrEA1).

Mitigate air pollution and climate change

Most of the interviewees mentioned that the mitigation of climate change and local air pollution are also important objectives (ISA2, NSA3, NSA4, NSA5, NSA6, NSA9, NPA8, NPA10), especially since the COP21 in 2015. However, some explicitly emphasized that they are less relevant than the objectives previously described (see Sections 4.1 and 4.2) (NSA3, NSA11, NPA3). Key objectives were to foster the government's domestic and international reputation, which led to the approval of ambitious RE targets and anti-pollution regulations (see Section 2). However, the enforcement of environmental regulations remains limited, as actors profiting from coal have substantial influence over policymakers (see also Section 4.1).

International and domestic reputation

Higher RE targets and more ambitious pollution standards are two critical policies that have been promoted by Modi's government. The RE targets are in line with India's NDCs, which envisage a 40% share of REs in the installed capacity by 2030 and thus a substantial increase from the 24% in 2020 (CEA, 2020).[17] Enforcing the pollution standards would potentially further reduce the price-gap between renewables and coal[18] and may lead to the retirement of 6 GW of old power plants, which lack the physical space to be retrofitted (NPA9).

Environmental policies helped to promote Modi's international reputation and to establish better international relations (NSA3, NSA5, NSA11, NPA2, NPA8, NSA6, NSA12). The COP21 was Modi's first international event as prime minister and thus an occasion to establish diplomatic relationships (NSA3). By promising efforts towards climate change mitigation, the Indian government could ensure international support in other strategic topics, such as, for example, geopolitics (NSA3) (Shidore and Busby, 2019a).

Domestically, announcing ambitious targets for the expansion of RE energies helped Modi establish his image as a leader, innovator, and first mover, which later became instrumental in securing support for his re-election campaign (Shidore and Busby, 2019b). Setting ambitious RE targets was a low-cost political strategy (NSA3, NSA5), given that the electricity grid was capable of integrating the thus far low shares of fluctuating wind and solar electricity (NPA10). With the setting of the RE targets, private investments significantly increased. In addition, Modi wanted to distance himself from coal, which, at the time of his first election, was linked to several corruption scandals (ISA1, NSA11).

The reformed pollution regulations also addressed the requirement for reduced local pollution of the urban middle class (NSA12, NSA6). The rapidly increasing urbanization since 2010 exacerbated transport pollution in large cities, which regularly leads to "front page" newspaper articles and record-high pollution levels (NSA12). Urbanization and rising average incomes have created a vocal and politically organized urban middle class, which has become increasingly visible through additional registered environmental NGOs that influence the policy process. The main channels of influence of the NGOs are the National Green Tribunal and the Supreme Court. For example, Greenpeace criticized the lack of compliance with pollution standards by private power generation companies at the Supreme Court and the National Green Tribunal (Sethi, 2019; The Economic Times, 2017). While the Supreme Court had historically been reluctant to take strong action against the power sector, some interviewees claim that the increased relevance of pollution heightened the likelihood of more severe rulings against pollution technologies in the power sector (NSA12, NSA6).

Reduce regulations

Although the Indian government approved more stringent pollution regulations, they have only been weakly enforced due to successful lobbying of incumbents. For example, when the deadline for retrofitting set by the MoEFCC expired in December 2017, almost no coal-fired power plant had been retrofitted (Garg, Narayanaswamy, Ganesan, &

[14] Coal freight tariffs are calculated on a ton per km base. For power plants located far from a mine, coal transport costs can account for 50% of the total fuel cost (NSA5, NSA9, (Kamboj & Tongia, 2018)).

[15] These renewables plants (mostly solar PV) on the West coast (i.e. Gujarat) are particularly cheap because of the optimal location and policy incentives (mainly enforced RPOs and subsidized transmission charge) (NSA3, NPA10).

[16] For example, a 1080 MW project in Telangana was initially halted by the National Green Tribunal, but subsequently greenlighted by the Mistry of Environment after the intervention of BHEL (Mahajan, 2018; SourceWatch, 2019).

[17] The renewable shares include: Small Hydro Project, Biomass Gasifier, Biomass Power, Urban & Industrial Waste Power, Solar and Wind Energy.

[18] Retrofitting increases costs for coal power generation between 0.34 and 0.87 INR per kWh (V. Garg et al., 2019). With costs between 2.5 and 3 INR per kWh for recently deployed REs, pollution standards are a sizeable instrument to reduce the price-gap between coal and REs.

Viswanathan, 2019). Instead of fining non-compliant companies, the MoEFCC simply postponed the deadline to 2022 (Central Pollution Control Board, 2018). It was reported that the Association of Power Producers, an industry association for private power producers, having well-established contacts with the Ministry of Power and within the PMO (ISA1), successfully argued for the technical infeasibility of the deadline in 2017 and obtained a postponement. This case is a concrete example of a common process in India's policymaking: societal actors are formally eligible to provide comments and inputs to policies before their approval. Yet, whether these comments influence the policy design, depends in particular on the personal or institutional contacts with the decision-makers (ISA1, NPA5, NPA8, NPA9, PEA3). In addition, private companies often directly hire former government officials to exploit their network.[19]

Discussion and conclusion

Since India's independence, satisfying the demand for sufficient and affordable electricity has been a key objective for the government. Energy policies favoring coal were established, while publicly owned companies primarily commissioned large-scale coal-fired power plants. With the power sector liberalization in the early 2000s, private actors also heavily invested in coal projects, not least because incentives for renewables were ineffective. In 2020, planned coal-fired power plants are again almost exclusively publicly funded and satisfy the objectives of ensuring long-term security of supply and energy independence. Besides, there are additional drivers for the ongoing coal deployment; in addition to power generation, we find that publicly owned companies in India, especially CIL, create regional employment and economic opportunities, which lead to stark regional dependencies on coal. In addition, local and national politicians personally benefit from established and additional coal infrastructure. Despite this, the increasingly important environmental problems and pressure from the international community have recently resulted in more ambitious environmental policies, such as substantial renewable targets and more stringent pollution standards. While the renewable targets have successfully attracted RE investments, the enforcement of the pollution regulation has been delayed by private actors in the power sector.

Disincentivizing ongoing private and public coal faces various obstacles. Despite the overcapacity and the financial distress of operating coal-fired power plants, the coal pipeline still includes 54 GW from public, and 11 GW from private companies (as of July 2020 from Shearer et al. (2020)). Reducing the regulatory incentives favoring coal investments, and in particular, removing implicit and explicit coal subsidies, could effectively discourage additional private coal investments and potentially redirect financial flows towards renewables. However, redirecting public investment seems even more challenging, given that within the central government coal is considered the main source of power generation to ensure long-term reliable electricity supply.

Furthermore, we identify a number of additional barriers to declining public coal investment, namely i) a prevailing belief of parts of the Indian administration that coal is a superior technology compared to renewables, and that there are perceived techno-economic constraints of RE-based electricity systems, such as high storage costs and lacking grid stability, ii) a regional reliance on coal for development, jobs, and fiscal revenues, and finally, iii) vested interests of public actors.

To change beliefs and perceptions is extremely challenging. Even some interviewees in favor of an energy transition towards REs expressed doubt about the ability of REs to cover baseload electricity demand in India in the absence of economically viable storage options. Occasionally, interviewees mentioned that showcasing functioning electricity systems based on REs of industrialized countries could be pivotal in dispersing fundamental technological doubts. A larger penetration of global electricity systems with REs may thus contribute to such a mind shift, while international demonstrations among decision-makers could accelerate the process.

An inclusive regional transition that provides alternatives to coal in Eastern India could be an important condition for an eventual coal phase-out. Previous phase-outs in other countries show that abrupt and unmanaged energy transitions can create social distortions, while managed, but delayed and suboptimal, phase-outs, as in Germany, risk becoming extremely costly (Oei et al., 2020). Early and well-organized transitions may prevent regional coalitions of actors from slowing down or hindering a phase-out. A transition away from coal would require creating new economic, cultural, and educational opportunities for the regions involved. To ensure a just transition, the numerous, but only weakly represented informal workers in the mining sector, should receive particular consideration by transition policies. Thus far, discussions about energy policy in India have been concentrated at the national level. Involving the Eastern Indian “Coal Belt” states, in particular, would thus be a first and important step. Moreover, India could establish a discussion forum that develops ideas for future regional economic development and industrial diversification. This could involve representatives from different governance levels, but also non-governmental societal institutions (Chandra, 2019). In the absence of private investment, much of the Indian coal belt has been held up economically through public investment by various government programs, PSUs, and other mechanisms (Jaitley, 2017). Attracting new forms of private sector investment will be an important part of a just transition in India (Bhushan et al., 2020).

International financial institutions may provide further entry points for an Indian energy transition by, for example, increasing the share of loans which are conditional on sustainability criteria. International financial aid is often already targeted at RE development. Furthermore, international shareholders can pressure the Indian state-owned banks to avoid lending to carbon intensive projects (Ghosh, 2020). The COVID-19 crisis in 2020 might also increase the influence of international financial flows due to the lower revenues of the government and private companies. Yet, when loans are conditioned to sustainability criteria, monitoring and enforcing environmental regulations against the interests of powerful vested interests would remain an important challenge.

The COVID-19 crisis hit coal-fired power generation particularly hard. The fall in demand following the strict lockdown measures was almost entirely born by the coal power plants, with a decreased output of 29% in 2020 compared to 2019 (Parray, 2020). This exacerbated their already precarious financial situation and further reduced the demand for new coal-fired power plants. However, the crisis might also delay needed investments in the RE sector (Bridge to India, 2020). It remains to be seen which of the two effects will prevail. Despite these short-term developments, we expect that India's key objectives remain unchanged. It thus seems unlikely that the identified drivers for coal will soon disappear.

Declaration of competing interest

The authors declare no competing interests.

Acknowledgments

We gratefully acknowledge funding from the German Federal Ministry of Education and Research (BMBF), funding code 01LS1610B (Pep 1.5) and 01LA1826A (PEGASOS). The authors thank all interviewees for their valuable contributions, without which this case study could not have been conducted. We further thank Jan Steckel, Michael Jakob for comments on earlier drafts, GIZ for the support during our field research in Delhi, as well as participants of research seminars at the MCC and of the General Conference of the European Consortium for Political Research 2019 in Wroclaw for valuable comments and

[19] For example, the current director general of APP was a former government official involved in the power sector development (The Hindu Buisiness Line, 2011).

suggestions. This paper has not been submitted elsewhere in identical or similar form.

Appendix A. Supplementary information

Supplementary data to this article can be found online at https://doi.org/10.1016/j.esd.2021.02.003.

References

BHEL (2018). Bharat Heavy Electricals Limited—Annual Report 2017–18. New Delhi (India): BHEL House.

Bhushan, C., Banerjee, S., & Agrawal, S. (2020). *Just Transition in India: An inquiry into the challenges and opportunities for a post-coal future.* iForest, New Delhi (India).

Biber, E., Kelsey, N., & Meckling, J. (2017). The Political Economy of Decarbonization: A Research Agenda. *Brooklyn Law Review*, *82*(2), 605. https://brooklynworks.brooklaw.edu/blr/vol82/iss2/8.

Bogner, A., Littig, B., & Menz, W. (Eds.). (2009). *Interviewing experts*. UK: Palgrave Macmillanhttps://doi.org/10.1057/9780230244276.

Brauers, H., & Oei, P. -Y. (2020). The political economy of coal in Poland: Drivers and barriers for a shift away from fossil fuels. *Energy Policy*, *144*, 111621. https://doi.org/10.1016/j.enpol.2020.111621.

Bridge to India (2020). India Renewable Map. New Delhi (India): Bridge to Indiahttps://bridgetoindia.com/report/india-re-map-june-2020/.

Buckley, T., & Garg, V. (2019). *India's electricity sector transition still on track despite a weak FY2018/19.* Lakewood (OH): The Institute for Energy Economics and Financial Analysis (IEEFA)https://ieefa.org/ieefa-briefing-note-indias-electricity-sector-transition-still-on-track-despite-a-weak-fy2018-19/.

CEA (2018). National electricity plan (volume I): Generation. New Delhi (India): Central Electricity Authorityhttp://www.cea.nic.in/reports/committee/nep/nep_jan_2018.pdf.

CEA (2019). Draft report on optimal generation capacity mix for 2029–2030. New Delhi (India): Central Electricity Authorityhttps://cea.nic.in/reports/others/planning/irp/Optimal_generation_mix_report.pdf.

CEA (2020). National Power Portal. Accessed October 19, 2020. https://npp.gov.in/publishedReports.

Central Pollution Control Board. (2018). CPCB notification. http://cpcb.nic.in/openpdffile.php?id=UHVibGljYXRpb25GaWxlLzE2MTlfMTUyMzg3MTY5OF9tZWRpYXBob3RvMTMzMzgucGRm.

MOSPI (2019). Energy statistics 2019—(Twenty sixth issue). New Delhi (India): Central Statistics Office Ministry Of Statistics And Programme Implementationwww.mospi.gov.in/sites/default/files/publication_reports/Energy%20Statistics%202019-finall.pdf.

Chandra, R. (2019). *A coal commission for India.* The Indian Expresshttps://indianexpress.com/article/opinion/columns/a-coal-commission-for-india-5520686/.

Chandra, R. (2018). *Adaptive state capitalism in the Indian coal industry.* Doctoral dissertation: Harvard University, Graduate School of Arts & Scienceshttp://nrs.harvard.edu/urn-3:HUL.InstRepos:41127494.

Chawla, K., Waldron, M., Dutt, A., Aggarwal, M., Toril, A., & Nobuoka, Y. (2018). Clean energy trends: Evolving investment landscape for grid-connected renewable energy projects in India. New Delhi (India): Council on Energy Environment and Waterhttps://www.ceew.in/publications/clean-energy-investment-trends.

Cheng, C., Lee, Y. J., Murray, G., Noh, Y., Urpelainen, J., & Horn, J. V. (2020). Vested interests: Examining the political obstacles to power sector reform in twenty Indian states. *Energy Research & Social Science*, *70*, 101766. https://doi.org/10.1016/j.erss.2020.101766.

Cohen, N., & Arieli, T. (2011). Field research in conflict environments: Methodological challenges and snowball sampling. *Journal of Peace Research*, *48*(4), 423–435https://doi.org/10.1177/0022343311405698.

Creutzig, F., Agoston, P., Goldschmidt, J. C., Luderer, G., Nemet, G., & Pietzcker, R. C. (2017). The underestimated potential of solar energy to mitigate climate change. *Nature Energy*, *2*(9), 17140. https://doi.org/10.1038/nenergy.2017.140.

Dorband, I., Jakob, M., & Steckel, J. C. (2020). Unraveling the political economy of coal: Insights from Vietnam. *Energy Policy*, *147*, 111860. https://doi.org/10.1016/j.enpol.2020.111860.

D'Sa, A., Murthy, K. N., & Reddy, A. K. (1999). India's power sector liberalisation: An overview. *Economic and Political Weekly*, 1427–1434https://www.jstor.org/stable/4408049.

Dubash, N., Kale, S. S., & Bharvirkar, R. (2018). *Mapping power: The political economy of electricity in India's states.* Mapping power: The political economy of electricity in India's states. Oxford (New York): Oxford University Presshttps://doi.org/10.1093/oso/9780199487820.001.0001.

Dutt, A., Aggarwal, M., & Chawla, K. (2019). *What is the safeguard duty safeguarding? Analysing impact on solar manufacturing and deployment in India.* New Delhi (India): Council on Energy Environment and Waterhttps://www.ceew.in/publications/what-safeguard-duty-safeguarding.

Energy, EtWorld (). https://energy.economictimes.indiatimes.com/news/renewable/india-imported-solar-power-equipment-worth-1180-mn-from-china-in-apr-dec-fy20/74493914.

Gadag, G., Chitnis, A., & Dixit, S. (2011). *Transition from MoU to competitive bidding: Good take-off but turbulence ahead.* Pune (India): Prayas Energy Group.

Garg, V., Gerasimchuk, I., Beaton, C., Bandyopadhyay, K. R., Whitley, S., Worrall, Leah, Scott, A., Patel, S., Chugh, G., Gupta, A., Jain, A., Malhotra, R., Sodhi, G., & Tripathi, S. (2017, November 28). India's Energy transition: Mapping subsidies to fossil fuels and clean energy in India. International Institute for Sustainable Development Place: Manitoba (Canada) https://www.iisd.org/library/india-energy-transition-mapping-subsidies-fossil-fuels-and-clean-energy-india.

Garg, V., Narayanaswamy, D., Ganesan, K., & Viswanathan, B. (2019). *The cost of meeting air pollution standards in the coal-fired electricity sector.* Manitoba (Canada): International Institute for Sustainable Developmehttps://www.iisd.org/publications/indias-energy-transition-cost-meeting-air-pollution-standards.

GBD MAPS (2018). *Burden of disease attributable to major air pollution sources in India (Special report 21).* Boston (MA): Health Effects Institutehttps://www.healtheffects.org/publication/gbd-air-pollution-india.

Geels, F. W., Sovacool, B. K., Schwanen, T., & Sorrell, S. (2017). Sociotechnical transitions for deep decarbonization. *Science*, *357*(6357), 1242–1244https://doi.org/10.1126/science.aao3760.

Ghosh, T. G. (). https://www.business-standard.com/article/finance/us-norwegian-investors-press-sbi-over-loan-to-adan-coal-mine-in-australia-120120401180_1.html.

Hirth, L., & Steckel, J. C. (2016). The role of capital costs in decarbonizing the electricity sector. *Environmental Research Letters*, *11*(11), 114010https://doi.org/10.1088/1748-9326/11/11/114010.

Holton, J. A. (2007). The coding process and its challenges. The Sage handbook of grounded theory. Thousand Oaks (CA: SAGE, 265–289https://dx.doi.org/10.4135/9781848607941.n13.

IISD (2021). The evolution of the clean energy cess on coal production in India. Retrieved July 10, 2020, from https://www.iisd.org/sites/default/files/publications/stories-g20-india-en.pdf International Institute of Sustainable Development Place: Manitoba (Canada).

IPCC (2019). *Chapter 2: Mitigation pathways compatible with 1.5°C in the context of sustainable development.* IPCChttps://www.ipcc.ch/report/sr15/mitigation-pathways-compatible-with-1-5c-in-the-context-of-sustainable-4-development/.

Isoaho, K., Goritz, A., Schulz, N., et al. (2017). Governing Clean Energy Transitions in China and India. In D. Arent, C. Arndt, M. Miller, F. Tarp, & O. Zinaman (Eds.), *The Political Economy of Clean Energy Transitions*. Oxford (UK): Oxford University Presshttps://doi.org/10.1093/oso/9780198802242.003.0012.

Jaitley, Arun (2017). Chapter 4: Reconciling Fiscal Federalismand Accountability: Is there a Low Equilibrium Trap? *Economic Survey. 1.*. India: Ministry of Finance & Government of Indiahttps://EconPapers.repec.org/RePEc:ess:wpaper:id:12443.

Jakob, M., Flachsland, C., Steckel, J. C., & Urpelainen, J. (2020). Actors, objectives, context: A framework of the political economy of energy and climate policy applied to India, Indonesia, and Vietnam. *Energy Research & Social Science*, *70*, 101775. https://doi.org/10.1016/j.erss.2020.101775.

Jenkins, J. D. (2014). Political economy constraints on carbon pricing policies: What are the implications for economic efficiency, environmental efficacy, and climate policy design? *Energy Policy*, *69*, 467–477https://doi.org/10.1016/j.enpol.2014.02.003.

Kamboj, P., & Tongia, R. (2018). Indian Railways and coal: An unsustainable interdependency. Brookings India Place: New Delhi (India) https://www.brookings.edu/research/indian-railways-and-coal/.

Khagram, S. (2004). Dams and development: Transnational struggles for water and power. Ithaca (NY): Cornell University Presshttps://www.jstor.org/stable/10.7591/j.ctv3mtbqn.

Krishna, C., Sagar, A. D., & Spratt, S. (2015). *The political economy of low-carbon investments: Insights from the wind and solar power sectors in India (No. 104; IDS Evidence Report).* The political economy of low-carbon investments: Insights from the wind and solar power sectors in India. Brighton (UK): Institute of Development Studieshttps://www.ids.ac.uk/publications/the-political-economy-of-low-carbon-investments-insights-from-the-wind-and-solar-power-sectors-in-india/.

Lal, S. (2006). *Can good economics ever be good politics? Case study of the power sector in.* Washington (DC): World Bankhttp://hdl.handle.net/10986/7032.

Luderer, G., Vrontisi, Z., Bertram, C., Edelenbosch, O. Y., Pietzcker, R. C., Rogelj, J., ... Kriegler, E. (2018). Residual fossil CO2 emissions in 1.5–2°C pathways. *Nature Climate Change*, *8*(7), 626–633https://doi.org/10.1038/s41558-018-0198-6.

M&A Critique. (2014). Adani Power Ramps Up Capacity. India: M&A Critique. https://mnacritique.mergersindia.com/adani-power-ramps-up-capacity/.

Mahadevan, M. (2019). The price of power: Costs of political corruption in Indian electricity. *Working Paper*https://conference.nber.org/conf_papers/f130302.pdf.

Mahajan, A. S. (2018). Rebooting BHEL. *Business News*https://www.businesstoday.in/magazine/the-hub/rebooting-bhel/story/294453.html.

Malik, A., Bertram, C., Despres, J., Emmerling, J., Fujimori, S., Garg, A., Kriegler, E., Luderer, G., Mathur, R., & Roelfsema, M. (2020). Reducing stranded assets through early action in the Indian power sector. *Environmental Research Letters*, *15*(9), Article 094091.

Min, B., & Golden, M. (2014). Electoral cycles in electricity losses in India. *Energy Policy*, *65*, 619–625https://doi.org/10.1016/j.enpol.2013.09.060.

Ministry of Finance, Department of Revenue (2018). Notification n. 519, no. 01/2018-Customs (SG), PART II—Section 3—Sub-section (i). *The Gazette of India.* The Gazette of India.

MNRE. (2020). State-wise installed capacity of grid interactive renewable power as on 30.09.2020. https://mnre.gov.in/the-ministry/physical-progress.

MNRE (2015). Tentative state-wise break-up of renewable power target to be achieved by the year 2022 so that cumulative achievement is 175,000 MW. https://web.archive.org/web/20191205223226/https://mnre.gov.in/file-manager/UserFiles/Tentative-State-wise-break-up-of-Renewable-Power-by-2022.pdf.

Oei, P. -Y., Brauers, H., & Herpich, P. (2020). Lessons from Germany's hard coal mining phase-out: Policies and transition from 1950 to 2018. *Climate Policy*, *20*(8), 963–979https://doi.org/10.1080/14693062.2019.1688636.

Ordonez, J. A., Jakob, M., Steckel, J. C., & Fünfgeld, A. (2021). *Coal, power and coal-powered politics in Indonesia.* (under review).

O'Reilly, M., & Parker, N. (2013). Unsatisfactory Saturation': A critical exploration of the notion of saturated sample sizes in qualitative research. *Qualitative Research*, *13*(2), 190–197https://doi.org/10.1177/1468794112446106.

Pai, S., & Carr-Wilson, S. (2018). Total transition: The human side of the renewable energy revolution. Calgary (Alberta): Rocky Mountain Books.

Pai, S., Zerriffi, H., Jewell, J., & Pathak, J. (2020). Solar has greater techno-economic resource suitability than wind for replacing coal mining jobs. *Environmental Research Letters*, *15*(3), 034065https://doi.org/10.1088/1748-9326/ab6c6d.

Parray, M. T. (). https://www.brookings.edu/blog/up-front/2020/06/15/is-covid-19-an-opportunity-to-clean-up-indias-coal-power-plants-faster/.

Pelz, S., & Urpelainen, J. (2020). Measuring and explaining household access to electrical energy services: Evidence from rural northern India. *Energy Policy*, *145*, 111782. https://doi.org/10.1016/j.enpol.2020.111782.

Ramamurthi, P. V. (2016). Political economy of renewable energy deployment in India. *Economic & Political Weekly*, *51*(38), 21https://www.epw.in/journal/2016/38/commentary/political-economy-renewable-energy-deployment-india.html.

Schmidt, T. S., Schmid, N., & Sewerin, S. (2019). Policy goals, partisanship and paradigmatic change in energy policy–Analyzing parliamentary discourse in Germany over 30 years. *Climate Policy*, *19*(6), 771–786. https://doi.org/10.1080/14693062.2019.1594667.

Sethi, N. (2019). Govt set to dilute 3.5-year-old air pollution norms for thermal plants. Business Standard India. https://www.business-standard.com/article/economy-policy/powermin-wants-to-dilute-3-5-year-old-pollution-norms-for-thermal-plants-119081200721_1.html.

Shearer, C., Myllyvirta, L., Yu, A., Aitken, G., Mathew-Shah, N., Dallos, G., & Nace, T. (2020). Boom and Bust 2020: Tracking the Global Coal Pipeline. Global Energy Monitor. Greenpeace International, CREA, and Sierra Club, 28https://endcoal.org/global-coal-plant-tracker/reports/boom-and-bust-2020/.

Shidore, S., & Busby, J. W. (2019a). One more try: The International Solar Alliance and India's search for geopolitical influence. *Energy Strategy Reviews*, *26*, Article 100385. https://doi.org/10.1016/j.esr.2019.100385.

Shidore, S., & Busby, J. W. (2019b). What explains India's embrace of solar? State-led energy transition in a developmental polity. *Energy Policy*, *129*, 1179–1189https://doi.org/10.1016/j.enpol.2019.02.032.

Singh, A. (2010). Towards a competitive market for electricity and consumer choice in the Indian power sector. *Energy Policy*, *38*(8), 4196–4208https://doi.org/10.1016/j.enpol.2010.03.047.

Somananthan, E., & Chakravarty, S. (2019). There is no economic case for new coal plants in India. In Proc. *24th Annual Conference of the European Association of Environmental and Resource Economists*, *13*(EAERE).

SourceWatch. (2019). Bhadradri power station. https://www.sourcewatch.org/index.php/Bhadradri_power_station.

Sreenivas, A. C., Dharmadhikary, Shripad, Dixit, Shantanu, Dukkipati, Srihari, Gambhir, Ashwin, Josey, Ann, & Ashok (2018). Many Sparks but Little Light: the Rhetoric and Practice of Electricity Sector Reforms in India. *Prayas (Energy Group): Prune (India)* http://www.prayaspune.org/peg/publications/item/332-many-sparks-but-little-light-the-rhetoric-and-practice-of-electricity-sector-reforms-in-india.html.

Standing Committee on Energy (2018). Stressed/non-performing assets in electricity sector. *Stressed/non-performing assets in electricity sector*. Standing Committee on Energy.

Stuligross, D. (1999). The political economy of environmental regulation in India. *Pacific Affairs*, *72*(3), 392https://doi.org/10.2307/2672228.

Tagotra, N. (2017). The political economy of renewable energy: prospects and challenges for the renewable energy sector in India post-Paris negotiations. *India Quarterly*, *73*(1), 99–113https://doi.org/10.1177/0974928416686584.

The Economic Times. (2017). NGT raps MoEF over emission standards for thermal power plants. Mumbai (India): The Economic Times.https://economictimes.indiatimes.com/news/politics-and-nation/ngt-raps-moef-over-emission-standards-for-thermal-power-plants/articleshow/60813505.cms.

The Hindu Buisiness Line (2011). Association of power producers to be headed by Khurana. *The Hindu Buisiness Line: Chennai (India)*https://www.thehindubusinessline.com/economy/Association-of-Power-Producers-to-be-headed-by-Khurana/article20090524.ece.

The Wire (2018). *In Relief to Tata, Adani, Essar, Gujarat allows pass-through of higher coal cost.* New Delhi (India): The Wirehttps://thewire.in/energy/in-relief-to-tata-adani-essar-gujarat-allows-pass-through-of-higher-coal-cost.

Toman, M. A., Chakravorty, U., & Gupta, S. (2003). *India and global climate change: Perspectives on economics and policy from a developing country*. Washington (D.C): Resources for the Futurehttps://www.routledge.com/India-and-Global-Climate-Change-Perspectives-on-Economics-and-Policy-from/Toman/p/book/9781891853616.

Tongia, R. (2007). The political economy of Indian power sector reforms. In D. G. Victor, & T. C. Hellers (Eds.), *The Political Economy of Power Sector Reform* (pp. 109–174). Cambridge (UK): Cambridge University Presshttps://doi.org/10.1017/CBO9780511493287.005.

Tongia, R., & Gross, S. (2019). Coal in India – Adjusting to transition. New Delhi (India): Brookings Indiahttps://think-asia.org/handle/11540/9782.

WEPP (2017). *World Electric Power Plants Data Base.* London (UK): S & P Global Platts.

Worrall, L., Whitley, S., Garg, V., Krishnaswamy, S., Beaton, C., et al. (2018). *India's stranded assets: How government interventions are propping up coal power*. London (UK): ODIhttps://www.odi.org/publications/11185-india-s-stranded-assets-how-government-interventions-are-propping-coal-power.