CIF CLIMATE INVESTMENT FUNDS

ReACT

A SIMPLIFIED GUIDE TO REPURPOSE COAL ASSETS

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CLEAN TECHNOLOGY FUND //

TOPICS

- Coal Transition
- Climate Finance
- Technical Assistance

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KEY MESSAGES

Coal transition plans must be developed considering maturity of local markets, regulatory readiness & availability of right types of financing. Innovative financing models blending public/ private resources & utilizing concessional financing are expected to play a vital role.

Based on full/partial re-use of existing infrastructure, all technical, economic, regulatory, social & environmental criteria must be considered to identify optimal climate-smart alternatives to repurpose coal assets.

DFIs play key roles in galvanizing action by utilizing their expertise and resources to provide demonstration effects at scale, supporting fiscally viable transition models, local & regional capacity building, as well as enabling policies and regulations.

While designing coal early retirement, it is crucial to incorporate mitigation measures to address adverse impacts experienced by the local workers and communities.

EXECUTIVE SUMMARY

Introduction

The Climate Investment Funds (CIF) is one of the world's largest and most ambitious climate finance mechanisms. Founded in 2008, it represents one of the first global efforts to invest in a dedicated climate finance vehicle. At present, CIF is working towards developing strategies for the early retirement of coal power plants (CPPs) in developing countries. Towards that end, the approximately USD 2.5 Billion Accelerating Coal Transition (ACT) program has been undertaken for facilitating this transition. This study for determining repurposing strategies in South Africa, India, and Indonesia (collectively referred to as 'the target countries') is one of the initial steps of this program.

To understand the opportunities and importance of coal transitions through the repurposing of coal assets, Black & Veatch reviewed the regulatory environments of the target countries. The study aims to understand the existing regulatory environments, develop an implementable technical framework for the selection of CPPs and corresponding repurposing concepts, and identify potential financial solutions in each of the target countries.

Findings

Key Technical Considerations for Repurposing

The selection criteria that spans across technical, commercial, regulatory, social and environmental aspects for the repurposing of existing coal plants are presented in Section 2.1. Furthermore, the available repurposing concepts at various stages of market maturity are identified and discussed in Section 2.2. They are aligned along the four strategies of increasing integration with the existing physical infrastructure of a coal power plant. These concepts are categorized according to five broad end-uses: Electricity Generation, Energy Storage, Hydrogen/Ammonia

Production, Carbon Sink, and Non-Energy Non-Carbon Uses. The concepts in each category are evaluated on a combination of category-agnostic and category-specific criteria covering technical, commercial, social, and environmental aspects.

Finally, Section 2.3 provides some case studies, where the implementation of a few repurposing concepts at the site of a CPP, have been carried out.

Selection of Financing Mechanisms

Various financing mechanisms that have been, or are currently being, undertaken across the world to implement repurposing solutions for CPPs are presented in Section 3. It also lays down the key guiding principles and the steps for the development of coal-repurposing financial mechanisms for an asset, depending on the repurposing solution selected and the financial pool identified as part of Section 4.

In the short term, the financial mechanism is expected to be either government-led or private sector-led, depending on the criticality of the asset and the value-for-money analysis (covered in Appendix E).

- In the case of government-led repurposing, the government may utilize internal funds (as seen in the case of German auctions) or borrow debt to repurpose the plants or seek assistance from development finance institutions (DFIs) for grants / concessional debts (as seen in the case of South Africa's Just Transition Transaction and the 'refinancing at corporate level' structure envisaged under the Indonesian energy transition mechanism (ETM)).
- In case the repurposing activity is to be led by the private sector, the mechanism utilized would differ as per the ownership of the plant. In the case of government-owned plants, the said plant will have to be spun off from the government entity, prior to the selection of the private partner, which shall be undertaken through an auction process. On the other hand, in the case of privately owned plants, the repurposing exercise shall be implemented as per the choice of the repurposing solution and the existing owner's capacity to carry out the successful implementation of the repurposing solution. The involvement of the private sector has been described in detail in the Chilean and Southeast Asian market contexts.

In the long term, it is envisaged that the market will move towards the utilization of carbon markets and bonds to undertake the repurposing exercise.

Overall, on the financing aspect, the DFIs are expected to play a critical part in order to successfully implement the repurposing exercise with the following key roles:

- Assisting in establishing precedents and leading to the increased involvement in the sector;
- Providing concessional finance and liquidity support mechanisms;
- Building the capability of governments to run future tender processes; and
- Providing support in policymaking.

Regulatory and Financing Landscape

This section provides an overview of the regulatory and financing landscape in the three countries. Black & Veatch evaluated 18 aspects related to the regulatory environments of the target countries to assess their readiness in respect of the decommissioning and repurposing of CPPs. The detailed analysis of this readiness assessment is summarized in Sections 4.1.1, 4.2.1, and 4.3.1 for South Africa, India, and Indonesia, respectively. In addition, the current and forecasted supply-demand situation of the electricity sector, the role of coal in electricity generation as well as the overall economy, key market players and regulatory authorities, and policies pertinent to the development of a low-carbon electricity sector were analyzed for the three countries.

From a financial standpoint, the analysis aims at identifying the financing pool available to fund the repurposing of CPPs in the target countries through an assessment of the state of public finance, financial institutions, capital markets, and emission trading, apart from other parameters. A summary of the key findings from the analysis is provided below for each target country.

SOUTH AFRICA

- For South Africa, the greenhouse gas (GHG) emissions reduction targets, as communicated in its Nationally Determined Contributions (NDCs), were found to be reasonably aligned with the objective of transitioning away from coal-based power. The involvement of MDBs was noted in coal-transition initiatives and favorable foreign investment regulations in the power sector were observed. Owing to the dominant nature of Eskom, the state-owned utility, in generation, transmission, and distribution, no evident power purchase agreements (PPAs) were found, which could potentially pose contractual challenges for a candidate CPP selected for decommissioning or repurposing. The share of renewables in the generation mix appeared to be increasing and associated tariffs were found to be competitive with the conventional power generation alternatives, suggesting minimal resistance to the commercial growth of renewables in the country.
- Policies and regulations favoring complete abstinence from new CPPs were not evident and planning documents were observed to have plans for the addition of new coal power capacities to supplement the energy security of the country. Also, no clear mechanism that would prevent the reuse of decommissioned CPPs was observed.
- South Africa has faced an economic downturn since the global financial crisis in 2008. The country faces several challenges, such as low economic growth, below-forecast tax revenue collection, rapidly rising debt levels, and a widening fiscal deficit. Eskom is facing severe challenges, in terms of non-cost-reflective tariffs, heavy planned and unplanned downtime of generation plants, and ballooning receivables. These factors have restricted Eskom's capacity to undertake any large-scale repurposing exercises. The financial services sector is developed, and the private banks may be able to fund the coal-repurposing initiative in the country. The overall low rating of the country, due to its high debt levels and fiscal deficit, limits the debt capital market's capacity to fund the CPP-repurposing exercise. The green bond market in South Africa may be a suitable financing mechanism in the future. However, this market is not currently developed at a scale that is sufficient to provide the adequate financing support required in the short term. The carbon trading market in South Africa is currently at a nascent stage and concentrated in the hands of a few players. It may be a potential source of financing in the long run;

however, there is a risk the carbon trading activity would be concentrated in the hands of a few entities.

INDIA

- For India, several policies promoting renewables and other non-coal-based power were found to be effective. For new non-coal-based projects to enter the market, an established bidding and power procurement mechanism was noted. Favorable foreign investment policies are present in the country. A variety of PPA structures were observed in practice in the country, but the majority of them were found to have well-defined breakage cost computations and provisions for the government to take over the power plant by means of a force majeure. An increasing trend of renewables is evident in India, which appears to be backed by competitive renewable tariffs. The grid infrastructure was also found to be reasonably suitable to handle non-coal-based power. Well-defined mechanisms for forecasting future power requirements and generation planning were noted in the country.
- Certain aspects, such as PPAs that do not have firm provisions for early project buyouts by the off-taker and termination at will, limited effective policies that discourage coal power, and the presence of direct and indirect incentives for coal as a fuel can be addressed by the government to further ease the transition away from coal. Even the NDC targets can be supplemented by a firm action plan to effectively achieve the committed targets in a timebound manner.
- No concrete long-term strategies for coal transition and energy sector-specific GHG emissions reduction targets were observed. Also, no clear mechanism to prevent the reuse of decommissioned CPPs was observed.
- In India, the government may find it difficult to support the large-scale repurposing of CPPs, due to its weak fiscal position (low tax base and, the delay in the divestment process) and the high level of debt. In terms of public sector players, National Thermal Power Corporation (NTPC) is relatively better-placed than its state-owned counterparts in the other two countries. Power-financing companies, such as the Power Finance Corporation (PFC) and REC Limited (formerly the Rural Electrification Corporation Limited and a subsidiary of PFC) are also strong, in terms of their credit profiles and can support CPP-repurposing activities. India has a fairly developed financial market and experience in issuing green bonds, which can support the repurposing of coal plants. However factors, such as the dominance of government securities and high hedging costs, may lead to issues with their utilization in raising financing. India has a market-based mechanism named ESCerts that work on the Perform, Achieve, Trade (PAT) principle and incentivizes firms to improve energy efficiency. The ESCerts mechanism currently faces issues, such as oversupply, low prices, and volumes, but they may be a viable source of finance in the longer run.

INDONESIA

- Most of the PPAs were in conjunction with the state-owned utility PLN (PT Perusahaan Listrik Negara, or State Electricity Company). These PPAs were found to have clearly defined exit provisions, facility buyout options, and contract breakage computations. Certain MDBs' active involvement in the coal-transitioning initiatives were also evident in the country. Reasonably favorable foreign investment policies are present in the country.
- Long-term strategies for coal transitioning appeared to be reasonable. Well-defined mechanisms for forecasting future power requirements and generation planning were noted in the country. An increasing trend of renewables, though not significant, is evident in Indonesia. For new non-coal-based projects to enter the market, an established bidding and power procurement mechanism exists. Indonesia has policies that discourage coal-based power, as well as those that promote non-coal based power.
- Though a reasonable long-term strategy for a coal transition has been formulated, it appeared that the country's NDCs were not synchronous with these strategies, in terms of clearly defining a transition pathway. Rather, the NDCs were conservative in this aspect. So there is potential

for strengthened policies to incentivize the long-term national transition away from coal.

- It was found that the tariffs of renewable-powered electricity are not competitive as compared with the conventional power sources on account of tariff-fixing mechanisms favoring the latter.
- Indonesia is constrained in its ability to fund large-scale coal-repurposing exercises, due to a low tax base and a ceiling on the fiscal deficit that the country can run on. PLN's end-user tariffs are non-cost-reflective, which limit its capacity of the company to finance large-scale CPPs-repurposing initiatives. The banking sector is strong and regulated, and can provide large-scale funds for the repurposing initiative. However, the underdevelopment of the equity and debt markets, and the concentration of the green bond market are some of the challenges of the Indonesian financing landscape. The carbon market in Indonesia is also at a preliminary stage, with guidelines for the development of the market issued only in October 2021.

Environmental and Social Benefits of a Coal Transition

To ensure a successful coal transition, it is essential to lay down a plan that accounts for the technical, social, and economic transition of coal districts and states, by putting the affected communities at the center of this plan.

Various case studies were analyzed by Black & Veatch to understand the impacts of the closure of coal-based power plants, especially on the local community and the workforce. Special care must be taken to mitigate these impacts. To decommission CPPs and transition towards clean green energy, the process of change should be fair and reasonable for all parties involved.

Besides the obvious benefit of achieving the Paris Agreement goals on GHG emissions, and a net-zero target some of the other positive impacts of a coal transition are reduced pollution, decreased water consumption, improved public health, green jobs creation, increased diversification and energy security, enhanced resilience to disasters and climate change vulnerabilities, and greater access to energy.

LIST OF ABBREVIATIONS

ACS	Average Cost of Supply
ACT	Accelerating Coal Transition
ADB	Asian Development Bank
AFBC	Atmospheric Fluidized Bed Combustion
AIFI	All-India Financial Institution
APL	Adani Power Limited
ASEAN	Association of Southeast Asian Countries
AT&C	Aggregate Technical & Commercial Loss
AT&C	Aggregate Transmission and Commercial
BAPPENAS	Ministry of National Development and Planning
BaU	Business as Usual Scenario
BESS	Battery Energy Storage System
C&I	Commercial and Industrial
CARE	Credit Analysis and Research Limited
CCS	Carbon Capture and Storage
CEA	Central Electricity Authority
CEF	Clean Energy Fund
CERC	Central Electricity Regulatory Commission
CFADS	Cash Flow Available for Debt Service
CFBC	Circulating Fluidized Bed Combustion
CIF	Climate Investment Funds
CIL	Coal India Limited
CNE	Comisión Nacional de Energía (Chile)
CO2	Carbon Dioxide
COVID	Coronavirus Disease
CPP	Coal Power Plants
CPSE	Central Public Sector Enterprise

CRF	Carbon Reduction Fund
CRISIL	Credit Rating Information Services of India Limited
CSIR	Council for Scientific and Industrial Research
CSL	Coal Supply Agreement
CSP	Concentrated Solar Power
CSR	Corporate Social Responsibility
CTF	Clean Technology Fund
DEN	National Energy Council
DFFE	Department of Forestry, Fisheries and the environment
DFI	Development Finance Institutions
DGNREC	Directorate General of New and Renewable Energy and Energy Conservation
DHFL	Dewan Housing Finance Corporation Ltd.
DICGC	Deposit Insurance and Credit Guarantee Corporation
DISCOM	Distribution Companies
Discoms	Distribution Companies
DMRE	Department of Mineral Resources and Energy
DVC	Damodar Valley Corporation
ECA	Export Credit Agency
EM	Emerging Market
ERA	Electricity Regulation Act
EUR	Euro
EV	Electric Vehicle
FDI	Foreign Direct Investment
FGD	Flue Gas Desulphurization
FO	Follow-on Offer
FTSE	Financial Times Stock Exchange
FY	Fiscal Year
g/kWh	Gram per kilowatt-hour
GHG	Greenhouse gas
GNI	Gross National Income
GW	Gigawatt
GWh	Gigawtt-hour
HELE	High Efficiency Low Emission
HFC	Housing Finance Companies
ICRA	Investment Information and Credit Rating Agency
IDR	Indonesian Rupiah

IFI	International Finance Institutions
IL&FS	Infrastructure Leasing & Financial Services
INR	Indian Rupee
IPO	Initial Public Offering
IPP	Independent Power Producers
IRP	Integrated Resource Plan
KEN	National Energy Policy
kWh	Kilowatt-hour
LC	Letter of Credit
LCOE	Levelized Cost of Electricity
LCOS	Levelized Cost of Storage
MDB	Multilateral Development Bank
MEMR	Indonesian Ministry of Energy and Mineral Resources
MNRE	Ministry of New and Renewable Energy
MoEFCC	Ministry of Environment, Forest and Climate Change
MoF	Ministry of Finance
MPWHS	Ministry of Public Work and Human Settlements
MSME	Micro, Small and Medium-Sized Enterprises
MSOE	Ministry of State Owned Enterprise
MSPGCL	Maharashtra State Power Generation Company Limited
Mt	Megaton
MTEF	Medium-term Expenditure Framework
MTSAO	Medium Term System Adequacy Outlook
MW	Megawatt
MWh	Megawatt-hour
MYPD	Multi Year Price Determination
NBFC	Non-Banking Financial Company
NBFI	Non-Banking Financial Institution
NDC	Nationally Determined Contributions
NEA	National Energy Act
NERA	National Energy Regulator Act
NERSA	National Energy Regulator of South Africa
NIP	National Infrastructure Plan
NPA	Non-Performing Asset
NTPC	National Thermal Power Corporation
OECD	Organization for Economic Co-operation and Development

PAF	Plant Availability Factor
PF	Pulverized Fuel
PFC	Power Finance Corporation Limited
PLF	Plant Load Factor
PLN	Perusahaan Listrik Negara
PPA	Power Purchase Agreement
PPF	Public Provident Fund
PPP	Public Private Partnership
PRI	Partial Risk Guarantee
PV	Photo Voltaic
RBI	Reserve Bank of India
RE	Renewable Energy
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
RMIPPPP	Risk Mitigation Independent Power Producers Procurement Programme
RMR	Reliability Maintenance Recovery
RPO	Renewable Purchase Obligation
RUED	Regional Energy Plan
RUEN	National General Energy Plan
RUKN	National Electricity Plan
RUPTL	Electricity Provisional Plan/Electricity Supply Business Plan
SA	South Africa
SARB	South Africa Reserve Bank
SARFAESAI	Securitization and Reconstruction of Financial Assets and Enforcement of Security Interest Act 2002
SCB	Scheduled Commercial Bank
SEBI	Securities and Exchange Board of India
SERC	State Electricity Regulatory Commission
SOE	State Owned Enterprise
SOx	Sulphur Oxides
TWh	Terawatt-hour
UCLF	Unplanned Capability Loss Factor
USD	United States Dollar
VFM	Value for Money
WALR	Weighted Average Lending Rate
YoY	Year-on-year

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LIST OF EXHIBITS

1. INTRODUCTION

Founded in 2008, the Climate Investment Funds (CIF) is one of the world's largest and oldest climate finance mechanisms. The CIF's Accelerating Coal Transition (ACT) Investment Program seeks to facilitate transition away from coal through early retirements of coal power plants (CPPs) in major coal dependent economies.

Developed countries find it easier to retire CPPs and develop other sources of electricity, either by repurposing the same site or by building other power generation assets. However, it is observed that developing countries find it difficult to make this transition and are forced to keep older and polluting CPPs running due to energy security issues, a lack of finance, political issues, as well as contractual and social obligations due to local jobs being linked to the projects.

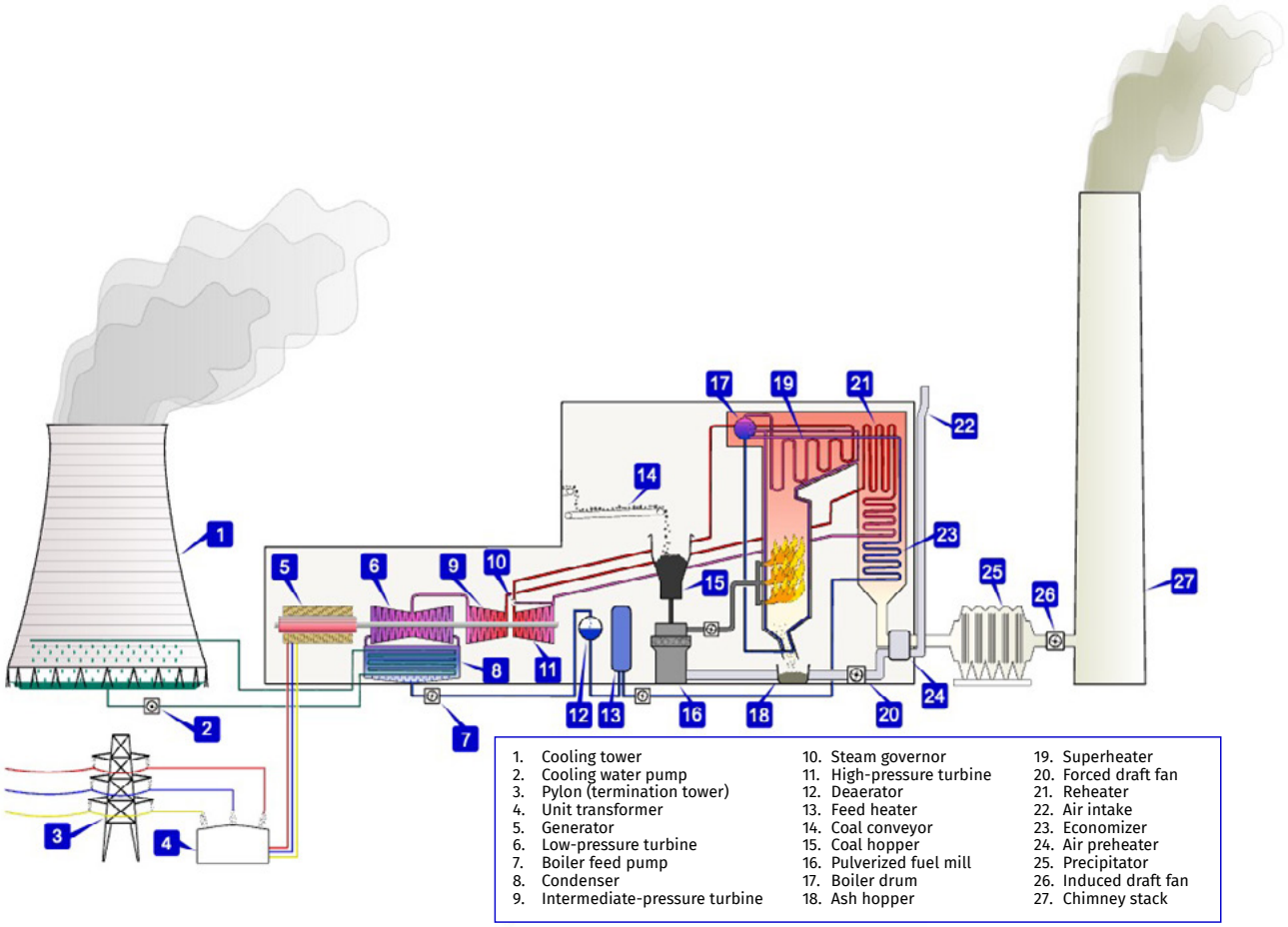
Towards that end, the approximately USD 2.5 Billion Accelerating Coal Transition (ACT) program has been undertaken for facilitating this transition. The following study looks closely at key technical considerations for repurposing coal assets including selection of CPPs, identification of a suitable alternative, exploration of possible financing solutions, as well as the resultant social, economic and environmental co-benefits.

This study will focus on CPPs in India, Indonesia, and South Africa as a sample of developing countries in different regions of the world. These countries have traditionally been dependent on coal, and finding solutions for reducing their reliance on CPPs can provide a positive and practical example for many other developing countries across the world.

1.1. Scope of Work

To understand the opportunities and importance of coal transitions, through the repurposing of coal assets, the study reviewed the technical, financial, and regulatory environment of the target countries. The study aims to provide the following outcomes:

- Reflect on the existing regulatory environment and develop an actionable technical framework for the selection of CPPs and corresponding repurposing concepts;
- Identify probable financial solutions in each of the target countries; and
- Highlight some of the benefits of such a transition.



1.2. Basic Overview of a Coal Power Plant

This section provides a basic overview of the functioning of a state-of-art coal power plant. The labeled parts in the diagram correspond to the numbers in the braces in the description below.

COAL SEGMENT

Coal is transported by a conveyor {14} from an external source into a coal hopper {15}, and then to a pulverized fuel mill {16} where it is ground to very fine powder by a mill. There, it is mixed with preheated air, obtained by passing atmospheric air {22} through a preheater {24} and driven by a forced draft fan {20}. The hot air-fuel mixture is forced at high pressure into a boiler where it rapidly ignites.

The heavier bottom ash from the combustion of coal is collected in an ash hopper {18}. Exhaust gas from the boiler is drawn by an induced draft fan {26} through an electrostatic precipitator {25} to filter out suspended particulate matter and then vented through a chimney stack {27}.

STEAM CYCLE

Almost-pure water flows vertically up through tubes lining the walls of the boiler where it turns into steam, and is passed to a boiler drum {17}, where steam is separated from any remaining water. The steam passes through a manifold in the roof of the drum into a superheater {19}, where its temperature and pressure increase rapidly. The steam is piped to a high-pressure turbine {11} — the first of a three-stage turbine process. The operation of this turbine is controlled by a steam governor {10}.

The exhaust steam from the high-pressure turbine, which has a lower pressure and temperature, is returned to a boiler reheater {21}. The reheated steam is then passed to an intermediate-pressure turbine {9}, and from there, directly to a low-pressure set {6}.

The exhaust steam from the low-pressure turbine flows through a pipe in the condenser {8}. Here, it is brought into thermal contact with cold water (that is, heat can be exchanged through the pipe, but the steam and the cold water do not mix), where it condenses rapidly back into water. The condensed water is then passed by a feed pump {7} through a deaerator {12}, and pre-warmed, first in a feed heater {13} powered by steam drawn from the high pressure set, and then in an economizer {23}, before being returned to the boiler, where the cycle originally started.

Smaller, simpler, or less efficient plants may have only one or two turbines, possibly with no reheater.

COOLING WATER CYCLE

The water from the condenser that was used to extract heat from the steam is sprayed inside a cooling tower {1}, creating a highly visible plume. Once it cools down, it is pumped back to the condenser, using a cooling water pump {2}.

This schematic is applicable for a CPP that uses cooling towers. If the power plant uses a once-through cooling system, then water from the condenser is treated and discharged into the water body, while new feedwater is pumped into the condenser using the cooling water pump.

ELECTRICITY GENERATION

The three turbines are coupled to the same shaft, as an electrical generator {5} generates intermediate-level voltage (typically 20–25 kilovolt [kV]). This is stepped up by a transformer {4} to a voltage more suitable for transmission (typically 250–500 kV) and sent out to a transmission system {3}.

2. POTENTIAL REPURPOSING SOLUTIONS

Coal forms a significant proportion of the generation mix, in developing economies around the world. In 2020, 9,421.4 terawatt-hours (TWh) of electricity, or 35 percent of the total generated electricity, were produced from the combustion of coal globally. Of this 35 percent, non-OECD (Organisation for Economic Co-operation and Development) countries accounted for 78 percent of its composition, despite producing only 59 percent of the world's electricity. Among these countries, coal-fired generation contributed to 46 percent of the total generation of electricity in non-OECD countries. Therefore, an unplanned retirement of coal-based generation facilities has the potential to not just impact the supply-demand situation, but also threaten the security and stability of the electricity grid.

Repurposing CPPs can help mitigate some of the potentially negative impacts of their early retirement. Further, repurposing concepts can be chosen in alignment with new economic incentives and policy initiatives within a just transition framework. However, these repurposing options also come with their own costs and impacts. Thus, it is important to understand and assess the available repurposing concepts.

In this chapter, the major criteria for selecting coal plants for repurposing, along with repurposing concepts and their selection criteria are discussed.

2.1. Selection of a Coal Power Plant (CPP)

The major criteria that can be considered for the selection of power plants can be divided into three categories: techno-commercial, regulatory and contractual, as well as social and environmental. This section briefly discusses these categories and enumerates the criteria therein.

2.1.1. Techno-Commercial Criteria

Techno-commercial criteria relate to the design and performance of a CPP. The broad idea is to prioritize the retirement of power plants with several characteristics: (i) low efficiencies by design, (ii) below-par performance by their rated characteristics, (iii) rising unreliability, and (iv) a lack of ancillary services that could justify their continued operation. The specific criteria considered in this category are presented in greater detail in the subsections below.

2.1.1.1. Age of power plant

Globally, CPPs are retired at an average lifetime of 38 years, though they have the ability to operate for longer. However, older plants are typically less efficient, highly polluting, and may be tied up in expensive PPAs, making it uneconomical to comply with stringent environmental regulations or compete with alternative technologies. According to a study by the IEA, the efficiency of new subcritical plants may be 38 percent on a lower heating value (LHV) basis, while that of an older subcritical plant may be 20–25 percent. Thus, the age of a power plant is an important factor for determining whether it should be retired.

2.1.1.2. Rated capacity

The rated capacity refers to the megawatt (MW) capacity of a CPP. CPPs of higher capacities will have larger land parcels and well-developed infrastructures associated with them, making them more suitable for repurposing. Further, repurposing large power plants may also provide economies of scale. Thus, while smaller power plants may be opted to be repurposed as demonstration projects, this framework considers the size of the power plant to be directly correlated with the suitability of repurposing.

2.1.1.3. Type of power plant

Boilers in CPPs are typically classified under three types: "Atmospheric Fluidized Bed Combustion (AFBC)," "Circulating Fluidized Bed Combustion (CFBC)," and "Pulverized Fuel (PF)." PF can be further subdivided into "subcritical," "supercritical," and "ultra-supercritical." Supercritical and ultra-supercritical boilers, considered to be modern technologies, are more efficient and flexible than AFBC and CFBC boilers. AFBC and CFBC boilers require minimal modifications to manage sulfur oxide (SOx) emissions, which can offset their slightly lower efficiency as compared with PF boilers. However, the introduction of stringent emission regulations, which require going beyond the levels achievable with in-furnace desulfurization, could necessitate additional modifications for AFBC and CFBC, and negate this advantage. Hence, CFBC and AFBC boilers, along with subcritical PF, make a stronger case for repurposing.

2.1.1.4. Average heat rate deviation

The efficiency of a CPP is assessed through its heat rate, which depends on its boiler, its turbine generator, and other auxiliary systems. While design efficiency is captured in the previous criterion, the deviation of actual efficiency from design efficiency is considered here. According to a study by the Central Electricity Authority (CEA, India), gross heat rate deviations are in the range of 13.6–24.1 percent for plant units sized between 100 MW and 500 MW. The average heat rate deviation of a power plant can be calculated as the difference between the average design heat rate of all the units (weighted by their capacities) and the actual heat rate, expressed as a percentage of the former. A significant deviation from the design heat rate means that the plant is suitable for repurposing.

2.1.1.5. Ramp rate

Coal-fired plants have typically been operating as baseload power plants. However, in an era of proliferating renewable energy deployments, it is necessary to have flexible sources in the generation mix. Essentially, these sources should be able to be ramped up or down to mitigate the issues of variability and intermittency arising from renewables. The ability of thermal power plants to provide such support has been studied by CEA. One metric measuring the flexibility of the generation source is the ramp rate — expressed as the ratio of the ramping gradient (MW/minute) to the capacity of the power plant (MW). A lower ramp rate may indicate the plant's unsuitability for supporting the grid, hence making the case for repurposing.

2.1.1.6. Forced outage rate

Data from CEA[1] indicates that the loss in generation due to forced outages increased from 12 percent in 2012–2013 to 19 percent in 2017–2018. An unreliable generation fleet leads to increased operation and maintenance (O&M) costs that will get passed down eventually to consumers. For a power plant, the most important indicator of reliability is the equivalent forced outage rate, which gives the probability that the plant will not be available to deliver its full capacity. It is calculated by taking the sum of each unit's capacity-weighted forced outage hours and derated hours divided by the sum of the total equivalent service hours, outage hours, and derated hours. The most unreliable plants should be prioritized for repurposing.

2.1.1.7. Load serving location

The primary region or location served by the CPP can be categorized as either "power surplus" or "power deficit." A load surplus may be a result of a growing generation capacity in the region, while declining loads may be attributed to economic reasons, or both. In the case of repurposing thermal power plants, a surplus offers an opportunity for retiring CPPs in

a region where the impact on the frequency of the grid is likely to be less severe. Thus, power plants located in power surplus areas can be prioritized for repurposing.

2.1.1.8. Plant load factor (PLF)

The PLF is the ratio of a power plant's actual generation to its maximum generation if it were operating at its rated capacity. PLF is generally considered to be a measure of the capacity utilization of a power plant. The average PLF of CPPs in India has decreased from 73.3 percent in 2011–2012 to 56.0 percent in 2019–2020. A lower PLF will indicate that a plant is operating at a suboptimal level, characterized by operating parameters that are worse than the design limits, thereby making the plant a preferred candidate for repurposing.

2.1.1.9. Levelized cost of electricity (LCOE)

The LCOE comprises the capital expenditure, fuel costs, O&M costs, financing costs, as well as any regulatory costs, incurred in the generation of electricity. Repurposing CPPs provides an opportunity to retire higher-LCOE plants that impose a financial burden on the consumers or are subsidized by taxpayers. An analysis by the IEA[2] has estimated the LCOEs of CPPs, without a coal tax or carbon capture and storage (CCS), to be between USD 47.84 and USD 99.79 per megawatt-hour (MWh). However, it should be noted that the economic value of a generator's reliability and flexibility to meet grid requirements is not considered in the LCOE, but captured in other criteria.

2.1.2. Regulatory and Contractual Criteria

Regulatory and contractual criteria refer to the power plant company's statutory and contractual obligations. The broad idea underlying these criteria is to prioritize the repurposing of power plants, whose track record of compliance is poor, the cost of compliance is high, or the cost of exiting these obligations is low. The criteria considered under this category are set out below.

2.1.2.1. Local emissions track record

CPPs are sources of local air pollutants like sulfur dioxide (SO_2), nitrogen oxides (NOx), and particulate matter. However, the impact of the emissions may differ, based on the stack height, environmental characteristics, and the demographics of the area where the CPP is located. Therefore, the approach adopted is to understand the regulatory limits on emissions and compare them with the frequency and severity of the plants' transgressions. Specifically, the more frequent the transgressions, the more suitable the plant will be regarded to be for repurposing, based on this criterion.

2.1.2.2. Power Purchase Agreement (PPA)

A PPA or a Power Sales Agreement (PSA) is a primary contract between a generation company and a public utility or private party for the purchase or sale of power from a generating station. A PPA or PSA generally guarantees a secure revenue stream and includes other contractual details, such as risk allocations and structure, exit clauses, along with the expiration of the contract. The absence or imminent expiry of the agreement provides an attractive opportunity for retiring and repurposing a CPP, as compared with plants still having a significant remaining term.

2.1.2.3. Coal Supply Agreement (CSA)

A CSA with a coal supplier provides a steady supply of coal for operating a CPP. As with a PPA, a CSA also has its risk allocation and structure, supply price, exit clauses, and expiration of contract. The framework focuses on the origin of the coal being supplied, that is, whether it is imported, sourced domestically, or a mixture of both. While the use of domestic coal provides additional economic benefits to a country, such as energy security and employment generation along the entire value chain, imported coal, on the other hand, increases a country's import bill and risk exposure of its power system. Therefore, CPPs utilizing imported coal should be considered more favorable for repurposing under this criterion. It should be noted that the possible benefits of using imported coal, such as increased efficiency and reliability, will be accounted for in other criteria.

2.1.2.4. Coal supply constraints

Recently, coal supply constraints in many countries have placed CPPs at the risk of shutdowns, thus highlighting the significance of this factor for consideration in current and long-term scenarios. Here, this criterion considers the ability of CPPs to maintain average coal inventories in the longer run.

Based on industry practice, CPPs generally have coal inventories to cover 15 days of operation in the case of pit head plants, though the coverage can go up to 30–45 days, as the distance of a plant increases from its source of coal. Since the requirements may vary by location, type, and geography of the plant, among other factors, applying a single yardstick, in terms of the quantity of reserves, may not be appropriate. As such, the approach adopted in the framework is that plants unable to maintain the statutorily prescribed amount of reserves should be considered as favorable options for repurposing.

2.1.3. Social and Environmental Criteria

While statutory requirements regulate the social and environmental impacts of a power plant, they may not necessarily cover all aspects. Further, it may be important to distinguish between power plants, if there is a significant difference between them, even though they may both operate within the compliance limits. Thus, the following criteria also take into account the positive and negative impacts of CPPs on society and the environment, including air pollution, water pollution, and local employment.

2.1.3.1. Willingness of stakeholders

Identifying and engaging stakeholders affected by the decommissioning of a CPP constitute a crucial step, as they may wield significant influence on the process of repurposing the plant. Thus, obtaining the buy-in of key stakeholders is important for undertaking the repurposing successfully. These key stakeholders are the owners, the lenders, the workforce employed at the power plant, and the government. Although "willingness" is a subjective measure, it can be gauged broadly through extensive engagement in the form of surveys and interviews.

2.1.3.2. Carbon dioxide (CO_2) emissions

CO_2 emissions constitute one of the key drivers for the accelerated retirement of CPPs. Although the efficiency or heat rate is an important determinant of CO_2 emissions, the latter also depends on the characteristics of the fuel and the use of any carbon capture technology. Thus, this should be considered as a separate criterion. Typically, the specific CO_2 emissions (that is, CO_2 emissions per unit of electricity generated) ranges from 0.8–1.1 kg-CO_2 per kilowatt-hour (kWh) [9, 10].

2.1.3.3. Impact on local economy

A CPP plays a significant role in the local economy, especially in developing countries. The corporation that owns the power plant engages with the community due to a mixture of regulatory (government-mandated corporate social responsibility [CSR]), economic (legitimacy theory for businesses), and ethical reasons. As such, the decommissioning of a CPP may adversely impact the local economy with varying degrees contingent on the corporate contribution vis-à-vis the local administration's capacity to absorb the shock. Thus, the parameter that should be chosen for measuring the impact is the annual CSR expenditure by the corporation in the local area expressed as a fraction of the annual local budget for expenditure on public goods. Essentially, it would be preferable to prioritize the retirement of CPPs with the lowest contribution to the local economy. Depending on the geography and civic administration, "local" could refer to the municipality, district, or any other appropriate administrative unit.

2.1.3.4. Impact on local employment

In addition to being an overall contributor to the local economy as discussed above, a CPP is also a key source of employment in its area. The decommissioning of a power plant may thus lead to a considerable loss of livelihoods for the communities depending on it. Thus, the parameter that should be considered is the number of direct and indirect jobs supported by the power plant as a fraction of the

labor force. In effect, it would be prudent to prioritize the retirement of CPPs with the lowest contributions to the local employment.

2.1.3.5. Effluents and water pollution

Coal-fired thermal power generation impacts the water ecosystem in three substantial ways. First, the slurry discharged or stored in coal ash ponds may mix with groundwater, lakes, ponds, or other water bodies, thereby contaminating them with toxic substances such as heavy metals. Second, in plants employing the once-through cooling system, the cooling water, after absorbing heat from the steam cycle, is discharged into a water body such as a river, lake, or sea. The discharged water can increase the overall temperature of the water body, negatively impacting aquatic ecosystem. Third, in plants using cooling towers, there is higher consumption of water, which can contribute to increased water stress in the region. In India, new freshwater-based CPPs are required to achieve zero-wastewater discharge and a specific consumption of less than 3 liters per kilowatt-hour (L/kWh).

2.2. Potential Repurposing Concepts and their Selection

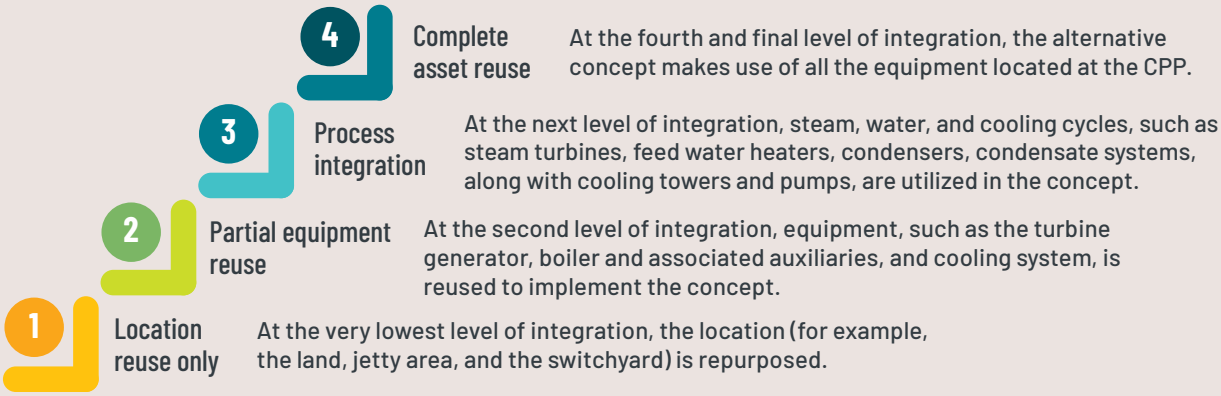
This section describes the methodology of how the repurposing concepts were identified and discusses the analysis for selecting the concept to be applied to a coal plant chosen in the previous stage.

2.2.1. Identification of Repurposing Concepts

In order to identify the repurposing concepts available in the market, a combination of secondary research and expert interviews was used. The secondary research covered academic literature on mature technologies and case studies detailing successful examples of CPP repurposing. Although these examples were found in developed economies, they involved repurposing concepts that have achieved technological maturity around the world. Relatively new technologies were studied, using concept notes prepared by the respective developers including, Siemens Gamesa, Rolls-Royce, and NuScale Power. In addition, in-depth discussions were conducted with Black & Veatch's subject matter experts (SMEs) in the fields of established and emerging technologies, such as energy storage, renewable natural gas, and hydrogen technologies. The research also draws upon Black & Veatch's experience in engineering and the construction of conventional and renewable energy power plants.

Any repurposing concept, by definition, is a brownfield project that will be executed at the site of the selected CPP. The status of the existing infrastructure facilities is a key criterion in the evaluation of brownfield redevelopment projects. Once a CPP has been identified, the equivalent criterion is the extent to which the existing infrastructure will be used in the repurposing concept. The repurposing concepts, which have been studied, are categorized under four strategies, as described in Table 1.

TABLE 1. Strategies for Repurposing Coal Power Plants



This section discusses the concepts identified within each category, including references to existing examples of their application at what was previously a CPP.

2.2.1.1. Location Reuse Only

- **Solar photovoltaic (PV) power plant:** The site of the CPP facilities, and if required, adjoining land parcels are repurposed to set up a solar PV power plant. This concept has been implemented at CPP sites.
- **Onshore wind farm:** The site of the CPP facilities can be repurposed to set up a wind farm. Further, the existing power evacuation infrastructure can be utilized. This concept has been implemented at CPP sites.
- **Offshore wind farm:** Coastal coal-fired plants can be converted into interconnection hubs for offshore wind turbines, using the existing power evacuation system. Multiple projects repurposing CPPs to support offshore wind energy are underway [15, 16].
- **Battery energy storage system (BESS):** This concept involves installing an electrochemical energy storage system in place of the power plant. In addition to storing energy, it can also provide ancillary services, such as grid frequency regulation. The specific types of BESS being considered are lithium-ion (li-ion), redox flow, and metal-air batteries. Of the three, the first has been executed at a CPP site.
- **Compressed air energy storage:** The site stores energy in the form of compressed air during off-peak times and supplies energy in peak periods.
- **Second-life use of electric vehicle (EV) batteries:** This concept specifically aims to use EV batteries after their end of life in vehicles, as they still have significant useful energy storage capacity.
- **Gravity-based storage:** Excess energy is used to lift a mass, thereby generating gravitational potential energy. When required, the mass is lowered and the energy harnessed to spin a generator.
- **Flywheel:** A flywheel is a mechanical device that can store excess electrical energy by converting it into rotational kinetic energy. Whenever there is excess electricity, it is used to accelerate the flywheel, which leads to the accumulation of rotational energy. When required, the stored energy can be recovered by decelerating the flywheel.
- **“Green” hydrogen production:** The plant site is repurposed to produce hydrogen through the electrolysis of water or molten salt. The hydrogen, thus generated, can be used as a fuel in industries and transportation. While the share of “green” hydrogen in total hydrogen is less than 1 percent, it is expected to grow significantly.
- **Ammonia production:** Green hydrogen, generated as described above, can be further used to manufacture ammonia. While ammonia by itself has significant value as an input to various industrial processes, it can also act as an effective hydrogen carrier due to its higher density and the increased safety of transportation.

- **Reforestation in urban areas:** The site is made suitable for the regrowth of trees. Depending on the local sociogeographic conditions, this can include energy crops, commercial plantations, and natural forests.
- **Direct air capture of CO_2:** Electricity is used to capture CO_2 from the air, which is then either permanently stored in geological reserves or used for industrial and commercial purposes.
- **Agrivoltaics:** Crops, especially those that do not require a lot of sunlight, are grown on the ground of the site, while PV modules are installed at an elevation.
- **Commercial uses:** This concept uses the site for commercial purposes, such as data centers, amusement parks, museums, theaters, and commercial offices. The concept has typically been implemented in the case of plants located at urban locations or coastal plants.

2.2.1.2. Partial Equipment Reuse

- **Natural gas-fired combined cycle (NGCC) plant with carbon capture and storage (CCS):** The CPP is repurposed into an NGCC plant with CCS for reducing CO_2 emissions. While multiple CCPs have been repurposed into NGCC plants, CCS has yet to be well-established commercially. Further, there are also initiatives to develop turbines that can be fired or co-fired, using hydrogen.
- **BESS + Synchronous Condenser:** Along with the storage and ancillary services provided by the BESS, the synchronous condenser can help improve the power factor in the grid. This concept has been previously implemented at a unit of a CPP.
- **Process industries:** The power plant can be repurposed for industrial uses, such as ore processing, cement processing, fertilizer production, and rubber production. Depending on the industry, existing assets, potentially including the steam cycle, can be reused; thus, this concept may also fall under the strategy of process integration, described in the next section. The concept of using existing assets, which is well-established, has been implemented at CPP sites with varying degrees of asset reuse.

2.2.1.3. Process Integration

- **Nuclear small modular reactor (SMR):** SMR units are typically rated at under 300 MW. The reactor generates steam that is fed to the steam cycle. This concept is in the initial stages, where companies are analyzing technical and commercial factors for implementing this solution.
- **Geothermal plant:** Geothermal energy is used to generate steam that can be further used in a steam cycle. This concept has been studied at various levels and is technically implementable for Poland.
- **Molten salt thermal energy storage:** Here, excess renewable energy is stored as heat in the form of molten salt. When required, the heat is used to generate steam to run a turbine and generate electricity. This concept, in combination with concentrated solar power, has been studied at CPP sites in Chile.
- **Volcanic stone thermal energy storage:** Heat, generated from electricity, is used to heat up a rock bed made of volcanic stones. The system is discharged via a heat recovery steam generator to produce electricity when needed. The concept is currently in the pilot stage and commercialization at the MW scale has not taken place.
- **Miscibility Gap Alloy (MGA) technology thermal storage:** Energy, in the form of heat, is stored in MGA, and during times of peak demand, the steam turbine is run to generate electricity. The MGA comes in a modular form, and hence, it is easy to install and interoperable with the steam and water cycles of the existing CPP.

2.2.1.4. Complete Asset Reuse

- **Biomass-fired boiler:** The concept replaces the existing fuel, that is, coal, to biomass. This concept reuses the complete existing equipment with some modifications to use biomass as feedstock. This well-established concept has been implemented at CPP sites.
- **Municipal waste-fired boiler + CCS:** Coal is replaced by municipal waste. Along with the generation of electricity, this also helps to dispose of waste. Depending on the composition of the waste, the process can be made carbon-negative through the use of CCS technology.
- **Renewable natural gas (RNG)-fired boiler:** RNG is obtained by the gasification of biomass through chemical or biochemical processes. The RNG obtained can be used in the same way as natural gas, with the added advantage of the fuel being carbon-neutral. Though large-scale RNG plants are operational in Sweden, UK, and Canada, they are not being used solely for power production. Further, (fossil) natural gas remains cheaper than RNG currently.

2.2.2. Selection of Repurposing Concept

2.2.2.1. Categorization of Concepts by End-Use

While the repurposing concepts were classified according to the degree of reuse of existing assets in Section 2.2.1, the policy and regulatory environment is often defined by the broad end-use of the repurposing concept. For instance, an onshore wind power plant, a nuclear SMR, and a biomass-fired thermal power station will have more incentives and regulations in common than an onshore wind power plant, agrivoltaics, and the direct air capture of CO_2. Further, it is also easier for the decision-maker to compare among repurposing concepts with the same broad end-use. Thus, the concepts discussed above are classified under five categories, based on the end-use. These categories and the concepts under each category are presented in Table 2.

TABLE 2. End-Use Categories and Repurposing Concepts

Electricity generation	Energy storage	Hydrogen/ ammonia production	Carbon sink	Non-energy non-carbon uses
Biomass-fired boiler	Flywheel	"Green" hydrogen production	Direct air capture of CO_2	Commercial use
Geothermal plant	Li-ion BESS	Ammonia production	Reforestation in urban areas	Process industries
Municipal waste-fired boiler + CCS	BESS + Synchronous Condenser			Agrivoltaics
Natural gas-fired boiler + CCS	Molten salt thermal energy storage			
NGCC plant with CCS	Compressed air energy storage			
Nuclear SMR	Volcanic stone thermal energy storage			
Offshore wind	MGA technology thermal storage			
Onshore wind farm	Second-life use of EV batteries			
RNG-fired boiler	Redox flow BESS			
Solar PV power plant	Metal-air BESS Gravity-based storage			

2.2.2.2. Key Criteria for Concept Selection

Within each category, technical, commercial, as well as social and environmental criteria, are used in this framework to rank the repurposing concepts. While some of these criteria are unique to certain categories, others are more generic in nature, and thus, applicable to all categories.

Common Criteria

TECHNICAL CRITERIA

- **Use of existing assets:** A greater reuse of existing equipment will imply lower decommissioning costs and a reduction in the capital expenditure required to set up the generation facility. Thus, a higher degree of use of existing assets will make a repurposing concept more favorable.
- **Water requirement:** While a CPP will also consume water, this criterion assumes greater relevance in case of a shortage of water, or if the reduction of water use is a policy priority. Repurposing concepts with a lower water requirement will be regarded as more favorable. Although the actual water requirement for this criterion will depend on the exact project and site, the lifecycle-required water typically ranges from 4 cubic meters per gigawatt-hour (m^3/GWh) for wind power production to 1,000 m^3/GWh for natural gas.
- **Logistical requirement:** This criterion captures the level of transport and access to the site required to implement and operate the concept. It will be especially relevant in the case of plants located in hilly terrain or characterized by poor access for other reasons. Concepts that do not have high logistical requirements will thus be more favorable.
- **Safety:** This criterion quantifies the risks to the safety of workers, the community, and the environment.

COMMERCIAL CRITERIA

- **Execution time:** Longer timelines will increase the risk of cost overruns and delay the realization of benefits.

SOCIAL AND ENVIRONMENTAL CRITERIA

- **Job creation potential:** This criterion indicates the potential of the concept to create new jobs vis-à-vis the existing CPP. It does not, however, capture the retraining costs that may be incurred.

Criteria specific to Electricity Generation

TECHNICAL CRITERIA

- **Specific electricity output:** This criterion quantifies the average annual electricity output per unit area from the proposed concept vis-à-vis coal. The consideration of this category indicates the importance of the need to maintain generation levels, and thus, this criterion should carry significant weight. The parameter to assess this criterion ranges from 100 kilowatt-hour per square meter (kWh/m^2) for solar PV to 1,500 kWh/m^2 for a natural gas power plant.
- **Generation flexibility:** The generation technologies are broadly marked as "completely flexible" (that is, the output can be ramped based on demand); "partly flexible" (that is, the output is dispatchable but requires significant response time); and "inflexible" (that is, the output cannot be adjusted). Higher flexibility is considered to be an advantage. While generation technologies such as solar and wind are inflexible, baseload plants such as nuclear may be considered as partly flexible and gas turbine technologies completely flexible.

COMMERCIAL CRITERIA

- **Levelized cost of electricity (LCOE):** The LCOE — the ratio of discounted lifetime costs to discounted generation — encompasses the capital expenditure, lifetime, fuel costs, O&M costs, financing costs, as well as any regulatory costs. A lower LCOE is considered to be more attractive for the purpose of this evaluation. Estimates vary by country, depending on the costs of inputs, financing costs, and taxes. In India, for instance, the cost can range from USD36/MWh for solar PV and onshore wind to USD120/MWh for biomass.

SOCIAL AND ENVIRONMENTAL CRITERIA

- **Greenhouse gas (GHG) emissions:** This criterion captures the expected lifetime GHG emissions per unit electricity produced in terms of CO_2-equivalent (CO_2e). Lower emissions are considered to be better. Estimates for GHG emissions from the construction and operation of various power generation technologies vary from 10 grams of CO_2-equivalent per kilowatt-hour (gCO_2e/kWh) for onshore wind power to 250 gCO_2e/kWh for gas-fired combined cycle plants with CCS.

Criteria Specific to Energy Storage

TECHNICAL CRITERIA

- **Specific electricity output:** This criterion that quantifies the average annual electricity output per unit area (that is, MWh/m^2 or a similar unit) from the proposed concept indicates the energy storage capacity. A higher capacity is considered to be better.
- **Specific power output:** This criterion quantifies the maximum power output per unit area (that is, in MW/m^2 or a similar unit) from the proposed concept. It indicates the rate at which the energy storage system can supply electricity when required and a higher rate is considered better.

COMMERCIAL CRITERIA

- **Levelized cost of storage (LCOS):** The LCOS — the ratio of discounted lifetime costs to discounted energy storage over its lifetime — comprises the capital expenditure, lifetime, efficiency, O&M costs, financing costs, as well as any regulatory costs. A lower LCOS is considered to be more attractive. The LCOS will further depend on the type of application and revenue structure, for instance, whether it is for front-of-the-meter (wholesale, transmission and distribution [T&D], and utility-scale renewable generation) or behind-the-meter (co-located with commercial, industrial, hydrogen or ammonia production facility, along with renewable) applications.

SOCIAL AND ENVIRONMENTAL CRITERIA

- **GHG emissions:** This criterion captures the expected lifetime GHG emissions per unit electricity delivered, in terms of CO_2e. Lower emissions are considered to be better.

Criteria Specific to Hydrogen/Ammonia Production

TECHNICAL CRITERIA

- **Specific energy output:** This criterion quantifies the average annual delivered energy output per unit land area occupied (that is, in milliJoule per square meter [MJ/m^2] or a similar unit) by the plant. It indicates the generation capacity of the concept and a higher capacity is considered to be better.

COMMERCIAL CRITERIA

- **Benefit-Cost Ratio (BCR):** The BCR is the ratio of discounted earnings from the sale of the generated fuel to discounted lifetime costs. It captures the market value of the fuel, capital expenditure, lifetime, input costs, O&M costs, financing costs, as well as any regulatory costs. A higher BCR is considered to be more attractive for the purpose of this evaluation.

SOCIAL AND ENVIRONMENTAL CRITERIA

- **GHG emissions:** This criterion captures the expected lifetime GHG emissions per unit energy produced, in terms of CO_2e. Lower emissions are considered to be better.

Criteria Specific to Carbon Sink

TECHNICAL CRITERIA

- **Specific carbon mitigation:** This criterion quantifies the average annual CO_2 extracted from the atmosphere per unit area (that is, in ton CO_2/m^2 or a similar unit). It indicates the carbon mitigation capacity of the concept and a higher capacity is considered to be better.

COMMERCIAL CRITERIA

- **Levelized cost of carbon mitigation (LCOCM):** The LCOCM is the ratio of discounted lifetime costs for the concept to the discounted amount of CO_2 extracted over its lifetime. Thus, it captures the capital expenditure, lifetime, O&M costs, financing costs, as well as any regulatory costs. A lower LCOCM is considered to be more attractive.

Criteria Specific to Non-Energy Non-Carbon Uses

COMMERCIAL CRITERIA

- **Market and Social Suitability:** This criterion qualitatively captures the market and social suitability of the specific nature of the concept being planned.

SOCIAL AND ENVIRONMENTAL CRITERIA

- **GHG emissions:** This criterion captures the expected lifetime GHG emissions, in terms of CO_2e. Lower emissions are considered to be better.

Table 3 summarizes the criteria considered for each category.

TABLE 3. End-Use Categories and Criteria for Assessment of Concepts

	ELECTRICITY GENERATION	ENERGY STORAGE	HYDROGEN/ AMMONIA PRODUCTION	CARBON SINK	NON-ENERGY NON-CARBON USES
Technical Criteria					
Use of existing assets	●	●	●	●	●
Water requirement	●	●	●	●	●
Logistical requirement	●	●	●	●	●
Safety	●	●	●	●	●
Specific electricity output	●	●	Specific energy output	Specific carbon mitigation	-
Generation	Generation flexibility	Specific power output	-	-	-
Commercial Criteria					
Execution time	●	●	●	●	●
Cost	Levelized cost of electricity (LCOE)	Levelized cost of storage (LCOS)	Benefit-Cost Ratio (BCR)	Levelized cost of carbon mitigation (LCOCM)	Market and Social Suitability
Social and Environmental criteria					
Job creation potential	●	●	●	●	●
GHG emissions	●	●	●	-	●

BOX 1. Repurposing Case Studies

CASE OF THE W. C. BECKJORD POWER PLANT

After 62 years of operation, Duke Energy's W. C. Beckjord power plant in the US was economically obsolete; thus, a multi-year decommissioning process was initiated. As Duke Energy was already operating a transmission substation on the property, the company considered tapping into the ancillary service market by providing a fast-response system for regulating grid frequency. With this end in mind, a 2-MW / 800-kWh li-ion-based battery storage system was established on the site in 2015.

The system passed tests of the frequency regulation market and came online to provide power in seconds, as opposed to traditional power plants that could take up to 10 minutes or more to ramp up. Such repurposing solutions enable the performance of grid services for customers, ultimately driving revenue streams for the utility and increasing grid reliability and services for the transmission network.

CASE OF THE DRAX POWER STATION

The Drax Power Station in the United Kingdom (UK) converted its four coal-fired units to run on biomass. With biomass fired in the power station, compressed wood pellets (instead of coal) are fired in the boiler. The majority of the equipment in the project, including the boiler, turbine, and generator, remained unchanged, except for some changes in the material handling and firing of biomass in the boiler. Facilities, called the "EcoStore," which are advanced technological structures specially designed for storing biomass, had to be created.

In line with UK's goal to wean itself away from coal, there are plans to repurpose Units 5 and 6 into a combination of combined cycle gas turbines and up to 200 MW of BESS to become completely coal-free.

3. POTENTIAL FINANCING MECHANISMS

3.1. Introduction

This section aims to provide a framework for identifying suitable financial mechanisms for implementing repurposing solutions for CPPs in the target countries.

Several financial mechanisms have been implemented / are currently being developed across the world to accelerate the retirement and repurposing of CPPs. Relevant case studies of such financial mechanisms have been included to demonstrate use cases for target geographies. Ultimately, the selection of a suitable financial mechanism will depend on the financing climate in the target countries (highlighted in Section 4) and the technical solution (covered in Section 2.2.2).

In principle, an effective financial mechanism should ensure that the incentives of all key stakeholders are aligned and that the value unlocked through such repurposing is distributed among the key stakeholders, including workers, communities, governments, coal plant owners, as well as their investors and financiers.

This chapter includes the following sections:

- Key principles guiding the development of coal-repurposing financial mechanisms;
- Key steps in structuring a financial mechanism for a coal-repurposing transaction;
- Financial mechanisms implementable in the short term and those more suited for the long term; and
- Roles that can be played by Development Financial Institutions (DFIs) to promote such repurposing.

3.2. Key Principles for Developing Financial Mechanisms

Highlighted below are the key principles guiding the development of coal-repurposing financial mechanisms:

- **Financially Viable:** The financial mechanism should be designed by taking into consideration the impact of the repurposing exercise on the financial positions of all the stakeholders. The viability of the repurposing solution will depend on multiple factors, such as the underlying cash flows of the existing plant, the proposed repurposing solution, and the proposed financial mechanism.

  A detailed analysis is needed to assess the potential and variability of profitability for existing owners of these plants. CPPs with long-term take-or-pay-based PPAs and long-term coal supply agreements are likely to have stable and predictable cash flows. In such cases, the existing owner(s) will consider appropriate alternatives to participate in the repurposing exercise. This may be achieved by structuring the deal in a manner that ensures the certainty of cash flows from the repurposed project (for example, if the underlying asset is repurposed to be a solar asset, the existing owner may request long-term PPAs providing a similar protection).

- **Scalable Solution:** The financial mechanism should ensure that the public funds "crowd-in" additional private sector investments. This is necessary to achieve scalable solutions that can be utilized to meet the target of the 1.5°C-reduction set in the Paris Agreement. Thus, the financial mechanism need not only be asset-

specific; rather, it should use set templates that are easily replicable across multiple assets within the target countries.

- **Accrual of Additional Benefit:** For countries with significant exposure to coal in the power sector, in order to achieve emission reductions in line with the Paris Agreement targets, a large-scale repurposing initiative is required. The financing pool available to support such large-scale initiatives is inherently limited in nature so financing models should not be "incentivizing" CPPs that will naturally decommission in due course. **The financing pool should be used to transition only the additional capacities of coal that would have continued to operate in the normal course of business.** This will ensure that the limited financial resources available for coal repurposing / transitions are utilized efficiently.
- **Just, Equitable, and Sustainable Transition:** Coal is strategically important in target countries, so coal-repurposing initiatives will likely impact stakeholders across the value chain. The stakeholders include multiple parties:

1 | Existing owners;

2 | Direct employees responsible for the operation of CPPs;

3 | Indirect contracted parties — individuals employed as part of the wider coal supply chain — a critical component of whom will be coal miners, but may also include freight operations and other ancillary services (catering, cleaning, etc.);

4 | Wider communities — certain areas are heavily reliant on either CPPs or coal mines as the center of the economy, and so the removal of such a CPP's economic activity can have a significant impact (for example, through workers leaving or having less disposable income, thereby causing knock-on effects on shops, restaurants, and transport); and finally

5 | End-consumers who are ultimately likely to bear the cost of such a repurposing exercise.

So, apart from the cost of the technical solution that should be considered while proving the financial feasibility, the social cost of the initiative also needs to be identified. This should include the costs of developing alternative skill sets, jobs in alternative sectors, along with the social and economic development of coal-dependent regions, amongst others. The transition support needed should be driven by the location and type of asset to be retired. Assets situated in more isolated locations, where local townships have limited economic activities apart from coal, are likely to have a high impact on the local economy. Similarly, assets with mine-mouth coal operations are likely to have more significant knock-on effects, as the repurposing of CPPs will result in the closure of two sources of employment.

The just transition cost may far outweigh the cost of repurposing the existing asset (depending on the just transition impact and the technical solution proposed). In this context, the financial mechanism should consider the holistic cost of a transition to ensure that all parties across the value chain are well-protected and compensated for the adverse effects of repurposing a CPP.

3.3. Key Steps in Structuring a Financial Mechanism for Coal-Repurposing Transactions

Highlighted below are the key steps for structuring a financial mechanism for coal-repurposing transactions:

- Step 1: Identification and allocation of scope;
- Step 2: Selection of a procurement model;
- Step 3: Establishment of a detailed transaction structure; and
- Step 4: Assessment of implementation capacity.

Step 1: Scope Identification and Allocation

The scope of a repurposing transaction can be broadly categorized under the following areas:

- Decommissioning of the existing asset (if required);
- Repurposing (including the construction of a new asset, where relevant) and the operation of the asset; as well as
- Ensuring a just and equitable transition.

STRUCTURING THE SCOPE OF DECOMMISSIONING AND REPURPOSING AN ASSET

As highlighted in Section 2.2.1, the decommissioning of the existing asset, required for repurposing solutions, will be based on (i) location reuse only or (ii) process integration. In this scenario, a new asset will be required to be constructed and operated once the existing asset is decommissioned.

- For repurposing solutions where decommissioning is required, the decision whether to split

  1 | (a) the decommissioning of the existing asset and (b) the construction and operation of the new asset or

  2 | combine activities (a) and (b) together

  will depend on whether the repurposing solution is a power-based concept or not. In case the asset is being repurposed into another form of a power generation plant, the transition can be structured to attract state-owned utilities or power sector-based developers. Such entities tend to have experience in decommissioning power projects, and so the scope under activities (a) and (b) can be combined.

- However, if the asset is being repurposed into a non-power-based concept (such as the commercial development of the site or reforestation in urban areas), the scope of the decommissioning of the existing asset will need to be segregated from the scope of constructing and operating the new asset. This will enable non-power sector players (such as real estate developers, if the target repurposing solution is the commercial development of the site), who will have no /limited prior experience in the decommissioning of the power project, to participate on a standalone basis, which is likely to increase the pool of available developers for such a transaction. In this scenario, the off-taker is expected to act as a counterparty to both the power sector-based developers (who will be responsible for decommissioning the existing asset) and the non-power sector player (who will be responsible for the construction and operation of the new asset). This simplified structure will allow the off-taker to select the most suitable player for each of the activities described in (a) and (b).

Alternatively, for repurposing solutions based on (i) a complete asset reuse or (ii) a partial asset reuse, the scope will be limited to the repurposing of the existing asset (without complete decommissioning) and the operation of the repurposed asset. In this scenario, the transaction can be structured to attract power sector-based developers.

ENSURING A JUST AND EQUITABLE TRANSITION

In countries that have significant exposure to coal, coal repurposing will impact not only the power plants but also the larger value chain. Given the enormous impact of CPP repurposing on various communities, a just and equitable transition from

coal becomes an essential aspect of the exercise that needs to be managed prudently. Therefore, this scope should be retained by the government, with DFIs providing the necessary support. Further, private sector entities may not be best suited to cover this scope, as they will primarily be commercially focused.

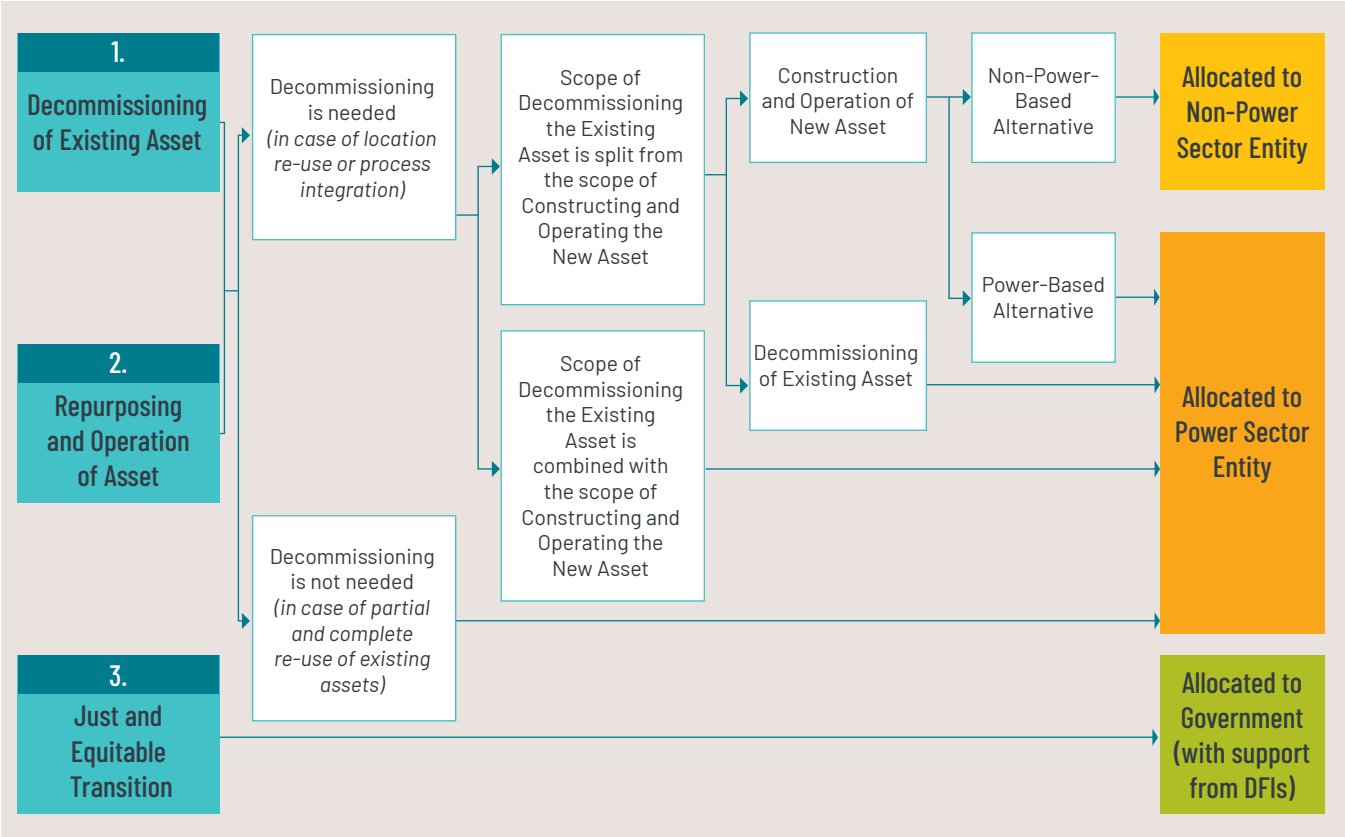


FIGURE 1. Structuring Scope of Decommissioning and Repurposing of Assets

Step 2: Selection of a Procurement Model

After the identification and allocation of the scope of the repurposing exercise, the next step is to select a suitable procurement model for the repurposing transaction (that is, a traditional public sector procurement model vs. a public-private partnership [PPP] model). The choice of the procurement model will depend on:

- **Criticality of the Asset:** While the repurposing of most CPPs can be managed via the PPP route, there may be certain CPPs that are of strategic relevance to the off-taker (such as a large-scale plant that is the only or primary source of power in a region). In such cases, repurposing may be handled by the government / state-owned enterprises (SOEs) themselves, instead of utilizing the PPP model.
- **Value-for-Money (VFM) Analysis:** For non-critical assets, the off-taker will need to select between utilizing the traditional procurement model and the PPP model for repurposing. The PPP model may offer several advantages over the traditional procurement model, which include increased budgetary financial flexibility by better aligning the off-taker's expenditure over the life of the asset (by shifting from upfront cash outflow to output-based payments over the life of the asset); enhanced delivery due to the use of technical innovation and best practices by private sector entities; along with the optimal allocation of risk.

A VFM analysis could be utilized to compare the whole-of-life cost of repurposing the asset under consideration under the traditional procurement model vs. the PPP model. Further details on the VFM analysis have been included in Appendix E.

Step 3: Establishment of a Detailed Transaction Structure

Under this step, a detailed commercial and risk assessment is undertaken to establish the framework for implementing the transaction, which covers the following areas, amongst others.

Assessment of the Existing Capital Structure of the CPP: The existing capital structure of the CPP will need to be factored in and carefully managed while designing and implementing a contractual structure and a risk management framework. Highlighted below are the key aspects to be considered while assessing the existing capital structure for both independent power producers (IPPs) and SOE-owned plants.

- **IPPs:** In the case of the repurposing for IPPs, if an existing debt is outstanding, the lenders may seek the repayment of an outstanding debt due to the change in the underlying project. In such a case, the cost of unwinding existing hedges, any prepayment penalties, etc. need to be considered in the assessment of the existing capital structure.
- **SOE-owned Plants:** SOE-owned plants are typically financed, using a corporate facility. In case the repurposing solution involves decommissioning a CPP, there may be a need to write off the existing asset from the balance sheet, which may have accounting implications. Covenants under existing financing documents may also have restrictions against such an impairment of the asset. The financing of SOE-owned plants may be through sovereign debt; as a consequence, it may have covenants and restrictions that must be managed at a government level.

Contractual Structure and Risk Allocation Framework: In order to design an appropriate transaction structure and a risk allocation framework, the technical nuances of the repurposing solutions have to be taken into consideration. Illustrations of the impact of the technical solution proposed for repurposing are included in Table 4.

- The establishment of a transaction structure may be relatively simpler when a traditional procurement model is selected for implementing the repurposing solution, as the government / SOE will be responsible for managing the entire scope of the repurposing exercise. However, due consideration will need to be provided to ensure the bankability of the structure and the fulfillment of all the lender requirements (if repurposing is not funded through internal accruals).
- Establishing a contractual structure and risk allocation framework for projects by utilizing a PPP model may be more complicated, especially for repurposing solutions that do not have many established precedents. Each repurposing solution has unique risks associated with it, which need to be identified, allocated, and managed appropriately. Solutions that have market precedents may be easier to finalize. For example, in the case whereby an existing CPP is repurposed to set up a new solar power plant, the structure for the construction and operation of a solar power plant is well-established. However, the contractual obligation and risk allocation for the decommissioning of the plant need to be considered. Establishing a contractual structure and risk allocation framework for technical solutions that are relatively less established / or for initial pilot phases may be relatively complicated. A detailed market assessment should be conducted to ensure that an appropriate contractual structure and risk allocation framework is devised, and is acceptable to the off-taker, sponsors, lenders, and other stakeholders involved in the repurposing solution.

Assessment of the viability of the proposed financial mechanism: After the establishment of the contractual structure and risk allocation process for the repurposing solution, an assessment of the viability of the proposed financial mechanism should be undertaken. The viability of the repurposing solution will depend on multiple factors, such as

the underlying cash flows of the existing plant, the proposed repurposing solution, and the proposed financial mechanism, amongst others.

- The assessment of the viability of the proposed solution should involve a detailed analysis of the overall costs and revenues of the repurposing solution. In case the result of undertaking such an analysis is positive (that is, the proposed solution is financially viable), the repurposing solution may be implemented without any grant / concessionary support from DFIs. However, should the analysis show that the proposed solution is not self-sustaining from a financial standpoint, the government and / or DFIs may be required to step in to enable the project to be financially feasible and attractive.
- The government can provide financial incentives in the form of tax breaks, tax reductions, or support in the form of grants. DFIs could also help by providing grants or concessional debts to enhance the viability of deals from a private sector perspective. Apart from concessional funding and grants, DFIs may also provide credit enhancement products, such as political risk insurance products, partial risk guarantees, and liquidity / payment guarantees, thereby de-risking the project for private sector investors and / or lenders.
- The assessment of the viability of the financial mechanism should be undertaken not only for the private sector and the government, but also from the view of the end-consumers. The financial mechanism so proposed should provide a cost-competitive solution for the end-consumers while being feasible for the other stakeholders. Such a solution will then have long-term applications and can be used to scale coal-repurposing initiatives.

Step 4: Assessment of Implementation Capacity

Finally, the off-taker needs to also assess the internal capacity of its team to structure and implement the financial mechanism for the proposed repurposing solution. Technical assistance may be provided by DFIs to the off-taker, in case it lacks the necessary capacity to implement such projects. This will be especially relevant for pilot transactions when precedents are being established. As DFIs are at the forefront of coal-transition efforts in emerging economies in Asia and Africa, they are thus well-placed to assist the off-taker in successfully implementing such transactions.

Impact of Proposed Technical Solution on Key Commercial Structuring Considerations

While formulating a contractual structure and a risk allocation framework, it is imperative to consider the specific nuances of the proposed technical solution for the repurposing of the CPP. Table 4[3] summarizes the key technical solutions that can be considered as part of the repurposing solution (as included in Section 2.2.1) and captures the key structuring considerations for each of the buckets. Additionally, the table also includes whether there is a need for splitting the scope of work (that is, decommissioning and setting up the new plant) for each proposed technical solution.

TABLE 4. Impact of Repurposing Solutions on Commercial Structuring Considerations[4]

TECHNICAL SOLUTION	SUITABLE DEVELOPER TYPE	PROBABILITY OF FINANCIAL VIABILITY ON A STANDALONE BASIS[5]
Solar / onshore wind / offshore wind *(Standalone or with Agrivoltaics)*	• Power sector-based entities such as IPPs and utilities. • Likely to have a large pool of suitable developers. • The entire scope may be implemented by a single developer. However, it may also be split to ensure a cleaner transaction structure.	• High — They are proven technologies with many precedents in the market.
BESS *(Standalone and with synchronous condenser)*	• Power sector-based entities such as IPPs, BESS operators, and utilities. • Likely to have smaller pool of suitable developers, as BESS has a limited track record (vs. solar or wind projects). • The entire scope may be implemented by a single developer. However, it may also be split to ensure a cleaner transaction structure.	• Medium — While the financial viability of BESS is generally established, its track record, especially when used for long duration storage, that is, over 4 hours, is still limited.
Compressed air energy storage	• Power sector-based entities such as IPPs and utilities. • Likely to have a pool of suitable developers.	• Low — While standalone solutions have been implemented, cost competitiveness is still to be achieved across geographies.
Green hydrogen / Ammonia Production	• Traditional developers active in the hydrogen / ammonia space and power sector developers. • Likely to have smaller pool of suitable developers, as technology is still emerging and lacks multiple established precedents. • The entire scope may be implemented by a single developer. However, it may also be split to ensure a cleaner transaction structure.	• Medium — Financial viability is dependent on securing a long-term offtake agreement for green hydrogen / ammonia.
Reforestation	• Contractors for decommissioning scope. • Forestry sector entities for repurposing scope.	• Uncertain — This depends on the site location.
Commercial use	• Contractors for decommissioning scope. • Real estate sector entities / other entities (as applicable) for the repurposing scope.	• Uncertain — This depends on multiple factors related to the proposed commercial use and will have to be evaluated on a case-to-case basis.
Process Industries	• Depends on the choice of process industry.	• Uncertain — This depends on the choice of the process industry.
Co-Fired Plant	• Power sector-based entities such as IPPs and utilities. • Likely to have a large pool of suitable developers .	• Low — While pilot projects have been undertaken, large-scale applications have yet to be implemented.

TECHNICAL SOLUTION FOR REPURPOSING	SUITABLE DEVELOPER TYPE	PROBABILITY OF FINANCIAL VIABILITY ON A STANDALONE BASIS[6]
Geothermal Plant / Molten Salt Thermal / Volcanic Stone Thermal Storage	• Power sector-based entities such as IPPs and utilities, etc. • Likely to have a smaller pool of suitable developers, as it is a niche technology with less resource potential (when compared to solar / wind projects).	• Medium — Viability will depend on the actual site location and the availability of required resources in proximity.
Biomass-Fired Boiler / Natural Gas-Fired Boiler + CCS	• Power sector-based entities such as IPPs and utilities . • Likely to have a large pool of suitable developers.	• High — They are proven technologies with many precedents in the market. • It should be noted that CCS is relatively expensive to implement.
Municipal Waste-Fired Boiler + CCS	• Power sector-based entities such as IPPs and utilities. • A smaller pool of suitable developers as technology is still emerging and lacks multiple established precedents.	• Medium — Financial viability is dependent on securing a long-term off-take agreement and a waste supply agreement. • It should be noted that CCS is relatively expensive to implement.
Renewable Natural Gas-Fired boiler	• Power sector-based entities such as IPPs and utilities. • Likely to have a large pool of suitable developers.	• Medium — This is due to the availability of cheaper sources such as natural gas. • Although natural gas is a cheaper source, this solution may utilize the carbon credits market (to improve the project economics).

3.4. Potential Financial Mechanisms for Coal Transition

Various financial mechanisms have been utilized / are currently under the implementation stage for implementing coal-repurposing projects. The selection of the appropriate financing mechanism should be based on the key commercial considerations covered in the previous section.

A brief decision matrix on the selection of a financing mechanism for both SOE-owned CPPs and coal-based IPPs is presented below.

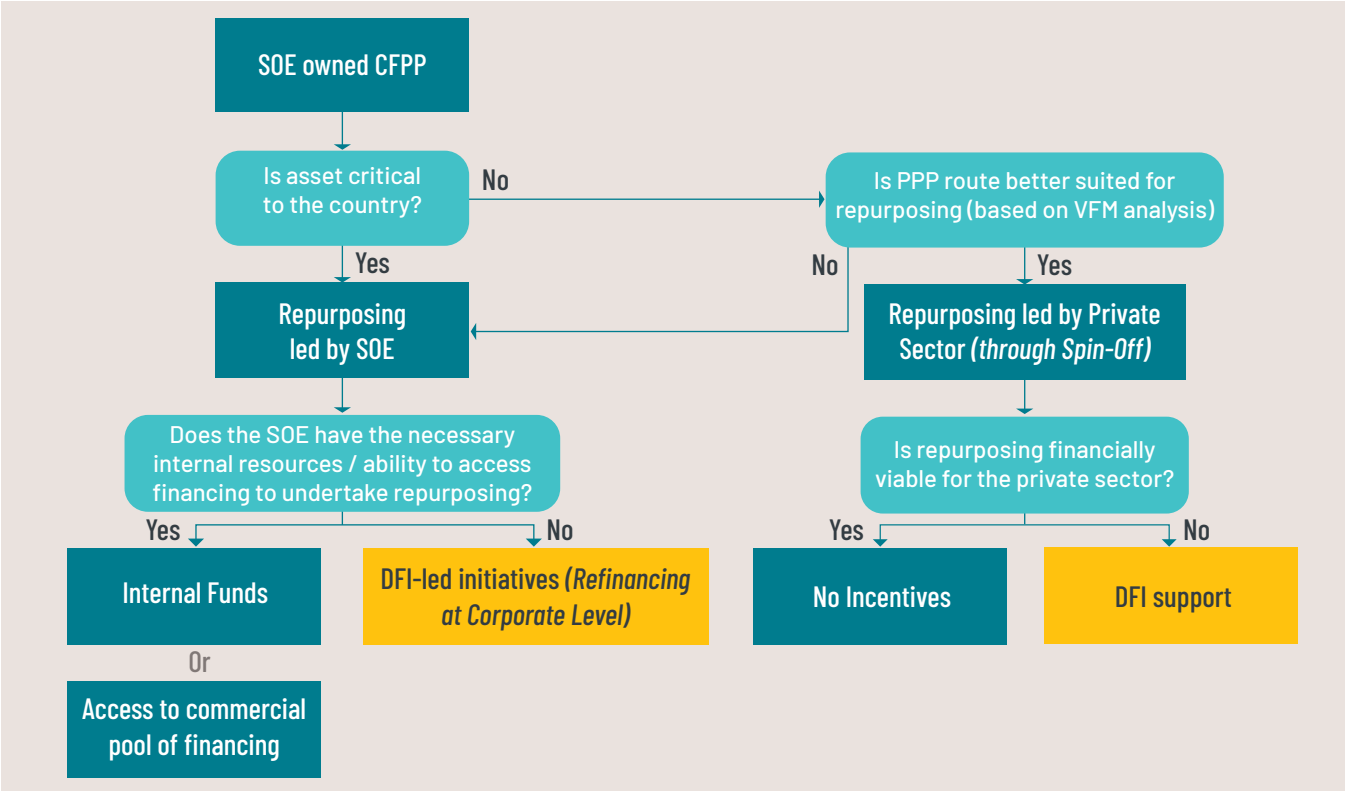


FIGURE 2. Decision-Making Matrix for SOE-owned CPPs

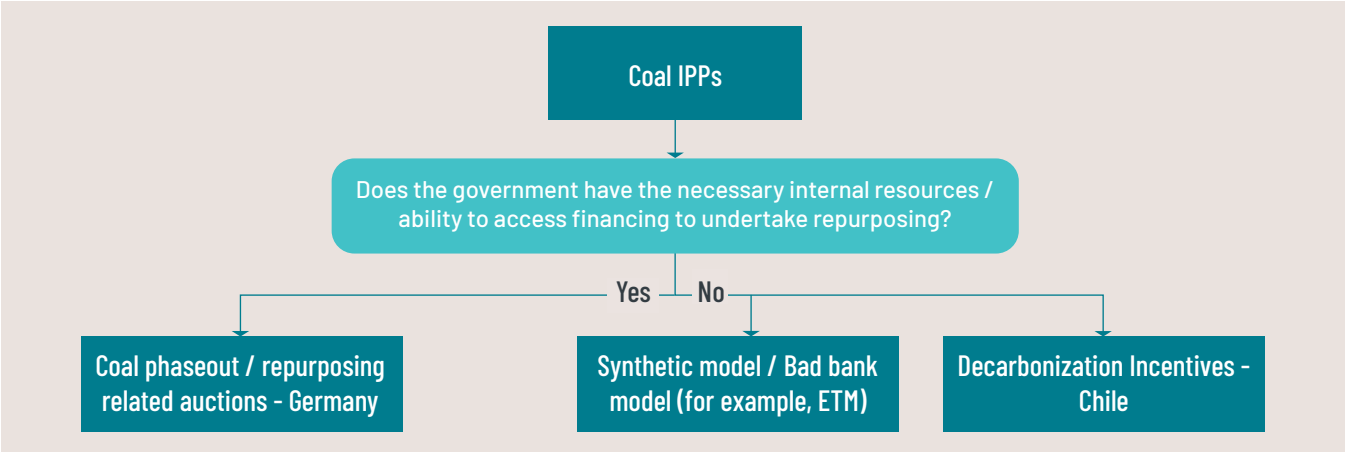


FIGURE 3. Decision-Making Matrix for Coal IPPs

3.4.1. Short Term

In the short term, depending on the route selected (private sector-led or government-led / SOE-led) for each asset in a particular geography, multiple financing options are available, as shown in the background document and the Annex. However, in the short term, the funds from the financial market will have to be crowded-in through DFIs, given the nascent stage at which coal-repurposing initiatives are at globally.

This section covers in detail the decision matrix around the selection of potential sources of financing in the short term and the ways in which these funds can be structured to ensure optimum utilization.

3.4.1.1. Government- Led / SOE-Led Financing

In the case where an asset or a pool of assets is to be retired by the government / SOE, there are four key sources of funds: internal funds, the ability to raise additional debt and concessional funds from DFIs, donors, and philanthropies.

Internal Funds / Commercial Debt / Sovereign Debt

In the case of the first two sources, wherein the government / SOE has a strong balance sheet and financial strength, they could lead the coal-repurposing / transition and set precedents for private sector participation. The government / SOE can opt for the following strategies to promote the coal-repurposing initiative:

FINANCIAL INCENTIVE FOR A PRIVATE COAL FLEET

This would involve creating a retirement schedule for all or a majority of the CPPs in the country and offering compensation to plant owners opting to retire the plant according to the schedule. This strategy should be coupled with a deadline of when the entire coal fleet will become obsolete and not be allowed to operate (thus providing an incentive for plant owners to opt for the compensation route and shut down their plants early). This strategy was utilized in Germany to achieve the early retirement of CPPs (details provided in the box below).

BOX 2. Coal Phaseout Auctions: Germany

Germany has a power mix that is significantly reliant on renewables: they contributed to 40.9 percent of the energy mix in 2021, increasing from 35.3 percent in 2018. The sources of energy in Germany comprise coal-based plants (27.9 percent), nuclear power plants (11.9 percent), and gas-based plants (15.3 percent), with the remaining share coming from other sources.

In order to end the use of CPPs by 2038, the Act to Reduce and End Coal-Powered Energy and Amend Other Laws (Coal Phaseout Act) was enacted in August 2020 by the Government of Germany. The act aims to gradually reduce and eventually end the use of coal energy in Germany. The intention behind the Act is to "reduce emissions and provide the public with a safe, a cost-effective, an efficient, and a climate-compatible energy supply."

The Phaseout Plan

Under the phaseout plan, no new coal plants may start operating after August 14, 2020, except for those that had received a license to operate before January 29, 2020. The act offers financial compensation to the operators of coal plants. In addition, it amends the German Renewable Energy Sources Act to codify the goal to raise the percentage of renewables to 65 percent by 2030.

Under another act, the Structural Support for Coal Regions Act, the government aims to provide financial support of up to EUR14 billion to lignite-coal regions and EUR1.09 billion to hard-coal regions. In addition to the above, the Act provides up to EUR26 billion in support through measures, such as highway and rail infrastructure improvement or the expansion and creation of up to 5,000 additional jobs in federal agencies in the coal regions. This has been included in the Act to ensure a just transition for the communities engaged in the coal industry.

The phaseout plan mandates that by 2022, the power generated from both anthracite (hard coal) and lignite (brown coal) must be reduced to around 15 GW each. By 2030, the output is further reduced to 8 GW for hard coal and to 9 GW for lignite. Finally, by 2038 at the latest, the use of coal plants must cease completely. The Act also mandates reviews of the phaseout schedule in 2026, 2029, and 2032, respectively, to decide whether a complete exit may be achieved by 2035.

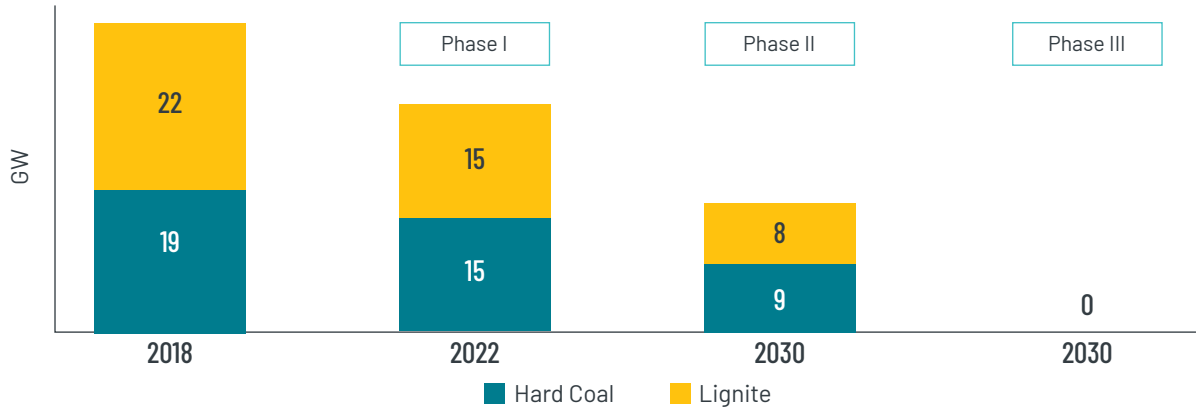


FIGURE 4. Active Capacity for Hard Coal and Lignite Plants in Germany

Retirement mechanism of Hard Coal

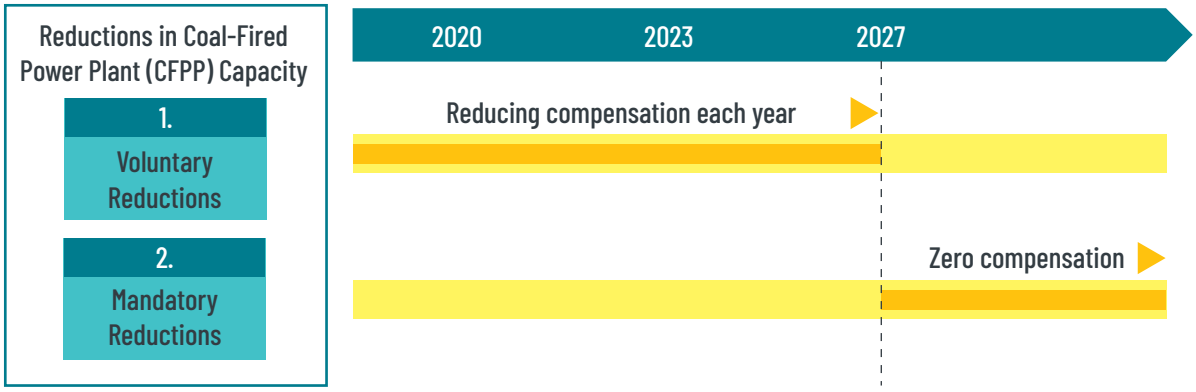


FIGURE 5. Retirement Mechanism of Hard Coal

The Act aims to retire the hard coal power plants through an auction system wherein operators may voluntarily offer capacity reductions until 2027 and receive compensation in return. The program has been structured such that it compensates operators for early retirement. The compensation provided to the operators decreases over the period up to 2027. In the 2020 auction, the maximum remuneration was EUR165,000/MW. The Federal Network Agency (BNetzA), the entity organizing the auctions, draws up a list of plants to be shut down each year. Post-2027, there will be forced closures without compensation. In terms of the grid stability and security, the government believes that the combination of renewable energy sources, reserve and gas power plants, short- and long-term storage facilities, along with flexible loads and exchanges with other countries, will provide sufficient capacity to meet the challenges of the energy transition.

Auction Results

The first phase of the auctions was held in September 2020. A total of 11 hard coal plants, with a total capacity of almost 4,800 MW, were awarded a tender. Under the first phase of the auction, the majority of the capacity awarded was to the modern, efficient hard coal power plants. The tender was significantly oversubscribed, with bids ranging from EUR6,047 to EUR150,000/MW (against a cap of EUR165,000/MW). The volume-weighted average award bid is EUR66,259/MW.

The second phase of the auctions was held in April 2021. The capacity of the coal plants to be retired under the second round of auctions totaled 1,514 MW (against a target of 1,500 MW). The capacity came from three bids, the largest one of which came from Uniper Kraftwerke GmbH for 757 MW. Kraftwerk Mehrum GmbH and Central German Braunkohlengesellschaft mbH participated with 690 MW and 67 MW, respectively. The individual bids in the competitive round ranged from zero to EUR59,000/MW. The maximum amount that could be sought by the participants was EUR155,000/MW.

The bids were converted into EUR/ton CO_2, based on the average annual CO_2 emissions per MW observed for each plant over the previous three years. Given that modern plants are more efficient, they were operated more than older units. As a consequence, the bids of younger plants were divided by a higher total amount of CO_2, therefore moving them up in the bid. This led to the inefficient early closures of modern plants and the operation of older dirtier plants.

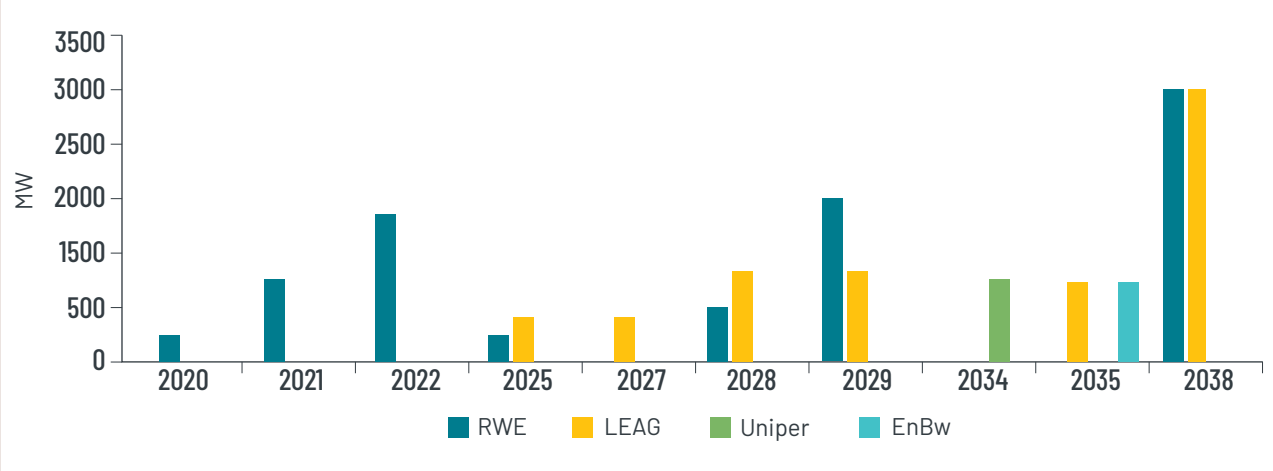


FIGURE 6. Retirement mechanism of Lignite

The decommissioning of lignite plants has been agreed with the major power-producing companies under contractual agreements specifying the retirement schedules. A specific end-date and compensation to be paid to the plant owners have been determined under the phaseout plan for lignite-based plants. The total cost of the lignite exit is anticipated to be around EUR55 billion. This cost consists of the compensation to operators for the shutdown of lignite plants and related opencast mining, along with adaptation payments for older workers in lignite mines and hard coal and lignite power plants, who will lose their jobs due to the coal exit and development of clean energy.

The Act has been criticized by the opposition parties in the Parliament and environmental groups due to reasons, such as delaying the necessary exit from coal energy and paying too much compensation to coal plant operators. Additionally, the exceptions made under the Act, with regard to the anthracite-fired Datteln 4 plant that started operating in the summer of 2020 and the designation of the Garzweiler II CPP as “essential for energy purposes,” have been criticized as being counterproductive to the objective of coal retirement.

According to recent press articles, it has been announced that Germany may decide to push its coal decommissioning plans back to even later and switch back to CPPs for its energy needs. This move comes in the context of the Russian invasion of Ukraine and the consequent move to reduce dependence on Russian fossil-based energy exports.

RETIREMENT OF AN SOE-OWNED COAL FLEET

In a country where a significant share of the CPPs is owned by SOEs, the government / SOE can aim to repurpose / retire their fleet earlier than the plants' natural course of retirement.

If adequate funds are available with the governments / SOEs themselves for the transition exercise, they should aim to undertake the activity through such funds. However, if there is limited availability of funds, the government may undertake the decommissioning and setting up of the new facility and raise the concessional debt / grant solely for the just transition exercise.

Grant / Concessional Debt / Concessional Finance

In the case where the repurposing / transition of the CPPs is being led at the SOE level, but neither the entity nor the government has the financial capability to provide the funds or the market standing to raise the debt, the SOE will have to look for an alternative mechanism to finance the repurposing activity and the just transition cost.

In many countries, the majority of the CPPs are owned and managed by SOEs and the governments have limited strength to finance the repurposing process. In such a scenario, the applicability of concessionary / blended finance can be explored.

Concessional financing for a project is typically provided by DFIs and requires that the financed assets adhere to their development mandates. A moral hazard problem may arise because a concessional loan may provide the buyer with a counterproductive incentive to engage in riskier behavior, thereby undermining its purpose to guard against risk. To dispel the moral hazard problem and reward projects that are financially viable, concessional financing is issued usually only after comprehensive due diligence and screening.

In the context of a coal-repurposing initiative, concessional finance can help immensely in reducing the cost of capital for a project. This helps equity investors to realize the returns early and support the phasing out of CPPs earlier than the end of their useful lives.

1 **Refinancing at the Corporate Level**

A concessional finance mechanism may be structured in the form of refinancing at the corporate level. As part of this strategy, the government / SOE can look to refinance their debt taken at the portfolio level for the CPPs. Such a strategy is similar to what is currently being implemented in South Africa with Eskom, and is also under consideration under the "Portfolio Approach" of the ETM initiative (being led by the Asian Development Bank [ADB]).

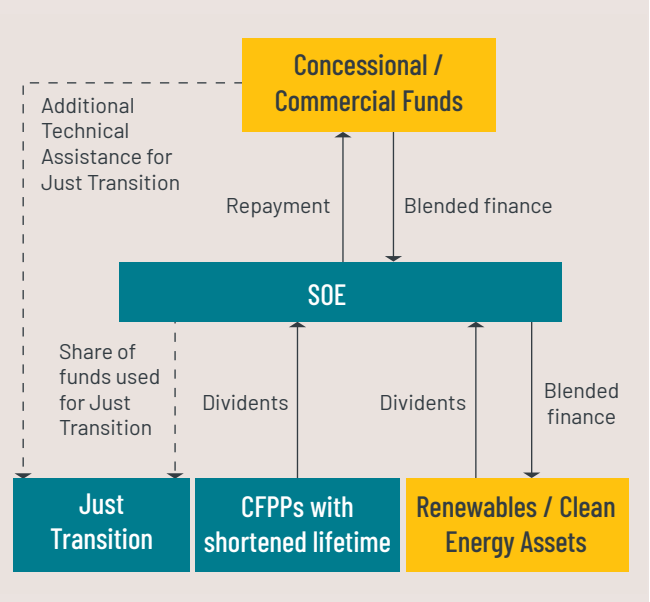


FIGURE 7. Performance-Linked Refinancing at the Corporate Level

The use of this mechanism involves providing a performance-linked facility to the SOE that will be used to invest in setting up a renewable / clean energy asset to replace the existing CPPs. The key success factor of this structure is the involvement of significant concessional financing (for example, grants and concessional debts). Concessional funds will reduce the cost of capital for the new asset and incentivize the SOE to facilitate the early retirement / repurposing of the CPPs. DFIs will play a key role, given their ability to provide concessional finance, thereby de-risking and crowding-in funds from commercial lenders.

A corporate facility will be provided, subject to the satisfactory completion of certain key performance indicators (KPIs) such as those described below:

- Adherence to a shutdown / repurposing schedule for each CPP that forms part of the SOE portfolio;
- Achievement of agreed level of CO_2 reduction; and
- Replacement of the CPP with predefined renewable capacity in order to ensure energy security / grid stability.

Other conditions related to the disbursements of the facility and penalties can be tailored to each situation in order to ensure that the SOE is keeping its side of the bargain. Further, additional concessional capital / technical assistance can be provided under such a structure to lead a just transition. Such concessional funds will be provided, subject to various safeguards including those set out below:

- Disbursement conditional on achieving certain KPIs; and
- Utilization of a given tranche within a stipulated time frame followed by a report delineating the usage of the funds.

2 **Securitization**

Another effective method to instill coal transition, in the absence of own funds, is securitization, which will allow an SOE to build in a fair return on investment into the electricity tariff that is payable by end-consumers. Utilizing these returns as a security, a low-cost bond (for example, the green bond) can be raised, the proceeds from which can be utilized to support the early retirement / replacement of coal plants and ensure that workers and communities receive funding. The mechanics of this structure are covered in detail in the box below.

BOX 3. Securitization in the United States

Principally, securitization is a financing mechanism that pools the assets expected to generate future revenues and sells them as a debt security. “Ratepayer-backed bond securitization” is the securitization of a stream of expected future ratepayer revenues.

Securitization supports the early retirement and replacement of CPPs in regulated utility markets (for example, US), where utilities are allowed to build in a fair return on investment into electricity tariffs. Securitization aims to create a win-win situation for the consumers, utilities, as well as the workers and communities. As a CPP retires, consumers pay lower electricity rates, utilities invest in and benefit from clean energy replacement, and workers and communities receive funding to support local economic development.

The securitization structure disallows the utilities from earning returns on uneconomic coal and refinances this customer obligation, thereby enabling the utility to retire the CPP and reinvest in cleaner and cheaper generation. It replaces the utility investors’ returns (on the debt and equity investment) by a much lower interest rate bond that is paid back over a long period of time. Securitization achieves this low interest rate due to the high certainty of the repayment of the bond, as utilities can include a surcharge on customers’ electricity bills to pay back the debt (that is, it securitizes customer surcharges).

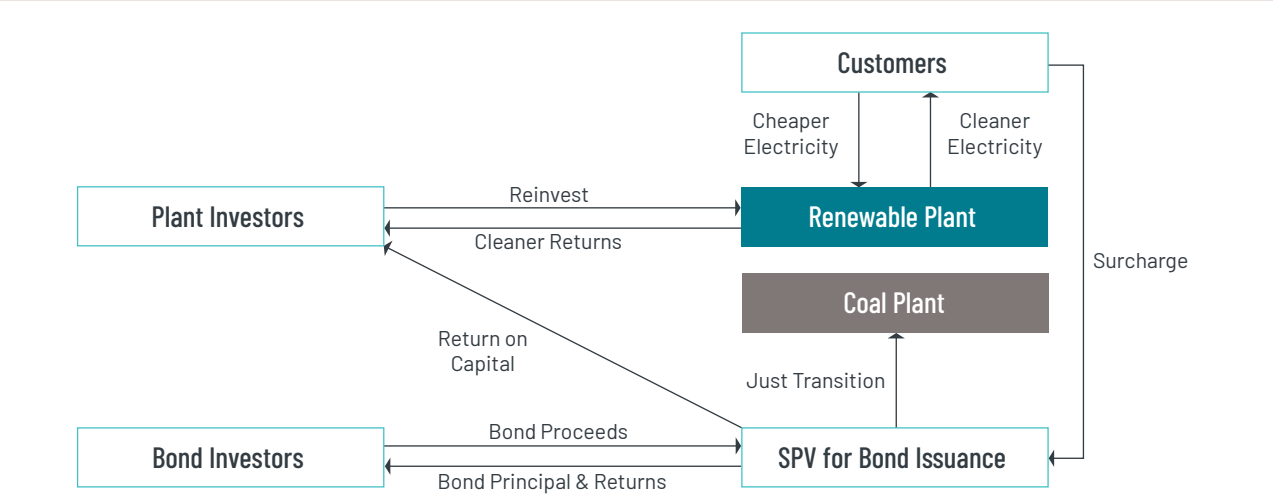


FIGURE 8. Securitization Structure

When structured effectively, securitization can reduce customers' electricity costs, compensate coal plant workers, and allow utilities to reinvest their capital in clean replacement generation, thereby generating immediate and long-term savings for the ratepayers. Such savings can be reinvested into transition assistance to help in the upliftment of the affected communities and provide for their prosperity in a decarbonized economy. These savings also allow the utilities to reinvest their capital in cheaper and cleaner energy assets.

However, a critical success factor of this mechanism is the commitment of a concerned state body / government to make this mechanism work. Hence, legislation must be passed by the relevant authorities to ensure that bonds receive a high rating, which maximizes savings for customers.

The securitization structure was utilized in the USD360 million ratepayer-backed bond issuance in New Mexico in April 2020. The electric utility in New Mexico, the Public Service of New Mexico (PNM), utilized the securitization mechanism to fund the early retirement of the coal-fired San Juan Generating Station. The proceeds of the issuance will be utilized as follows:

- USD283 million — Compensation to PNM for the write-down of the coal plant
- USD30 million — Plant decommissioning and coal mine reclamation
- USD40 million — A just transition fund

The retired plant capacity is envisaged to be replaced by renewable projects (650 MW of solar, 300 MW of storage, and 24 MW of demand response).

The securitization structure will help the utility by ensuring suitable payments for the decommissioning of the CPP. The ratepayers will also benefit from the transaction through reduced payments for electricity and pollution levels.

For the securitization structure to work, target countries should have robust capital markets, especially climate finance markets / bonds. As evidenced in Section 4, the three target countries have a successful track record of raising funds through bonds and particularly green / sustainable bonds in the past.

However, the utilities are often limited in their ability to pass the costs to customers, due to subsidized electricity tariffs, poor bill collection, or political sensitivities around raising electricity prices. Due to the above reasons, it may become difficult to implement securitization in the target geographies.

As a precondition, a detailed renewable energy scale-up will have to be prepared by the government in order to ensure energy security during this process of transition. The renewable energy scale-up can be executed on an EPC (engineering, procurement and construction) basis or a PPP through an auction process whose details have been discussed above.

BOX 4. Climate Finance Bonds

Climate bonds are fixed-income financial instruments linked to climate change solutions. Such bonds are issued in order to raise finance for climate change solutions. They may be GHG reduction projects ranging from clean energy to energy efficiency, or climate change adaptation projects. The various types of climate finance bonds include those described below:

Green bonds

Green bonds are fixed-income instruments, with proceeds earmarked exclusively for new and existing projects that have environmental benefits. The examples of project categories that are eligible for green bond issuance include renewable energy, energy efficiency, clean transportation, green buildings, wastewater management, and climate change adaptation.

Sustainability bonds

Sustainability bonds are debt instruments whose proceeds are used to finance or refinance a combination of green and social projects or activities. Such bonds may be secured or unsecured, and may be issued by companies, governments, and municipalities for assets and projects.

Sustainability-linked bonds

Sustainability-linked bonds are performance-based non-earmarked bonds, whose financial or structural characteristics (for example, coupon rate) are adjusted according to the achievement of predefined sustainability objectives. The performance of the issuer is evaluated against the KPIs or sustainability development goals. The evaluation of the progress in meeting such KPIs / sustainability development goals leads to a trigger in the bond characteristics (such as an increase in the coupon rate for not meeting the targets). Such bonds are instrumental in encouraging the issuers of such bonds to make sustainability commitments and adhere to them.

Climate Transition bonds

Climate transition bonds are new products that aim to finance the transition to a low-carbon economy. These bonds are often used in industries that typically do not qualify for green bonds, such as large carbon-emitting industries like oil and gas and aviation. Key elements differentiating a climate transition bond from a green or a sustainability bond are the issuer's climate transition strategy, business model environmental materiality, a climate transition strategy that is science-based, and implementation transparency. The proceeds can be used exclusively to finance new and / or existing eligible transition projects. These bonds require the issuer to commit to shifting to more sustainable business practices.

Other labels

Some issuers have utilized a variation of the green bonds for sustainable debt funding. For example, blue bonds are utilized for the financing of water-related sustainable projects, while sustainable development goal bonds are issued to explicitly highlight that the issuers' mission is inherently sustainable.

Key highlights of the climate finance bond market are presented below:

- The issuance of the green bonds totaled approximately USD40 billion from the emerging markets in 2020.
- A total of 43 emerging economies have issued green bonds since 2012.
- The cumulative issuance of emerging market green bonds stands at a total of USD226 billion through 2020.
- Fifty percent of the cumulative green bond issuance has been from financial institutions.
- The projected annual emerging market green bond issuance is set to reach USD100 billion by 2023.
- A total of seven emerging markets debuted with green bond offerings in 2020.

Issuances of green bonds around the world have been a significant contributor to the financing needs of coal-transition efforts. Around 50 percent of the nonfinancial corporate green bonds, issued in the emerging markets, are in the power and utilities sector. However, a key limitation to the emerging market of green bonds has been the lack of recognized credit ratings. Such ratings are important, in terms of assessing the creditworthiness of the bond issuances. Of the total number of green bond issues in 2020, 23 percent were rated "investment grade" and another 12 percent rated "sub-investment grade."

3.4.1.2. Private Sector-Led Initiative

If the repurposing of a CPP is assessed to be led by the private sector, the financing structure will differ based on the ownership of the plant, that is, SOE-owned vs. private entity-owned.

SOE-OWNED PLANT

In order to facilitate the PPP structure for an SOE-owned plant, the first step will be to spin off the asset from the SOE's balance sheet and transfer these assets subsequently to the private sector, using the PPP model (either via an auction process or through direct negotiation).

The figure below displays the structure of the proposed mechanism.

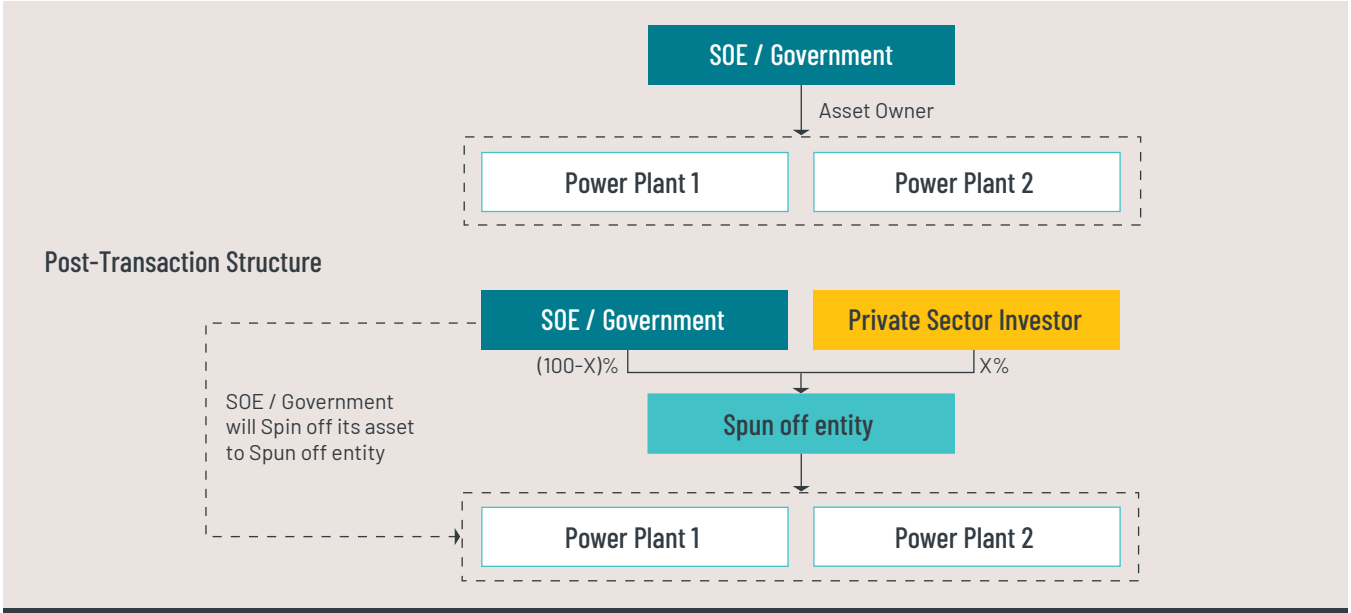


FIGURE 9. Structure of a SOE-Owned Power Plant Spinoff

Structuring a spin-off model involves the following considerations:

- **Linkage between the Upfront Compensation to the SOE, the Tariff Payable to the Private Entity, and Duration of the Concession Term:** The envisaged structure needs to achieve a balance amongst the three key financial aspects of the transaction:
    - **Compensation amounts payable by the private sector entity to the SOE:** This will be utilized to repay any corporate loan / take out equity invested by the SOE in the project.
    - **Annual tariff payable by the SOE to the private sector entity:** The private sector entity will size the tariff based on the O&M costs, the financing cost for the debt raised for the project, and the returns on the equity invested in the project.
    - **Duration of the Concession Term:** This involves the determination of the number of years of the concession term provided to the private sector entity.

In the event that an auction process is followed, any two of the aforementioned elements will be fixed, and the selection of the most optimized option will be based on the annual tariff quoted by the private entity.

- **Contractual Structuring:** Various contracts (for example, PPA, O&M, and coal supply) and permits will need to be created and/or renovated to the spun-off entity, with the required time set for reaching an agreement with different stakeholders.
- **Implications for the SOE's Balance Sheet:** The valuation at which the asset is spun off will be critical. As highlighted above, the valuation will impact the tariff charged by the private sector entity and so the SOE will be incentivized to keep the transfer value low. However, the value cannot be so low that it leads to significant losses, as the SOE may be governed by financial covenants under its existing financing documents.

PRIVATE SECTOR ENTITY-OWNED PLANT

For a privately owned plant, negotiations will need to be held with existing owners in order to align/incentivize them to repurpose the CPP. The key considerations for structuring these negotiations are presented below:

- **Repurposing Solution:** Given that the existing owner will mostly be an IPP, the repurposing solution selected for the CPP should take into account the domain expertise of the owner (for example, the selection of a natural gas plant for the repurposing solution rather than commercial use / a renewable plant, if the existing owner is a conventional power player).
- **Financial Sense:** Further, the solution proposed should make financial sense to them and ensure their minimum return requirement.
- **Transparency:** As part of the transaction, the existing owner will identify and quote a tariff for the repurposed plant, while the government runs a bilateral auction process to identify the least-cost tariff for the plant. Then, based on this tariff, the government needs to provide an opportunity to the existing owner to match it. This will ensure transparency in the whole process and the least possible cost for the service.

The following two case studies present insights into the involvement of the private sector in the decarbonization efforts in Chile and Southeast Asia.

BOX 5. Decarbonization-related Incentives: Chile

The Chilean economy relies significantly on coal-based electricity generation for its power needs. Chile produces 22 percent of its electricity from coal plants, with renewables and hydro-based energy constituting 23 percent and 26 percent, respectively. Gas-based generation accounts for 14 percent of the electricity mix, while the remaining 3 percent comes from oil-based plants.

Conscious of the reliance of Chile's power system on coal, the Ministry of Energy of Chile established the Coal Commission — a technical and interdisciplinary commission to evaluate the social, economic, and environmental effects of the phaseout and / or the conversion of CPPs. The Coal Commission was set up with the aim of formalizing the process for decarbonizing the energy system through the evaluation of the effects of the coal phaseout and the associated conversion or replacement of coal facilities.

The Coal Commission drafted a schedule for the phaseout of CPPs, while considering the social, environmental, and economic factors of the Chilean economy. The schedule called for the closure of eight plants within five years, representing 19 percent of the country's installed coal power capacity. Under the schedule, the closure of CPPs is to take place in two phases. The first phase originally foresees the exit of 8 units by 2024 (1 GW of installed capacity). The second phase involves the closure of the remaining CPPs in the country by 2040 at the latest.

In December 2019, in the context of the 2019 United Nations Climate Change Conference (COP25) Chile/ Madrid, a further agreement was reached between the government and the major power generating companies for the early closure of two CPPs. Subsequently, in May 2020, following pressure from environmental groups, ENEL (a major player in the power generation sector in Chile) announced the early closure of these CPPs — Bocamina I for December 2020 and Bocamina II for May 2022.

In recent times, power generating companies have volunteered and entered into agreements with the Chilean government to accelerate the coal phaseout process.

TABLE 5. Coal Phaseout Schedule in Chile

PHASEOUT SCHEDULE			
Coal-Fired Power Plant	***Company***	***Power Capacity***	***Phaseout***
Unit 12	Engie	85	Closed
Unit 13	Engie	86	Closed
Tarapacá	Enel	158	Closed
Unit 1 Ventanas	Aes Gener	114	Closed
Bocamina Unit 1	Enel	128	Closed
Unit 14	Engie	136	2022
Unit 15	Engie	132	2022
Unit 2 Ventanas	Aes Gener	204	2022
CTM 1&2	Engie	334	2024
Bocamina Unit 2	Enel	350	2022
PHASEOUT SCHEDULE			
Coal-Fired Power Plant	***Company***	***Power Capacity***	***Phaseout***
CTA	Engie	177	2025
CTH	Engie	178	2025
IEM1	Engie	377	2025

TABLE 6. Initiatives by Major Developers in Chile

ENGIE	ENEL	AES GENER
1. Engie announced that it will retire its entire coal portfolio in Chile by 2025, as it moves toward its 2050 carbon-neutrality target. 2. The group has a portfolio of coal-fired generation facilities amounting to almost 1.5 GW. 3. It has committed to closing six units (0.8 GW) of coal capacity, including the two facilities that are already closed in 2019, and converting the three newest units (0.7 GW) to gas or biomass by 2025. 4. In addition to the above, the group will develop a 2 GW renewable energy portfolio (including the newly announced 1 GW in addition to the 1 GW committed at the end of 2019).	5. Enel also closed its 128 MW Bocamina 1 and obtained authorization from the Chilean National Energy Commission (CNE) to close the 350 MW Bocamina 2 plant in 2022. 6. Enel is also planning to complete approximately 2 GW of renewable capacity by 2022.	7. AES Gener accelerated the decommissioning of two CPPs in Chile — the Ventanas 1 and 2 units with a total capacity of 322 MW. 8. The decision accelerates the retirement of Ventanas 1 and 2 by almost two years (in 2020 and 2022, respectively). 9. The company will retire four CPPs — a total of 1,097 MW — in Chile by January 2025, if supported by grid requirements. 10. AES Chile is also developing a pipeline of 2,039 MW of new solar, hydropower, wind, and energy storage.

PILOT PROGRAM TO MONETIZE THE COST OF DECARBONIZATION — ENGIE CHILE

The following section highlights the pilot program undertaken by Engie and IDB Invest to help achieve the aforementioned objective of early coal plant retirement. The program has been implemented to pilot a financing structure to support the decarbonization initiatives to provide a monetization mechanism for the actual CO_2 emissions reductions from fossil power plants. The pilot targets projects that will be voluntarily retired on an accelerated basis relative to their remaining useful life.

Under the pilot program, a financial package — consisting of a USD74-million senior loan from the Inter-American Development Bank (IDB) Invest, USD15 million of blended financing from the Clean Technology Fund (CTF), and USD36 million from the Chinese Fund for Co-Financing in Latin America and the Caribbean — will be used to develop the Clean Technology Projects. The pilot instrument monetizes GHG reductions by establishing a cost for abated emissions from the early retirement of CPPs and hence proving this benefit to Engie by lowering the interest rate of CTF's tranche.

Based on the pilot, Engie will develop the Calama Wind Power Plant with a capacity of 151 MW. The building of the Clean Technology Project (Calama Wind Plant) will be accompanied by the early retirement of the U14 (136 MW), U15 (132 MW), CTM1 (162 MW), and CTM2 (172 MW) CPPs.

The financing structure will establish a minimum price for the offset GHG emissions by lowering the financing cost in CTF's loan tranche. The cost of the displaced GHG emissions is to be calculated according to a tailor-made methodology for the project. The instrument is expected to serve as a model for accelerating energy decarbonization. In the upcoming years, as the regulated carbon market develops during the life of the loan, both CTF and ENGIE will share any increase in the minimum carbon price.

BOX 6. Energy Transition Mechanism (Synthetic Model)

The mechanism involves ETM to invest in coal fired power plants through senior / junior debt and / or other mezzanine capital at concessional rates. The concessional investment would lead to reduction in cost of capital for the coal fired power plants, thereby allowing early retirement / repurposing of these coal fired power plants.

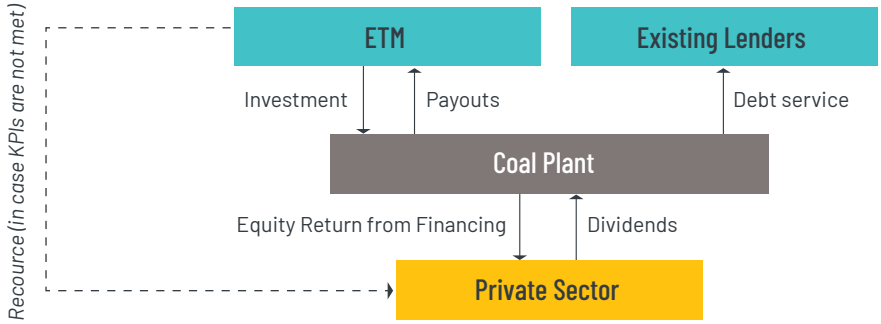


FIGURE 10. ETM Structure with Existing Lenders

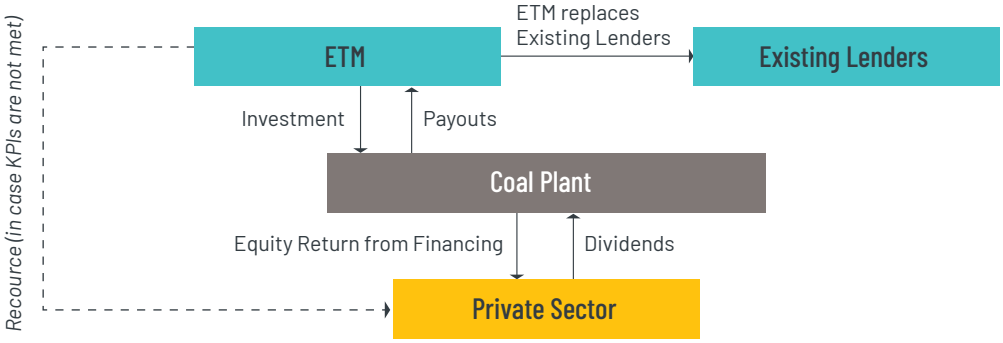


FIGURE 11. ETM Structure with the Takeout of Existing Lenders

The investment from ETM shall be available to Sponsors to be taken out as return. In an alternate scenario, the ETM investment can also be utilized to repay debt. The synthetic model would involve no change in the operational responsibility of the project and the same will be managed by the original sponsors.

KPIs could vary depending on the scope of the investment but could include items such as:

- Plant shutdown date as agreed at the time of the investment
- Utilization of funds by the sponsors for clean energy solutions

Penalties for not meeting KPIs could be discussed but may include:

- Default – inappropriate use of funds or failure to meet KPIs could provide ETM the right to immediate repayment from the Sponsors

3.4.2. Long Term

Over the long term, alternative financing pools may be available for coal-repurposing initiatives, such as (i) carbon markets and (ii) capital markets.

- **Carbon Markets**: Repurposed plant operators may consider carbon credit markets for monetizing the project's emissions reductions. Carbon credits are tradable permits or certificates that provide the holder of such credit the right to emit one ton of CO_2 / CO_2e GHGs.

  The carbon markets are classified under two main categories: compliance markets and voluntary markets. The compliance markets are typically set up by governments to target certain industries and sources that emit high levels of GHGs. This is accompanied by a typical cap placed on the GHG emission levels that the industry under consideration is obliged to comply with. The large emitters need to purchase carbon credits to offset their higher emissions or pay a fine.

  Voluntary markets are set up by private entities that develop and operate their marketplace to enable carbon offset transactions among participating entities. They are used by private companies to buy carbon credits on a voluntary basis, often to improve their public standing and to fulfill their CSR.

  As highlighted in Section 4, the carbon markets are at a very early stage of development in the target geographies and they will require a significant impetus from DFIs, target geography governments, and other developed nations to develop this mechanism.

- **Capital Markets:** As highlighted in Section 4, capital markets in the target countries are at a nascent stage, with issuances of bonds largely limited to government entities. Over the long term, capital markets are expected to mature and serve as an important source of financing coal-repurposing projects (similar to bond markets for renewable projects in developed economies). Developed capital markets will allow access to institutional investors and help in lowering the cost of commercial capital available for such repurposing projects.

BOX 7. Sustainability-linked bond issuance for Tauron Polska Energia S.A.

Background

The issue of the sustainability-linked bonds, executed by Santander Bank Polska, was the first sustainability-linked bond issuance in Poland. The issue was sized at PLN1 billion (USD250 million), with the European Bank for Reconstruction and Development (EBRD) subscribing for 24 percent (PLN240 million) of the total issue size.

The funds raised through the transaction will be utilized to support the transformation of the Tauron group by financing the development of renewable energy projects, along with the distribution and activities related to renewables or the transition toward zero emissions. A key feature of the bonds issue is the limitation of the use of the proceeds for financing new and existing coal units.

Working mechanism

The 5-year bonds will be guided by the sustainability targets, as identified by the issuer and the lead arranger:

- CO_2 emissions reduction: 2 percent per year on average; and
- Increase of renewable generation capacity: 8 percent per year on average.

In the event that the above targets are not met by the issuer, the interest rate will be increased in accordance with the terms of the issuance.

Benefits

- Twin financial incentives — reduce emissions and increase renewables capacity;
- Flexible mechanism for achieving sustainability targets; and
- Diversified investor pool to help spread the risk and lower the cost of financing.

3.5. Repurposing Upcoming Coal Plants

Section 3.4 focused on financing the repurposing of an existing operational plant. However, it is worth noting that in the three target geographies, there still exists a pipeline of CPPs that are either under consideration or construction with the public / private sector.

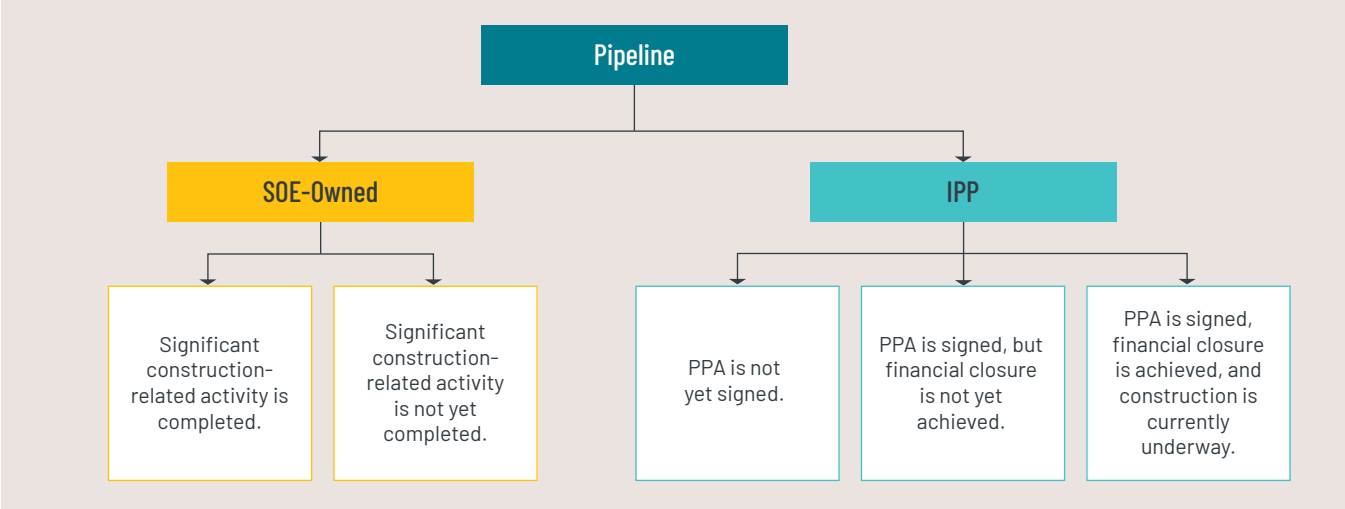


FIGURE 12. Classification of Upcoming Coal Plants

Given that the objective of the repurposing of existing coal plants is to reduce carbon emissions and help meet the Paris Agreement climate targets, installing new coal capacity might reduce the net benefit accrued through such efforts.

Moreover, investors mobilizing financing for coal-repurposing projects will consider the pipeline of coal-fired plants under construction and in the planning phase in the target geographies. They will expect the country's approach toward such new coal assets to be in line with their objective of repurposing existing assets, that is, there should be restrictions imposed on the establishment of CPPs moving forward, in order to reduce emissions. Such restrictions will only be possible by laying down relevant laws / regulations to that effect, prior to kickstarting repurposing activities, in order to display a commitment to emissions reductions and increase the investor base for financing purposes.

In light of this, countries may also wish to explore the retirement / replacement of CPPs currently in the pipeline. The section below explores the potential and key considerations for the retirement / repurposing of such plants based on their ownership and stages of development.

SOE-OWNED CPP	
Significant construction of the plant has been completed.	• They are likely to require longer operational time / higher financial support (if they are to be retired / repurposed early), as the SOE will have incurred significant capex up until now. Since the plants are not operational, no portion of such capex incurred will have been recovered. • Termination costs, related to the termination of any contract (such as an EPC contract and a supply contract), will have to be evaluated and may pose an additional cost.
Significant construction of the plant has yet to be completed.	• Given that the plant is at an early stage of construction, significant capex may not have been invested yet, and hence, the same can potentially be retired / repurposed at a low cost. • Termination costs, related to the termination of any contract (such as an EPC contract and a supply contract), will have to be evaluated and may pose an additional cost.
PRIVATE PARTNER-OWNED CPP	
PPA is not signed.	• The plants can be easily retired / repurposed without any significant cost, as the PPA is not in place (no obligation on either the off-taker or the private partner to construct the plant contractually), and as such, no investment has been made by either party. • Due to the absence of investment and executed contracts, there will be no just transition-related challenges.
PPA is signed, but financial closure has not been achieved yet.	• In most cases, the provisions of the PPA come into force once financial closure is achieved by the project. Additionally, the PPA does not generally include any provision for the termination of PPA by the off-taker prior to financial closure. • The contract signed for a specific plant will need to be analyzed to identify any potential costs that may be applicable. • Further, the possibility of alternative contracts with the private partner can be explored in good faith (such as a new contract for a renewable power plant) to compensate for losses in their investment pipeline. • Due to the absence of investments, there will be no just transition-related challenges.
Financial closure is achieved and construction is currently underway.	• These plants are likely to require a longer operational time / higher financial support (if they are to be retired / repurposed early), as the private partner would have incurred significant capex up until now. Since the plants are not operational, no portion of such capex incurred will have been recovered. Hence, significant compensation may be required to incentivize the private partner to retire / repurpose the plant. • Further, generally as per the PPA, such early retirement / repurposing may constitute an off-taker event of default, and so termination payments will be applicable (to cover outstanding senior debt, along with the equity contributed and the return on such equity). • The contract signed for a specific plant will need to be analyzed to identify applicable termination costs.

However, it is worth noting that new capacities being developed across target geographies feature new technologies and are expected to have higher efficiency, which will result in realizing a lower value of CO_2 abatement per USD of capital spent for the repurposing initiative.

3.6. Role of DFIs in Coal Repurposing

Due to a lack of established precedents for such coal-repurposing transactions in the target geographies, the participation of DFIs is essential for building the requisite momentum for coal transitions and crowding-in private sector participation.

Highlighted below are the key roles that can be played by DFIs for the development of large-scale CPP-repurposing initiatives in the target geographies:

- **Demonstration effect:** While CPP-repurposing efforts have gained significant momentum in recent times globally, there are limited financial mechanisms that have been successfully implemented across geographies. As such, DFIs are expected to play a critical role in mobilizing investments from the private sector by leading the development of initial transactions, thereby establishing a risk allocation and transaction framework that can serve as a precedent for similar transactions in future. DFIs' ability to understand and mitigate key risks will be critical in the structuring of initial coal-repurposing transactions in the target countries.
- **Support in establishing the financial viability of a transition model:** Private sector participation in the repurposing process is contingent on the financial viability of the underlying transaction. In the event that the proposed financial mechanism is not financially self-sustainable, the use of concessional grants / debts may be considered to enhance the viability of a project. Additionally, DFIs can also provide credit enhancement products, such as first-loss guarantees and partial risk guarantees, to enhance the risk profile of the proposed mechanism and crowd-in private sector investment. DFIs play an important role in crowding-in low-cost debts from donors, philanthropies, etc.
- **Capacity building:** As coal-repurposing initiatives are in their nascent stages, government stakeholders of target countries may not possess the necessary capacity to implement such transitions. On the other hand, DFIs have historically supported the implementation of multiple first-of-its-kind projects and helped governments develop the technical capability to undertake such projects independently. Furthermore, DFIs, being at the forefront of coal repurposing in emerging economies in Asia and Africa, are very well-placed to provide technical assistance to government stakeholders.
- **Support in establishing relevant policies:** Coal is strategically important in the target countries. CPP repurposing is expected to have long-term implications, so it is important to establish a long-term policy and regulatory framework to systematically address all the facets of the transition (not just financial but also technical, social, and legal). This may involve support in designing roadmaps for a coal transition and establishing long-term commitments for coal repurposing (such as developing coal phaseout commitments and imposing carbon taxes); fostering a conducive investment climate (including establishing alternative financing pools such as carbon credit markets); and establishing a relevant governance and reporting framework (such as an environmental, social, and governance [ESG] framework, along with climate risk disclosures and reporting requirements), amongst others. In this context, DFIs can support government stakeholders in developing policy frameworks to enable a smooth and sustainable transition away from coal.

3.7. Conclusion

As highlighted in Section 3.1, the ultimate selection of a suitable financial mechanism for a coal-repurposing solution should be based on the financing climate in the target geography and the technical solution proposed for repurposing.

Based on the overview of the financing landscape in Section 4, the tables below aim to summarize the applicability of various existing finance mechanisms under consideration in the target geographies. The ultimate selection will depend on multiple other

asset-specific factors covered under Section 3.3, such as the technical solution proposed, financial viability, criticality of the asset, and VFM, amongst others.

SOUTH AFRICA

	STRATEGY	SUITABILITY	REMARK
Government-Led	Coal Auction	Low 🟠	Large wage expense, below-forecast tax revenues, along with rising fiscal deficit primarily driven by COVID-19, have constrained the ability of the government to invest in any coal-repurposing activity.
	Retirement of the SOE coal fleet	Low 🟠	Eskom faces challenges on both operational and financial fronts and relies on continuous government support in the form of cash infusions and debt guarantees. Hence, Eskom will have limited capacity to lead a repurposing initiative, using internal funds / sovereign debt.
	Performance-linked Refinancing at the Corporate Level	High 🟢	Eskom has a near monopoly in the country's generation (90 percent of the electricity requirement of the country) and a significant chunk of coal assets in its portfolio (43.3 GW out of a total installed capacity of 51.1 GW). As such, Eskom is an ideal candidate to lead such an initiative through potential refinancing (given the lack of internal funds and the ability to raise debt). As covered in Section 3, such refinancing is currently underway in South Africa with Eskom.
	Securitization	Low 🟠	Utilities in South Africa may have a limited ability to pass the costs to customers due to subsidized electricity tariffs and poor bill collection. Hence, securitization will not be a feasible option in the current scenario.
Private Sector-Led	Carbon pricing model	High 🟢	While this solution could be feasible, its applicability will depend on the availability of a financial institution that will be able to provide a lower debt rate corresponding to carbon credits (such as IDB Invest in the case of Chile's decarbonization covered in Section 3.4.1.2).
	Synthetic Model	High 🟢	Given the existence of an active financial market, this solution will be feasible.

INDIA

	STRATEGY	SUITABILITY	REMARK
Government-Led	Coal Auction	Low 🔴	As highlighted in Section 4.2.3, the Government of India has limited fiscal room to fund a large-scale coal-repurposing initiative, as public finances are already stretched thin.
	Retirement of the SOE coal fleet	High 🟢	Given the profitable operations and the strong balance sheet, along with the ability to raise capital at favorable rates among utilities in the country, NTPC can evaluate the repurposing of its own coal plants.
	Performance-linked Refinancing at the Corporate Level	High 🟢	NTPC owns a significant portfolio of CPPs (almost one-fourth of the country's coal-based capacity); thus, it can lead the repurposing initiative in India through corporate-level refinancing.
	Securitization	Low 🔴	Given that utilities in India have limited ability to pass the costs to customers, due to subsidized electricity tariffs and poor bill collection, securitization will not be a feasible option in the current scenario.
Private Sector-Led	Carbon pricing model	High 🟢	While this solution could be feasible, its applicability will depend on the availability of a financial institution that is able to provide a lower debt rate corresponding to carbon credits (such as IDB Invest in the case of Chile's decarbonization covered in Section 3.4.1.2).
	Synthetic Model	High 🟢	Given the existence of an active financial market in the region, the proposed solution will be feasible.

INDONESIA

	STRATEGY	SUITABILITY	REMARK
Government-Led	Coal Auction	Low 🔴	As highlighted in Section 4.3.3, the Government of Indonesia's capacity to provide capital for repurposing is limited due to the country's low-tax regime and the ceiling on the fiscal deficit that the country can run.
	Retirement of the SOE coal fleet	Low 🔴	PLN relies heavily on the subsidy and compensation income from the government to cover the non-cost reflective tariff. This situation, coupled with its high debt level (that constrains its ability to mobilize capital), leaves no room for the entity to repurpose its coal fleet.
	Performance-linked Refinancing at the Corporate Level	High 🟢	PLN owns about three-fourths (that is 45.8 GW) of the country's total installed capacity, coupled with significant exposure to coal assets (64 percent of the total electricity produced by PLN in 2020). Given the large portfolio of coal plants and the balance sheet constraints, a coal-repurposing initiative can only be led by the entity through corporate-level refinancing.
	Securitization	Low 🔴	Given that utilities in Indonesia will have limited ability to pass the costs to customers, due to subsidized electricity tariffs, securitization will not be a feasible option in the current scenario.
Private Sector-Led	Carbon pricing model	High 🟢	While this solution could be feasible, its applicability will depend on the availability of a financial institution that is able to provide a lower debt rate corresponding to the carbon credits (such as IDB Invest in the case of Chile's decarbonization covered in Section 3.4.1.2).
	Synthetic Model	High 🟢	Given the existence of an active financial market, this solution will be feasible.

4. REGULATORY AND FINANCING LANDSCAPE IN KEY COUNTRIES

This section aims to provide an overview of the regulatory and financing landscape in key geographies of India, South Africa and Indonesia. It assesses the transition readiness of each country and comments on the gaps identified. The ability of the following financing pools to fund the investment required for a coal-repurposing initiative are reviewed and covered as part of the overview:

- Public finance sources (including government and various SOEs active in coal-based power generation);
- Financial institutions;
- Capital markets (including equity and debt capital markets, along with green bond markets); and
- Carbon credit markets.

4.1. South Africa

South Africa is the largest producer of electricity in Africa. Nominal installed capacity is 44 GW, but due to planned outages (loadshedding) only around half is supplied. The current supply shortfall is around 6 GW. The country is a participant of the Southern African Power Pool (SAPP) — one of the five regional power pools in Africa; the other four are the Eastern Africa Power Pool, the Central African Power Pool, the Western African Power Pool, and the North African Power Pool. South Africa, as a SAPP member, imports and exports power from its neighboring countries and traditionally acted as the "provider of last resort" when countries in the region came short of supply.

4.1.1. Readiness Analysis — Regulatory and Policy Environment

4.1.1.1. Overview of the Regulatory Environment

In South Africa, the electricity sector is principally governed by the provisions of the 2004 National Energy Regulator Act (NERA), the 2006 Electricity Regulation Act (ERA), and the 2008 National Energy Act (NEA). The sector comes under the purview of the Department of Mineral Resources and Energy (DMRE) that is headed by the Minister for Mineral Resources and Energy (Minister). The Government's role as the owner of Eskom is exercised through the Department of Public Enterprises, there are plans to move this responsibility to DMRE as well.

The National Energy Regulator of South Africa (NERSA) was established under the provisions of NERA and derives its key powers from ERA. In addition to the electricity sector, NERSA also regulates the gas and petroleum sectors in South Africa. The members of NERSA are appointed by the Minister. The electricity division of NERSA comprises four departments that are aligned to its primary functions as follows:

- Licensing and Compliance Department — Participants in generation, transmission, distribution, and trading are required to be licensed or registered with NERSA, unless exempted as per Schedule II of ERA.
- Pricing and Tariffs — Tariffs charged by Eskom to retail customers and municipal suppliers are submitted to NERSA and approved by it. The regulatory authority also issues a guideline for municipal tariffs; deviations from them need to be approved. NERSA also has the power to regulate prices at which power is sourced by Eskom and municipalities from IPPs.
- Electricity Infrastructure Planning — NERSA contributes to the development of the Integrated Resource Plan (IRP) and the promotion of renewable energy and energy efficiency.
- Regulatory Reform — NERSA is involved in the research and development of the electricity distribution industry.

Any administrative action or decision taken in the capacity of a tribunal by NERSA can be reviewed by the High Court.

Prepared by DMRE, the IRP is a guiding document for the electricity sector in South Africa that was first promulgated in 2011. It details the generation technology needed to meet the planned demand for 2010–2030. It was envisaged that the IRP would be a "living document" that would be updated at least once every two years. However, the next iteration was published only in 2019, with references to the frequency of updates dropped from this iteration. In addition to the demand forecast of the Council of Scientific and Industrial Research (CSIR), IRP 2019 was also based on inputs on the performance and costs

of technologies, the costing of the network integration of renewables, and the socioeconomic impacts of the energy transition.

Eskom, the state-owned electricity utility, plays a major role in the generation, transmission, and distribution of electricity in the country. In addition to generating 85 percent of the domestic production, Eskom is also responsible for the international trade of power and government-mandated power purchases from private generators. The utility also owns more than 30,000 km of transmission lines, along with multiple substations and related assets. As the sole transmission licensee and system operator in South Africa, Eskom fulfills multiple duties, such as providing a transmission network service and ensuring the short-term reliability of the country's power and compliance with the Grid Code. Although municipalities are responsible for the distribution of electricity within their boundaries, Eskom acts as the sole or joint final distributor in over 90 municipalities. Wherever Eskom is not the sole final distributor, the utility supplies power to the licensed distributor at a bulk supply tariff. Thus, Eskom supplies power directly to 40 percent of the country's end-users.

Eskom is in the midst of a major restructuring process that will see its three functions — generation, transmission, and distribution — unbundled into separate legal and functional entities. This will have significant implications on the electricity sector of the country, especially by inducing more competition in generation. Further, the unbundling of the state-owned utility will result in greater transparency on the financial and legal agreements among the three functions.

The addition of new capacity to be contracted by an organ of the state (such as Eskom or any municipality) is governed by the Electricity Regulations on New Generation Capacity. According to these Regulations, the ministerial determinations for new capacity are issued by the Minister in accordance with the IRP and concurred with by NERSA. Further, the determination also specifies whether the new capacity will be established by Eskom, any other government body, or an IPP. Through an amendment to the regulations in October 2020, energy storage was brought within the ambit of the rules, and municipalities were permitted to apply to the Minister to procure their own capacity in accordance with the IRP.

If the determination allocates new capacity to IPPs, the procurement is done via the IPP Office, originally established with a high degree of autonomy but now a sub-office of the DMRE. The IPP Office periodically undertakes IPP procurement programmes (IPPPPs) to complete these procurements in accordance with the determinations. So far, six rounds of large renewable IPPPP (REIPPP), two small renewable IPPPP (Small IPPPP), along with one round each of coal and co-generation have been completed. However, the coal IPP projects did not materialize for reasons that will be discussed in the next section of this report. Thus, Eskom does not purchase power from any CPPs operated by IPPs. In addition, as discussed above, the technology-agnostic REIPPP was also concluded to meet the shortfall in short-term demand.

Nine GW in total have been procured from renewable IPPs through bid windows. 91 of 92 projects, contracted in the first five REIPPPP bid windows, have achieved financial closure. The competitive bidding process, followed in the REIPPPP, has led to significant price reductions over time (Figure 13). The REIPPPP has resulted in socioeconomic benefits, such as foreign investment, job growth, and economic development for disadvantaged communities. International finance from over 23 countries accounts for 20 percent of the total financing for projects under the program. Further, over 60,000 job years had been created by projects under the REIPPPP as of June 2021, of which more than 20 percent are in the operations domain.

Eskom also allows consumers to generate their own energy, either for their own use or for supply to the grid. These "prosumers," that is, consumers-cum-producers, are also allowed to bank energy with the grid, in which case, they must be net consumers over the period of one year. Further, IPPs can also wheel energy on the Eskom grid to one or more off-takers, provided that the generator and the off-takers are connected at medium voltage or above. The PPA is signed between the IPP and the off-takers, and the former will then notify Eskom about the off-takers

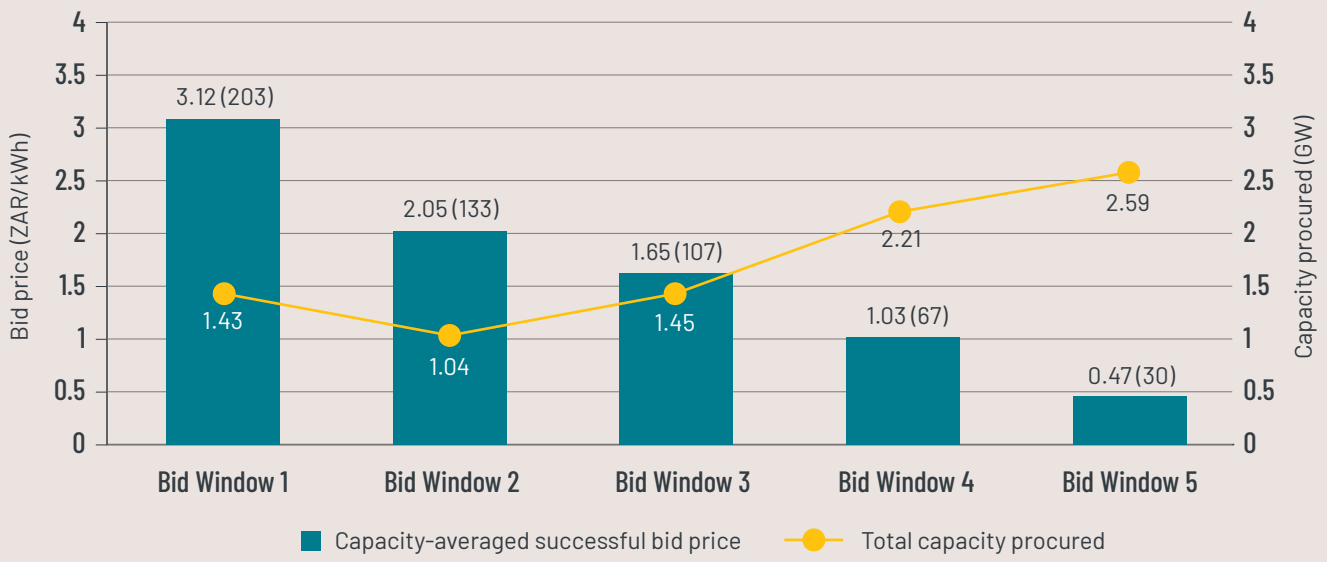


FIGURE 13. Capacity-Averaged Successful Bid Prices

Note: Prices in 2021 ZAR. The figure excludes Bid Window 3.5, as the capacity procured was only 200 MW. The values in parentheses indicate an equivalent in USD/MWh; exchange rate used: ZAR1 = USD0.065.

Source: IPPPP Overview, REIPPPP Bid Window 5 Press Release.

that the IPP has agreed to supply to. Further, if the off-takers are located within a municipal network, the agreement of the municipality will be required.

To incentivize the greater participation of IPPs in the generation ecosystem, the government amended Schedule II of the ERA in August 2021 to remove the licensing requirement for generation projects with a capacity not more than 100 MW. It has been communicated by the GoRSA that this upper limit will be scrapped entirely. Thus, it is quite easy for a private customer to contract capacity as compared with a public entity. The projects can be captive or wheeled through Eskom's network. These types of projects, predominantly solar PV, have taken up rapidly with an estimate provided by the Mining Council indicating that for the mining sector alone the pipeline exceeds 5 GW. The success of these types of projects are impacting the REIPPP as the latest round could only select a fraction of the planned capacity as the business-to-business projects have been allocated the spare transmission capacity in the most promising parts of the country (Eskom allocates of a first-come basis). Further, demonstration projects, irrespective of the use of energy storage or their connections to the grid, need not have a generation license, if they do not operate for more than 36 months.

A final player in the sector is the Department of Forestry, Fisheries and the Environment (DFFE). It was created in 2019 through the merger of the Department of Environmental Affairs with the fisheries and forestry branches of the Department of Agriculture, Forestry, and Fisheries. As air quality and climate change are covered under the mandate of DFFE, their regulations affect the electricity generation ecosystem, and consequently, the whole sector. DFFE have extended temporary exemptions several times to South Africa's laws covering air pollution. Compliance with laws would entail closure of almost coal stations. The cost of compliance at newly built Medupi is estimated to be 2.5 Billion USD.

Figure 14 summarizes the market participants and authorities in the electricity sector.

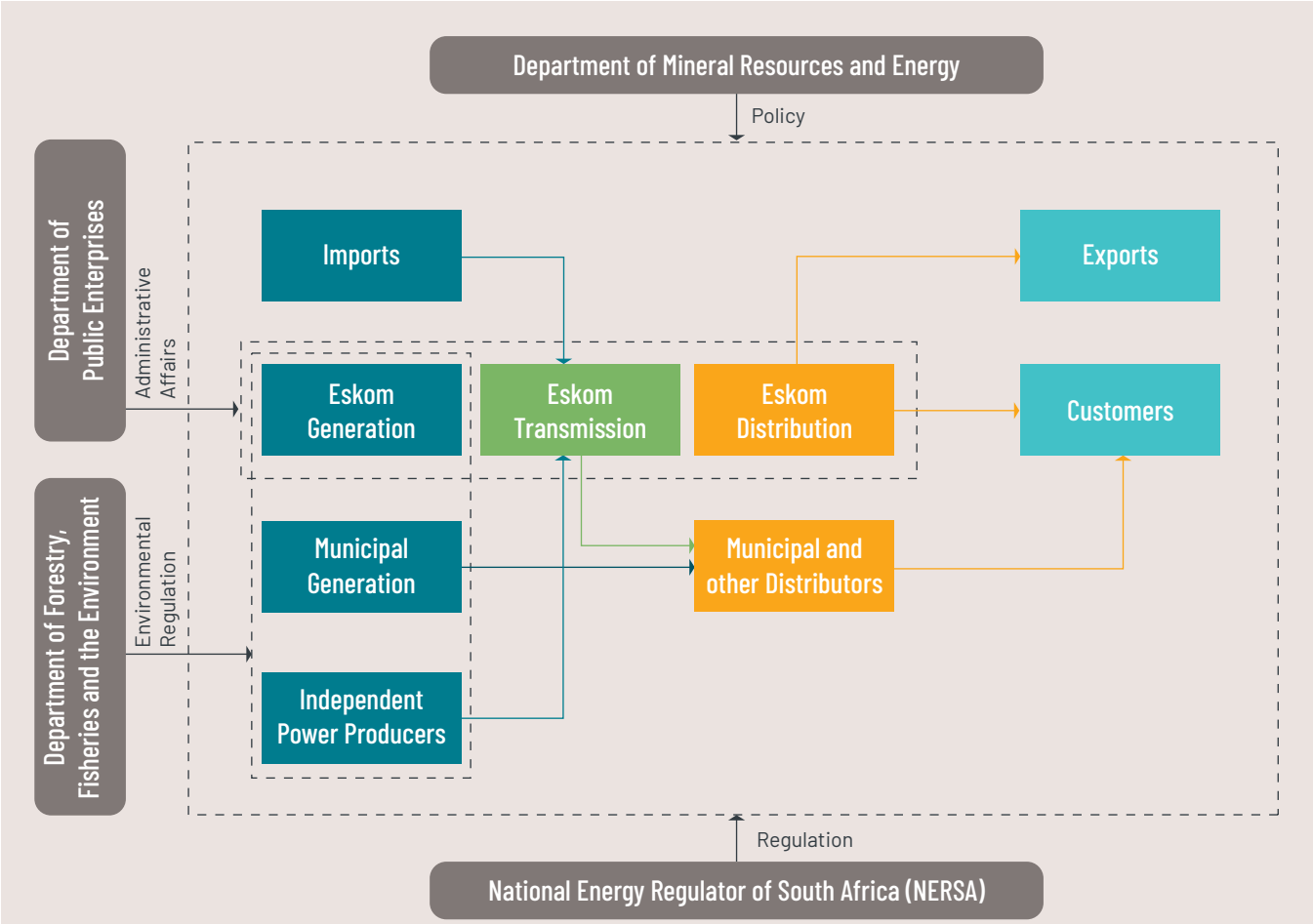


FIGURE 14. Overview of the Electricity Sector in South Africa

To summarize, the South African electricity sector is dominated by Eskom — the state-owned vertically integrated utility. This, in turn, has prompted the need for regulatory oversight, which is fulfilled by NERSA. Although the electricity sector comes under the direct purview of DMRE, other ministries including DFFE and DPE also have the power to effect changes in the sector. Incidentally, DMRE also oversees the policy environment for the coal value chain. IPPs, municipalities, and consumers are also important stakeholders in the electricity sector.

Laws, regulations, and other policy instruments, such as the IRP, are drafted by the concerned ministry, with feedback from the public solicited. Based on the comments received, the final version is drafted, and after fulfilling statutory requirements, if any, it comes into effect. This provides a template for the stakeholder consultation process that should be undertaken prior to the formulation of a policy regarding the decommissioning and repurposing of CPPs. A greater degree of buy-in from concerned stakeholders is expected to smoothen the regulatory process.

In addition to the market participants discussed above in this section, some other key influential stakeholders for the repurposing of CPPs are noted as follows:

- Municipality of the City of Johannesburg — It is the largest city in South Africa. The municipal government of Johannesburg is the distribution utility for the city. It has also signed a PPA with Kelvin Power Station — the only large coal IPP in the country.

- Mpumalanga Provincial Government — As Mpumalanga houses a significant proportion of the country's coal mines and power plants, the decommissioning of CPPs can have a significant impact on the economy of the province.
- Energy-Intensive Users Group (EIUG) — This group consists of significant industrial energy users. As most of these companies are in the fields of mining, materials beneficiation, and materials manufacturing, they play a key role in the country's economy. Thus, it is important to ensure that they have quality power supply.
- South African Wind Energy Association — An association of participants in South Africa's wind-power value chain, it advocates for policies that promote wind and renewable energy prospects for generation and socioeconomic benefits.
- South African Photovoltaic Industry Association (SAPVIA) — It is an association of participants in South Africa's PV industry, including the EPC sector and manufacturers. SAPVIA is a member-led organization formed with the express purpose of delivering a solar PV-powered future for South Africa.
- Seriti: One of the two largest coal suppliers to Eskom, it, along with Exxaro, has signed a memorandum of understanding (MoU) with Eskom to jointly develop renewable energy projects.
- Exxaro: It is one of the two largest coal suppliers to Eskom (also a part of EIUG).
- Sasol: A producer of coal, gas, liquid fuels, and other chemicals, it can potentially become a major supplier of gas to transition away from coal.
- Harith General Partners: A majority promoter of Kelvin Power Station, Harith General Partners is the only major coal IPP.

4.1.1.2. Vision and Policies for Low-Carbon Growth

South Africa has set itself a target of limiting its GHG emissions to 398–510 megatons (MT) CO_2e in 2025 and 350–420 MT CO_2e in 2030 in its latest NDCs submitted in September 2021 to the United Nations Framework Convention on Climate Change (UNFCCC). With electricity production estimated to account for 41 percent of the country's emissions, this sector is seen as key to achieving these targets. An analysis by the University of Cape Town (UTC), used to design the above NDC targets, projects that 83 percent of the reduction in GHG emissions vis-à-vis business-as-usual should take place in the electricity production sector. The main levers, proposed for meeting the sectoral target, are the renewable targets set out in IRP 2019, the National Energy Efficiency Strategy, and the carbon tax discussed below. Further, the country has committed to moving toward a goal of net-zero carbon emissions by 2050, although specific details have not been published. Similarly, Eskom also has an aspirational vision of achieving net-zero carbon emissions by 2050. In their messaging, South Africa and Eskom have placed an emphasis on achieving a just transition.

As mentioned previously in this report, IRP 2019 envisions an addition of 1.5 GW to the coal-fired generation capacity. The plan specifically states that the country "should not sterilize the development of its coal resources for purposes of power production." However, the plan seeks to develop power plants based on high-efficiency low-emission (HELE) coal technologies, including the use of CCS. It is noteworthy that Eskom has committed to not building, owning, or operating new CPPs. Accordingly, the Ministerial Determination published in September 2020 has allocated the new coal capacity to IPPs.

This decision should be seen in the context of the previous Coal IPPPP bid window. In October 2016, the then-Minister awarded the contract under the Coal IPPPP to the Thabametsi and Khanyisa Power Station projects. However, multiple environmental organizations filed petitions against the decision to build the power plants. Eventually, the Courts sided with the petitioners and set aside the environmental authorization given to both projects. Over the course of the case, multiple lenders, investors, and developers chose to pull out of the project due to environmental and social concerns. Thus, it is possible that the proposed 1.5 GW of new coal capacity may not materialize.

Furthermore, the Carbon Tax Act was passed in 2019, instituting a tax on primary sources of GHG emissions at a rate of ZAR120 (approximately USD7.70) per ton

of CO_2e, with an annual increase benchmarked to inflation. Specifically, facilities generating electricity higher than 10 MW are subject to the tax. This is in addition to the environmental levy imposed on electricity generation from fossil fuels and nuclear energy. However, due to the rebates, the effective tax liability of Eskom will not materialize until the end of 2022. From 2023, the utility estimated the annual impact of the tax to be ZAR11 billion, just above 5 percent of the company's 2021 revenue of ZAR204.3 billion.

For owners of facilities generating electricity from large solar PV (>1 MW), wind, small hydro (<30 MW), and biomass, Section 12B of the Income Tax Act provides for a deduction on the taxable income of 50 percent of the system's cost in the first year of purchase, 30 percent in the second year, and 20 percent in the third year.

The Komati power plant, commissioned between 1961 and 1966, which is due to shut down its last coal-fired unit in 2022, will serve as a flagship project for repurposing Eskom's CPPs. The plant site is being prepared for a 500-kW agrivoltaic plant and a microgrid fabrication plant. Further, the company has developed a pipeline of projects, including PV, wind, gas, storage, and microgrids, at the sites of multiple coal power stations for which it is seeking a total concessional funding of ZAR400 billion over 10 years. This funding has been proposed in the form of a multi-year, multi-tranche facility, funded by a multi-lender syndicate, along with various safeguards for the lenders, including a project-specific opt-out facility. The projects proposed to repower the Komati power plant include solar PV (100 MW), gas (1000 MW), and battery energy storage (244 MWh). This follows the issuance of an expression of interest for proposals for the development of a sustainable low-carbon industry at the Komati, Grootvlei, Camden, and Hendrina Power Stations.

In June 2021, the National Treasury published a draft of a green finance taxonomy framework, in association with the International Finance Corporation (IFC), Carbon Trust, and the National Business Initiative. This framework, which identifies "green" activities and establishes thresholds to quantify their sustainability, is expected to enable financiers to select projects that align with international best practices and South Africa's national objectives. The framework includes activities such as renewable power generation, electricity storage, and carbon capture. Further, a category of social resilience activities has been identified under the taxonomy; however, it has yet to be developed. This category could potentially include activities to strengthen the aspect of equity in the transition. Examples of such activities include reskilling programs and initiatives to support new and existing local businesses.

In August 2021, DFFE published a draft Climate Change Bill to coordinate the country's response to climate change and ensure a just transition to a low-carbon society. The Bill includes, inter alia, local and provincial responses to climate change, sector-specific adaptation strategies, and carbon budgets. A carbon budget will be allocated to significant GHG emitters by DFFE in accordance with the national target for GHG emissions. Exceeding this budget will lead to the imposition of a higher tax rate under the Carbon Tax Act discussed above.

To summarize, South Africa appears to have a deliberate pathway for lowering its GHG emissions, led by reductions in emissions from electricity production. The three principal levers to achieve the latter are as follows:

- fulfilling the IRP through the REIPPPP;
- allowing business-to-business generation;
- the Carbon Tax Act (and the associated provisions of the Climate Change Act); and
- improved energy efficiency.

The economic and social benefits of the REIPPPP, discussed in the Section 4.1.1.1, indicate how the transition can be made more just. Further, Eskom's commitment to achieving net-zero GHG emissions is backed by its decision to not participate in the development of new coal power generation. However, the utility has not previously committed to the accelerated retirement of its existing CPPs. The pilot repurposing projects at the Komati Power Station and others have the potential to demonstrate the

socioeconomic value to Eskom that can be realized from the early decommissioning of its coal-based assets.

Moreover, South Africa can look toward global support for its coal-transition initiative. The USD 8.5 billion Just Energy Transition Partnership (JETP)[7], announced in November 2021 among the governments of US, France, Germany, UK, the European Union (EU), and South Africa, highlights the global interest in South Africa's just energy transition. Further, Eskom is also in talks with multiple development banks, such as the African Development Bank (AfDB), the New Development Bank (NDB), the KfW Development Bank, the World Bank, and the Agence Française de Développement (AfD), to raise approximately USD2.3 billion for the repurposing of its CPPs. A well-defined policy to accelerate the retirement of CPPs and their repurposing can leverage this finance and technological developments to help South Africa realize its vision of net zero by 2050.

4.1.1.3. Readiness Review

The graphic here presents the analysis of the 18 important parameters that have been identified for assessing the country's regulatory and policy readiness for transitioning away from coal power. Each of these 18 listed parameters lie within one of the quadrants, which are in a descending order of preparedness from a "transition ready — advanced" stage to a "transition — not ready" stage. In addition, these 18 parameters are further segregated into three functional areas: climate, regulatory, or power sector.

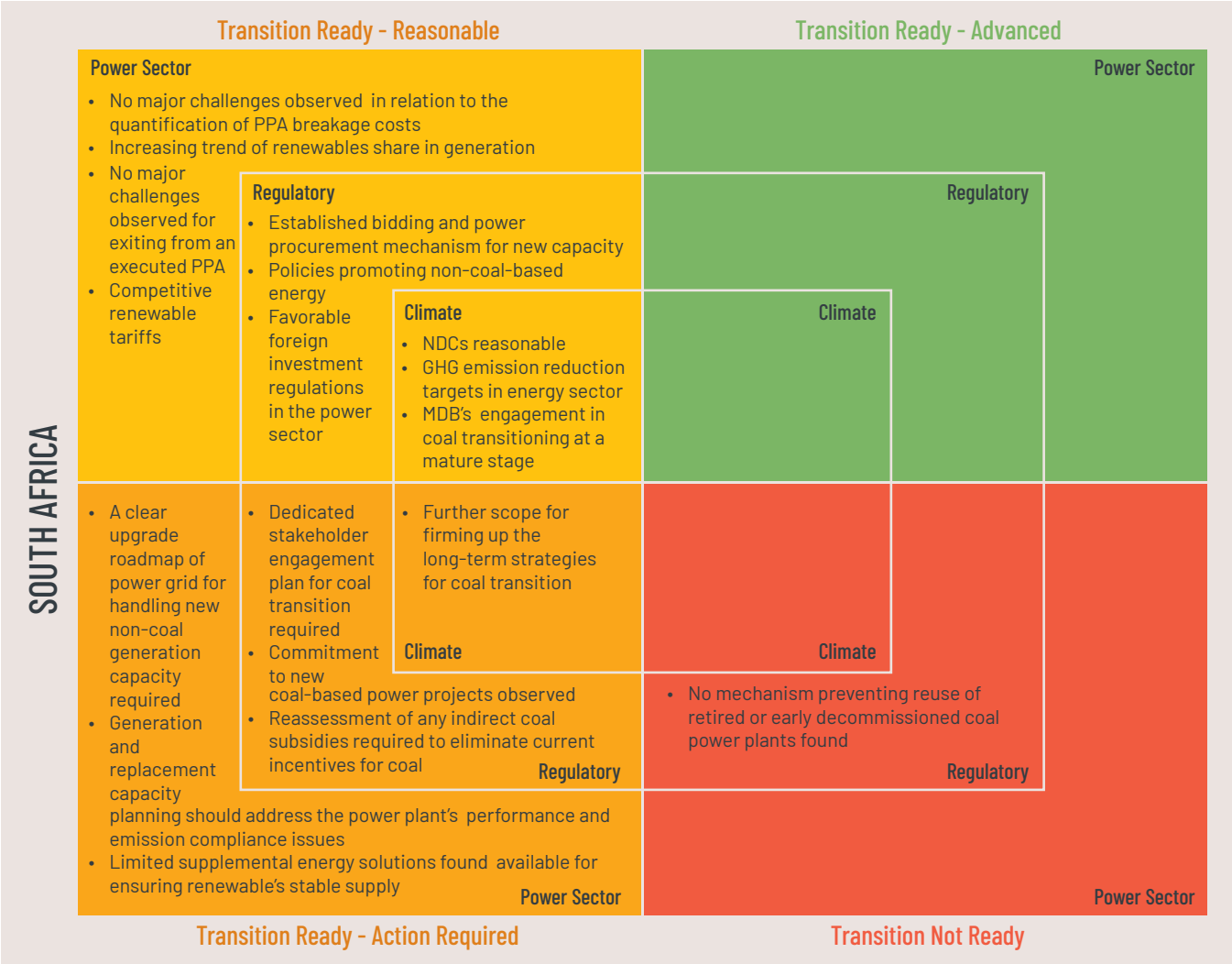


FIGURE 15. Transition Readiness Matrix of South Africa

The findings and assessment evaluating the country's coal-transition readiness are presented below.

TRANSITION READY — ADVANCED

For South Africa, out of the total 18 parameters used for assessing a country's coal-transition readiness, none was found to be in an advanced stage compared with the expected ideal transitioning scenario or requirements.

TRANSITION READY — REASONABLE

The following parameters were found to be reasonable, in terms of their role in coal-transition readiness.

- **Reasonable NDCs:** *(Parameter objective — Review of NDCs for understanding country-level goals for coal transitioning)*

  In its 2021 update, South Africa set absolute emission limits of 398–510 MT CO_2e by 2025 and 350–420 MT CO_2e by 2030. This represents a substantial improvement over its earlier target of 398–614 MT CO_2e for the 2025–2030 period. In the case of the electricity sector, South Africa plans to achieve these targets via the IRP, national energy efficiency measures, and the carbon tax. It is observed that in the Planned Policy scenario in the Technical Analysis undertaken by the Energy Systems Research Group at UTC to support the update of South Africa's NDCs, the forecasted emissions lie below 450 MT CO_2e in 2025 and 400 MT CO_2e in 2030. Further, even in the Existing Policy scenarios, the forecasted emissions do not exceed 500 MT CO_2e in any year. It can be interpreted that the targets have been set conservatively, thereby understating the country's mitigation potential. Also, it is observed that the NDC takes into account the relevant planning of the power sector.

- **Reasonable GHG emission targets:** *(Parameter objective — Review of country's targets around the GHG emissions reduction in the energy sector and assess whether there are any supporting policies around these targets)*

  Currently, the electricity sector contributes to 200 MT CO_2e of GHG emissions — approximately 83 percent of the planned GHG reductions for South Africa. South Africa envisions a reduction of 81.7 MT CO_2e in the electricity supply sector by 2030, as a result of its mitigation policies (that is, the difference between business-as-usual and planned policies). The planned policies include the carbon tax, the adoption of IRP 2019, as well as significant energy efficiency improvements in household appliances, residential and commercial buildings, along with manufacturing installations. While the existing measures and planning are in place to realize this reduction, the implementation should be undertaken efficiently.

- **Multilateral development banks' (MDBs) engagement in coal transition at a near mature state:** *(Parameter objective — Review of MDBs' activities in the region for aiding in funding gaps for coal-transition strategies and accelerating the decommissioning or repurposing of CPPs)*

  Eskom has engaged with multiple development banks for funding its Just Energy Transition strategy. It is observed that MDBs are active in the coal-transition program in South Africa, even if the initiatives are at a preliminary stage.

- **Favorable foreign investment regulations in power sector:** *(Parameter objective — Review of the country's foreign investment regulations in favor of the funding being planned to aid this accelerated coal transition)*

  The REIPPPP has attracted significant foreign investment, with an amount totaling ZAR41.8 billion (USD2.6 billion), which is approximately 20 percent of the total investment to date. Seventy percent of this investment has been in the form of equity and the rest in the form of debt.

  South Africa also announced that it has secured commitments of USD8.5 billion in financing over the next five years from UK, France, Germany, US, and EU to help install more clean energy, accelerate the country's transition away from coal

power, and cushion the blow for workers affected by the shift. The role played by the REIPPPP in boosting South Africa's profile as a destination for foreign investments in the energy sector is noted.

- **Reasonable policies promoting non-coal-based energy:** *(Parameter objective — Assessing whether there are adequate policies in place for the promotion of alternative sources of energy other than coal)*

  Measures taken to promote renewables in South Africa include the fulfillment of IRP 2019 and a tax rebate for the use of renewable sources for electricity generation. The government has recently raised the threshold for the licensing requirement for the new generation capacity to be 100 MW or more. It has also permitted municipalities, with permission from DMRE, to generate or procure generation capacity on their own. These measures will facilitate the growth of the share of renewables. It is observed that while utility-scale solar PV and wind have seen significant cost declines mainly as a result of the successful REIPPPP, there is significant potential and willingness amongst the renewable IPPs to increase the share of renewables, as evidenced by the overbidding of the REIPPPP bid windows. The relaxation in licensing requirements will promote renewables, as they are likely to be within the threshold of 100 MW.

- **Reasonably established bidding and power procurement mechanism:** *(Parameter objective — Assessing whether there is a defined bidding and power procurement mechanism for the selection of new projects that can potentially replace existing coal assets.)*

  Once the ministerial determination for the new generation capacity addition from IPPs is issued, the procurer initiates the procurement. Typically, DMRE, through the IPP Office, performs the role of the procurer. A bid window concerning the specific IPPPP (Renewables / Gas / Coal / Risk Mitigation) is opened, with the procurer issuing a request for proposal (RFP). Consultations with the interested bidders are held and then final bids are submitted.

  The bid evaluation takes place in two phases. First, bids need to meet the minimum technical, financial, economic development, and legal qualification criteria for the procurement of specific power system services and performance criteria from various generation technologies. The second phase involves the evaluation of qualifying bids on the basis of the bid price and the BBBEEE contributor-level status.

  It is noted that the overall project procurement procedure is defined. However, ambiguities associated with certain specific clauses, especially those relating to localization requirements and inclusive development, may lead to administrative, financial, and legal challenges. Examples include delays in bid windows and payment issues for the bid. There is a need to develop more clarity on project specifications during the bidding process in order to avoid any potential risks.

- **No major challenges observed for exiting from an executed PPA:** *(Parameter objective — Review of provisions for facilitating the early termination of a PPA or a PSA without breaching the existing legal and regulatory framework)*

  PPAs for coal-fired generation, with Eskom being one of the parties, were not available, and hence, they were not assessed. As almost all the CPPs in South Africa are owned by Eskom, which also supplies electricity to the end-users directly or through municipalities, PPAs are not expected to be a hindrance to early retirement, if Eskom is on board.

- **No major challenge observed with the quantification of PPA breakage costs:** *(Parameter objective — Assessing whether there is a mechanism outlined in the PPA for quantifying different breakage charges, such as the termination amount, the facility buyout price, and other forms of compensation)*

  PPAs for coal-fired generation, with Eskom being one of the parties, were not available, and hence, they were not assessed. As almost all the CPPs in South Africa are owned by Eskom, which also supplies electricity to the end-users directly or through municipalities, PPAs are not expected to be a hindrance to early retirement, if Eskom is on board.

- **Increasing trend of renewables share in generation:** *(Parameter objective — Assessing whether the share of renewables is increasing in the country's overall energy mix)*

  According to the IRP 2019, renewables (except hydro) will have a share of 24.5 percent by 2030 in the electricity generation, up from 2020's share of 5 percent. In 2010, the corresponding share was less than 0.5 percent.

- **Competitive Renewable Tariffs:** *(Parameter objective — Assessing whether current renewable tariffs are competitive enough to disincentivize coal power projects)*

  According to the REIPPPP's Bid Window 5, the tariffs are USD23.47/MWh–USD30.35/MWh) for solar and USD21.56/MWh–USD38.69/MWh for wind. As a comparison, the operational cost of generation of the coal fleet for Eskom (Employee + Maintenance + Coal = USD27.29/MWh). A detailed LCOE analysis for CPPs is under review. It is observed that the LCOE of newbuild renewables is in the same range as the marginal cost of generation from coal. Given the capital cost of a CPP and the declining costs for renewables, the latter is expected to become cheaper.

TRANSITION READY — ACTION REQUIRED

The following parameters were found to be nearly transition-ready, with some additional actions required.

- **Further scope for firming up long-term strategies for coal transition:** *(Parameter objective — Assessing what the country's long-term strategies are for the coal transition)*

  It is expected that coal production may decline by 15 percent in 2030 as compared with the values in 2019. This is mainly a result of the forecasted reduction in coal use for power generation according to IRP 2019. The 2030 National Development Plant (NDP) underlines the country's continued dependence on coal, including increased coal exports and the promotion of clean coal technologies. While the promotion of clean coal technologies is a welcome step over the current situation, it poses the risk of locking in new capital investments in coal. Focused planning on the decommissioning and / or repurposing of existing coal-based generation assets should be incorporated into the long-term strategies for achieving the effective decommissioning of CPPs from a decarbonization perspective.

- **Dedicated stakeholders' engagement plan for coal transition required:** *(Parameter objective — Assessing whether there is a dedicated engagement plan present that involves the major stakeholders associated with the repurposing of the coal assets and whether their feedback is incorporated to ensure effective regulatory processes)*

  No specific and evident regulations for the decommissioning of CPPs mandating stakeholder engagement or a consultation process were observed. However, recently, Eskom undertook a socioeconomic impact study for the shutdown of three of its thermal power stations. This included stakeholder engagement with district and local municipalities, ward councilors, a committee, non-governmental organizations (NGOs), and local businesses.

DMRE and NERSA also publish draft policies and regulations to seek feedback from the public. Examples of such processes include the IRP 2019 published by DMRE, wherein the final version in 2019 incorporated changes based on feedback received. Further, NERSA conducts public hearings when it awards licenses and makes decisions on tariffs.

It is noted that Eskom has taken steps to involve affected stakeholders. However, the lack of a transparent and formal consultation process may lead to decisions being challenged through legal or extra-legal means by some stakeholders. There is a need to formalize the process for stakeholder involvement during the decommissioning of CPPs.

- **Commitment to new coal-based power projects was observed:** *(Parameter objective — Assessing whether there are adequate policies and regulations in place for discouraging new coal projects)*

  Commitment to new coal-based power projects was observed. There is an allocation of 1.5 GW of new coal capacity between now and 2030. However, Eskom, the country's major state-owned utility, has stated that it will not build any new CPPs. Further, even though half the new coal capacity was supposed to come online by 2023, it has not been bidded out yet. It is noted that while the signs from Eskom are encouraging, the presence of new coal, despite it not being a least-cost electricity resource in the IRP 2019, is a hindrance. There is a need to revisit the IRP 2019 with respect to the planned new coal capacity and analyze whether another source can be employed.

- **Reassessment of any indirect coal subsidies is required to eliminate current incentives for coal:** *(Parameter objective — Assessing whether the coal used for power generation is being subsidized by the government)*

  The coal sector in South Africa is incentivized through the funding of water transportation projects for coal mining. It is understood that the coal used for power generation is subsidized indirectly in South Africa. Direct and indirect subsidies promoting the coal industry should be reviewed so that the market value reflects the true cost of production and its impact on the society.

- **A clear upgrade roadmap of the power grid for handling non-coal generation capacity is required:** *(Parameter objective — Assessing whether the power grids in the country are suitable for effectively handling new renewable capacity and non-coal-based electricity generation)*

  Eskom publishes a generation connection capacity assessment periodically. It provides information on the amount of new generation that can be connected and the power exported at various levels of transmission for the different areas. It shows that while capacity is available in Mpumalanga and Gauteng (the two provinces where coal generation is concentrated), the interprovince transmission capacity for power evacuation from the North West and Northern Provinces is observed to be minimal. Along similar lines, it can be assumed that the transmission capacity of provinces with the maximum renewable generation potential would also be lacking. Therefore, it is necessary to monitor incidents involving the curtailment of renewables and invest in the development of a power transmission infrastructure. A clear upgrade roadmap of the power grid to handle new non-coal generation capacity is needed.

- **Generation and replacement capacity planning should address the power plant's compliance with performance and emissions:** (Parameter objective — Assessing whether there is adequate planning and/or a mechanism present for addressing the energy security of the country to ensure that the new generation capacity planned to replace the coal projects being decommissioned is achievable.)

  The IRP 2019 had planned for a new capacity of 41.7 GW and a retirement of 11.0 GW of CPPs from 2018 to 2030. It is the Minister who issues determinations for new capacity and further specifies if the project is to be set up by Eskom, another state organ, or an IPP in which case, the off-taker will also be identified. While the Minister is not bound by the IRP, in practice, the determinations are supposed to adhere to it.

  The *Medium-Term System Adequacy Outlook* (MTSAO), published by Eskom, reports on the supply security situation for the next five years. According to the report published in 2020, the system adequacy in the medium term is subject to an achievement of an Energy Availability Factor (EAF) of at least 66 percent, which the current generation asset portfolio and the planned connection of new generation capacity coming online are able to deliver. Even so, it will be challenging for Eskom to meet the baseload capacity consistently in the future, considering its aging fleet of the coal assets and associated reliability issues.

  Furthermore, a delay in contracting new coal capacity, mentioned in IRP 2019, may put the electricity supply under significant stress, especially if it is a baseload plant. There is thus a need to revise the planned new capacity addition and / or improve the performance of the existing generation portfolio to meet the baseload demand. The reliability maintenance recovery (RMR) program, initiated by Eskom to improve the EAF, should also be expedited.

  Finally, as it is noted that the REIPPP bid windows are typically oversubscribed, it is likely that the IRP 2019's scheduled addition of renewables can be met, if bid windows are opened in time by DMRE.

- **Limited supplemental energy solutions found available for ensuring a stable supply of renewables:** *(Parameter objective — Assessing whether there are enough existing supplemental energy solutions available in the region to complement renewables, thus ensuring a stable power supply to meet demand)*

  To complement renewables, additions of gas power were observed to be an option in South Africa. There is a plan for new gas-fired plants for 3 GW in addition to the conversion of 3.8 GW of diesel-fired plants to gas-fired plants. It is noted that although there is a requirement of 3 GW of new gas-to-power capacity, the expected low utilization (pegged at 12 percent by the IRP) may not incentivize its development. Increasing its utilization will not only promote gas to power but also offer an alternative to shift away from coal. There is a need for the government to promote investments in the infrastructure to improve the growth of gas projects.

  Additionally, it is observed that 2 GW of storage and 2 GW of hydro are expected to come online by 2030, while South Africa is also a member of SAPP in which the rest of the countries have hydro-based generation.

TRANSITION – NOT READY

The following parameters were found to be significantly lacking in transition readiness or completely missing it.

- **Found no mechanism preventing the reuse of retired or early decommissioned coal power plants:** *(Parameter objective — Assessing whether there is a mechanism in place for preventing the relocation or reuse of decommissioned coal power generation facilities, which can potentially negate the impact of an accelerated coal transition)*

  No evident mechanism to prevent the relocation or reuse of coal power generation facilities was observed. As a part of the policy driving the early retirement of CPPs, there is a need to develop mechanisms to strongly disincentivize the reuse of coal to run the power plant.

4.1.2. Gap Analysis (Challenges)

This section presents the prominent challenges observed in the country in relation to the transition away from coal-based power, the penetration of a substitute for conventional power such as renewables, or overall sectoral planning.

APPEARANCE OF OUTDATED ASSUMPTIONS AND TRENDS IN IRP 2019

The IRP was last updated in 2019, with assumptions derived from reports published between 2017 and 2018. While the technological assumptions regarding capacity factors for renewable technologies appear reasonable, there have been significant changes in other assumptions. It is understood that the IRP has used inputs on the cost of generation technologies from the Economic Policy Research Institute (EPRI) in 2017. The costs of renewable energy + storage, as estimated by the report, have significantly decreased. The table below compares the EPRI estimate (for 2017) with annual estimates from Lazard (for 2018–2021) for the LCOE of coal and renewable energy + storage.

TABLE 7. LCOE for Coal and Renewable Energy + Storage

YEAR	ENTITY	COAL	RENEWABLE ENERGY + STORAGE
2017	EPRI	USD97.53/MWh	USD452.56/MWh
2018	Lazard	USD 101.50/MWh	USD 124.00/MWh
2019	Lazard	USD 109.00/MWh	USD 120.50/MWh
2020	Lazard	USD 112.00/MWh	USD 110.50/MWh
2021	Lazard	USD 108.50/MWh	USD 121.50/MWh

Sources: EPRI and Lazard.

The LCOE estimate by Lazard for 2021 can be benchmarked against the only winning bid in the REIPPPP that offered solar PV + BESS at an LCOE of ZAR1,885/MWh (approximately USD130/MWh). Further, the electricity demand, obtained endogenously from the economy-wide model in the technical

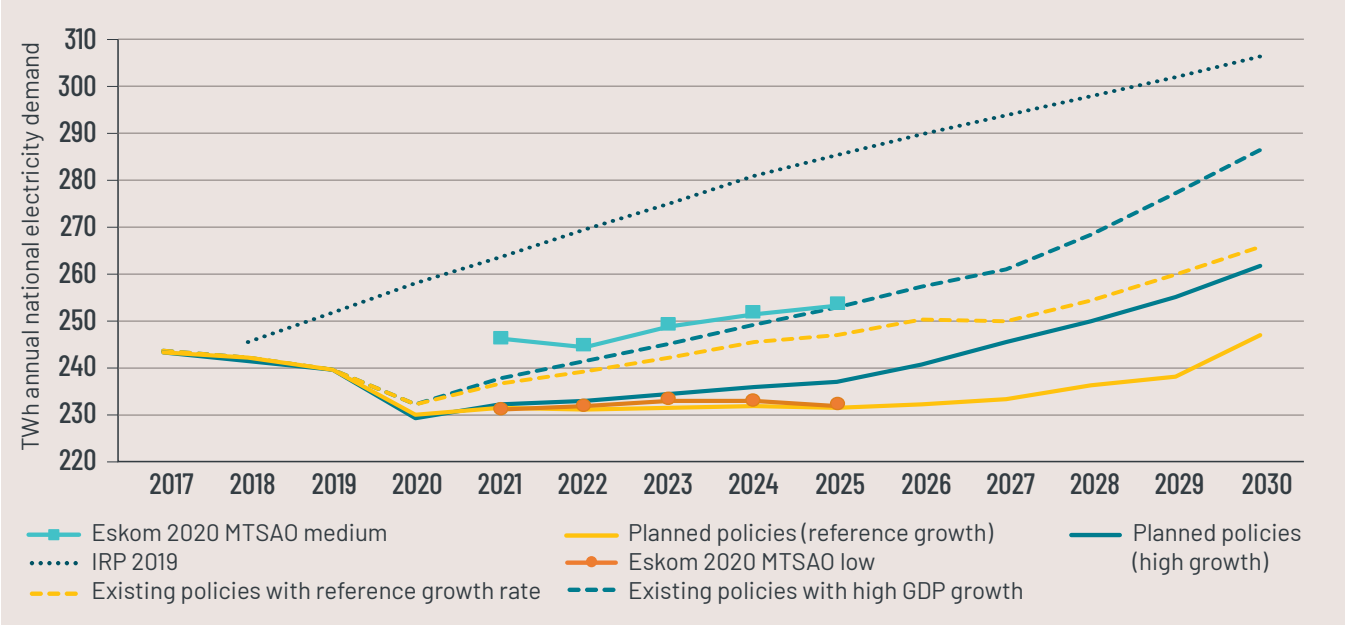


FIGURE 16. Electricity Demand Forecasts used in the IRP, MTSAO 2020, and the UCT Analysis

Note: The UCT technical analysis also sets out the demand forecasts in red and green for the high and reference growth rates, with the dashed lines representing scenarios for existing policies and solid lines for planned policies.

Source: Technical Analysis by UCT.

analysis used to support South Africa's updated NDCs discussed, was significantly lower than the projections used in the IRP 2019 (Figure 16).

In view of the lower demand and falling costs of renewable energy + storage, and the use of the two enabling levers discussed above (that is, the aggressive deployment of renewable energy + storage and improved reliability), the accelerated decommissioning of CPPs appears to be possible. This is borne out by a study by CSIR that examines multiple long-term scenarios (up to 2050) for South Africa's power sector, with decommissioning as an explicit policy goal as well as a result of least-cost utility planning. This is in contrast with the IRP, where decommissioning is considered only at the end of the 50-year design life of the unit. An updated IRP incorporating the updated trends of a lower demand and the falling costs of storage could help guide the early retirement of CPPs.

ESKOM'S FINANCIAL CONDITION

The financial health of Eskom remains a concern for the South African government. The utility reported an after-tax loss of ZAR18.9 billion — a slight improvement over the loss of ZAR20.7 billion at the end of FY20. Even after the infusion of ZAR56 billion by the government that helped the group reduce its debt by over a sixth, its debt continued to increase to hit ZAR400 billion at the end of FY21. As Eskom seeks additional funding for developing new generation and transmission capacity, as well as ensuring a just transition for affected communities and lenders, the viability of the projects and the group's sustainability must be ensured.

Its precarious position is further complicated by the unbundling process that is targeted to be completed by the end of 2022. A major factor that has aided Eskom in securing debt is the ZAR350-billion guarantee announced by the South African government in 2010. The division or distribution of financial assets and liabilities among the

generation, transmission, and distribution utilities will be key to understanding the financial incentives of the generation division with respect to the decommissioning of CPPs. For instance, while Eskom did not agree to the sale of the Medupi and Kusile power plants to ease its debt burden in 2019, it could be possible that, as a separate entity, the generation division may have a different opinion. As per the segmented financial report prepared by Eskom in compliance with its licensing conditions, this division generated 47 percent of the group's earnings before interest and taxes (EBIT), while accounting for 71 percent of the financing costs in FY21.

Post unbundling of Eskom, it is expected that the generation division will enter into PPAs or similar contractual arrangements with off-takers. These newly-entered PPAs should be well thought-out, in terms of effective exit arrangements, such as clear definitions of terminations-at-will, facility buyouts, and the computation of PPA breakage costs. This will facilitate relatively easy exits from contractual arrangements for candidate plants for decommissioning and repurposing.

4.1.3. Financing Landscape

The Republic of South Africa,[8] one of the largest economies on the African continent, has faced a challenging economic environment since the global financial crisis of 2008. The economic environment of the country is characterized by high unemployment rates, low growth rates (approximately 2 percent since 2014 and eventually turning to -6.4 percent in 2020), political and policy uncertainties, along with structural inequalities. The country faces a wide gap (USD146 billion) between the current levels and the target levels of infrastructure investment, as stated in the 2050 National Infrastructure Plan (NIP).

The public finance sources available for funding the coal-repurposing activity comprise the government's funds and the funds from Eskom. The government's ability to finance coal-repurposing investments is restricted due to low economic growth, a huge burden of wage expenses (roughly accounting for over one-third of its budgeted expenditure), and below-forecast tax revenue collection. It is also faced with the burden of increasing contingent liabilities, in the form of guarantees issued to SOEs, IPPs, and PPP projects. Rapidly rising debt levels and a widening fiscal deficit are other challenges faced by South Africa that have resulted in a sub-investment grade credit rating, thereby further limiting the government's ability to support the coal-repurposing exercise.

Eskom, the country's vertically integrated electricity utility, caters to over 90 percent of the country's electricity requirements; as such, it plays a pivotal role in South Africa's coal-repurposing landscape. The company suffers from challenges, such as heavy generation losses (due to the deferral and omission of essential maintenance); non-cost reflective tariffs (with the average tariff hike approval of 8 percent versus the applied 16 percent during the 2013–2018 period); heavy planned and unplanned downtimes of generation plants; along with ballooning receivables and debt-service obligations. These operational challenges have led to high leverage and weakened balance sheet which means Eskom requires continuous government assistance to sustain its operations leaving little room to finance repurposing of existing coal assets.

South Africa's financial services sector is well-developed and dominated by private banks. The country's banking sector is well-capitalized and has a strong balance sheet. Given the significant participation of banks in funding renewable energy projects in the country, South Africa's private banks are well-positioned to fund coal-repurposing projects as well. However, the banking sector faces a few challenges, such as the concentration of lending toward households; reduced liquidity due to the increase in the government's bondholding; and the low bankability of the existing infrastructure (especially energy and electricity) projects due to the absence of a guarantee from a strong entity / government.

In the shorter term, DFIs are expected to undertake the coal-repurposing projects / activities in the country to establish a proof-of-concept and develop a

relevant framework around the transition exercise. In the longer run, local commercial banks can then take the lead in such transactions.

TABLE 8. South Africa: Summary of Key Financing tools

	CAPABILITY TO FUND TRANSITION		
SOURCES	***Short Term***	***Long Term***	**COMMENTS**
Government	Low 🔴	Low 🔴	• The Government of South Africa has been running fiscal deficits to provide the necessary support to the population in the face of economic slowdown. • Large wage bills, below forecast tax revenues, high amounts of contingent liabilities due to government guarantees, and high-interest payments leave little room in the national budget for spending on infrastructure development activities (including any coal repurposing initiative). The sub-investment grade rating too has constrained the country's ability to fund large scale coal repurposing initiatives.
Eskom	Low 🔴	Low 🔴	• Eskom has been facing challenges on both the operational and financial front such as aging generation fleet, deferment of necessary maintenance activities leading to high unplanned shutdown time and rolling blackouts across the country in recent years, time delay and cost overruns in the commissioning of new capacities putting strain on financials. • Eskom relies heavily on continuous government support in the form of capital infusion and debt guarantees, it would have limited resources to fund coal repurposing initiatives.
Financial Institutions	High 🟢	High 🟢	• The banking sector in South Africa is fairly developed and dominated by five banks controlling over 90% of all assets. These large banks operate across the continent and have been a major source of capital for infrastructure projects historically. Domestic commercial banks have been leading financing in proven renewable deals (solar and wind), while DFIs are still more active in newer technology related to renewables (such as battery, etc.). As such active participation is expected from such DFIs on a short-term basis itself.
Capital Markets	Low 🔴	Medium 🟡	• South African equity markets are most developed in terms of market capitalization and liquidity as compared to other major African economies, but the market is heavily concentrated and dominated by several large companies. • The bond capital market in the economy is also the largest among the emerging economies. However, it is primarily crowded by government and public entities, with private non-financial corporations having miniscule participation. Additionally, the non-investment grade credit rating of the country acts as an effective cap on domestic issuances and limit participation by foreign investors in the market. • While on short term basis, active participation is not envisaged, capital markets can potentially be a source of capital for coal repurposing on a long-term basis as and when the market gets further developed and liquid. • The green-bond market is still under development and may prove to be a suitable source of financing the coal repurposing projects in the longer run.
Carbon Markets	Low 🔴	High 🟢	• Carbon trading markets in South Africa are currently in a nascent stage. However, markets have witnessed renewed interest from participants, driven by offset allowance available under the country's carbon tax. • In the long-term, markets are expected to be a significant source of capital for coal repurposing project as volumes and prices improve and become favorable.

In terms of market capitalization and liquidity, South Africa's equity capital markets are the most developed in the region (with a total market capitalization of USD1,254 billion as of September 2021). South African debt capital markets are among the major sources of financing for the economy after financial institutions. However, the debt capital markets are dominated by the government, SOEs, and financial institutions. The concentration is more pronounced in the secondary market trading activity. Given the concentration in the market and the country's sub-investment grade credit ratings, debt capital markets are expected to have limited participation in coal-repurposing projects in the short-to-medium term.

Green bond markets are comparatively underdeveloped and have seen few issuances over the year. The outstanding bonds are concentrated toward government issuances or issuances by municipalities. The National Treasury released a working draft of a green taxonomy for public consultation in June 2021 in order to boost the development of a green bond market.

Carbon trading markets in South Africa are in the nascent stage, though they have witnessed interest in recent times, driven by the permission to offset carbon tax liability by a carbon offset allowance. However, the markets are underdeveloped at the current stage and may not be able to provide meaningful capital for a large-scale coal-repurposing exercise in the short term. Moreover, the carbon emissions are heavily concentrated in the hands of a very few players; as such, this may result in the concentration of carbon trading activity in the hands of such few players. Given the limited suitability of the domestic carbon markets, South Africa may instead consider the well-established international carbon markets for financing coal-repurposing initiatives.

4.2. India

India is the third-largest producer of electricity globally, only behind China and US. It participates in the cross-border trade of electricity with Bangladesh, Bhutan, Myanmar, and Nepal.

4.2.1. Readiness Analysis — Regulatory and Policy Environment

4.2.1.1. Overview of the Regulatory Environment

India's Constitution places the electricity sector within the legislative scope of both the Parliament (Union) and the state legislatures. In case of a conflict, however, the Parliament has precedence over the laws made by state legislatures. This division of powers has created a complex regulatory framework, whereby some aspects are the same across the nation, but others are different.

The Electricity Act (2003) governs the activities related to the generation, transmission, distribution, trade, and the use of electricity in India. The Act also provides a detailed framework of entities that administer and execute its provisions, as described below.

The Ministry of Power (MoP) is primarily responsible for the development of electrical energy in the country. It is involved in national-level planning and policy making for the power sector, the monitoring of the progress of new power projects, as well as the administration and enactment of legislations regarding thermal and hydropower generation, transmission, and distribution. The National Electricity Policy, produced by MoP, communicates the government's broad vision for the electricity sector. While the current iteration of the Policy was published in 2005, an updated draft version was released in February 2021 for feedback from the public. The union government of India has approved a ~19750 crore INR National Green Hydrogen mission for incentivizing commercial production of green hydrogen and making India a net exporter, by developing a production capacity of 5 million metric tonne per annum and adding renewable energy capacity of about 125 GW (gigawatt) by 2030, to aid decarbonization of the industrial, mobility and energy sectors.

The Ministry of New and Renewable Energy (MNRE) is the nodal ministry of the Government of India for all matters related to new and renewable energy. The broad aim of the ministry is to develop and deploy new and renewable energy to supplement the energy requirements of the country. Hydropower, with an installed capacity of less than 25 MW, also falls under the ambit of MNRE.

Other important ministries at the national level include the Ministry of Coal that oversees policies, regulations, and legislations related to the extraction and sale of coal and the Ministry of Environment, Forest and

Climate Change (MoEFCC). MoEFCC is the nodal agency for planning, promoting, coordinating, and overseeing the implementation of India's environmental and forestry policies and programs. It liaises with global partnerships, such as the United Nations Environment Programme (UNEP), the South Asia Co-operative Environment Programme (SACEP), and UNFCCC. Further, through the Central Pollution Control Board, it regulates the emissions of various industrial processes including electricity generation. At the state level, corresponding ministries for power/electricity oversee the development of the electricity and renewable energy sectors in their respective states.

The Central Electricity Authority of India (CEA) advises the government on policy matters and formulates plans for the development of electricity systems. The Authority prescribes the standards on matters, such as the construction of electrical plants, electric lines, and connectivity to the grid; the installation and operation of meters; along with safety and grid standards. CEA advises the central government, state governments, and regulatory commissions on all technical matters related to the generation, transmission, and distribution of electricity. Among other documents, CEA produces the Electric Power Survey and the National Electricity Plan every five years to forecast the power demand in the country and prepare for it, respectively.

The Central Electricity Regulatory Commission (CERC) is the chief regulatory body in the power sector at the national level. Its responsibilities include setting the tariffs of generation companies owned or controlled by the central government; determining licensing, regulation, and tariffs for the interstate transmission of electricity; adjudicating disputes involving generating companies or transmission licensees in relation to any of the previous matters; and advising the MoP on the formulation of the National Electricity Policy and the Tariff Policy.

In each state, the respective State Electricity Regulatory Commission (SERC) is responsible for setting the tariffs charged by the state generation utilities; regulating the intra-state transmission and distribution of electricity; specifying and enforcing quality and reliability standards in the generation, transmission, and distribution of electricity; along with setting retail tariffs to be charged by distribution utilities.

The Forum of Regulators facilitates the exchanges of information, ideas, and perspectives between the CERC and the various SERCs. Further, the Appellate Tribunal for Electricity (APTEL) serves as a forum for aggrieved persons to appeal against decisions issued by CERC or the SERCs.

The generation utilities in India are classified under the central sector, the state sector, or the private sector, depending upon the ownership. Significant central sector generation utilities include NTPC, Damodar Valley Corporation (DVC), National Hydro Electric Power Corporation (NHPC), and Neyveli Lignite Corporation Limited (NLC). State-sector generation utilities are owned by their respective state governments. Private sector generation utilities include Tata Power, Adani Power, Torrent Power, and ReNew Power. The Association of Power Producers (APP) represents over 90 percent of the private sector generation utilities. At the end of March 2021, the share of the private sector in utility-installed capacity was 47 percent, followed by the state sector (27 percent) and the central sector (26 percent). The division is slightly more uniform when considering only coal and lignite, with the private sector accounting for 36 percent, while the state and central sectors both hold shares of 32 percent each.

The system operation is handled by agencies at three levels: a national load dispatch center (NLDC) that manages the grid at the national level; five regional load dispatch centers (RLDCs) — one each for the northern, southern, western, eastern, and the northeastern regions; along with state load dispatch centers (SLDCs). NLDC and the five RLDCs are integrated under the Power System Operation Corporation (POSOCO). Major transmission utilities in the country include the Power Grid Corporation (PGCIL), state transmission utilities, and private transmission utilities. Barring a few major cities in India, distribution is completely handled by the state distribution utilities.

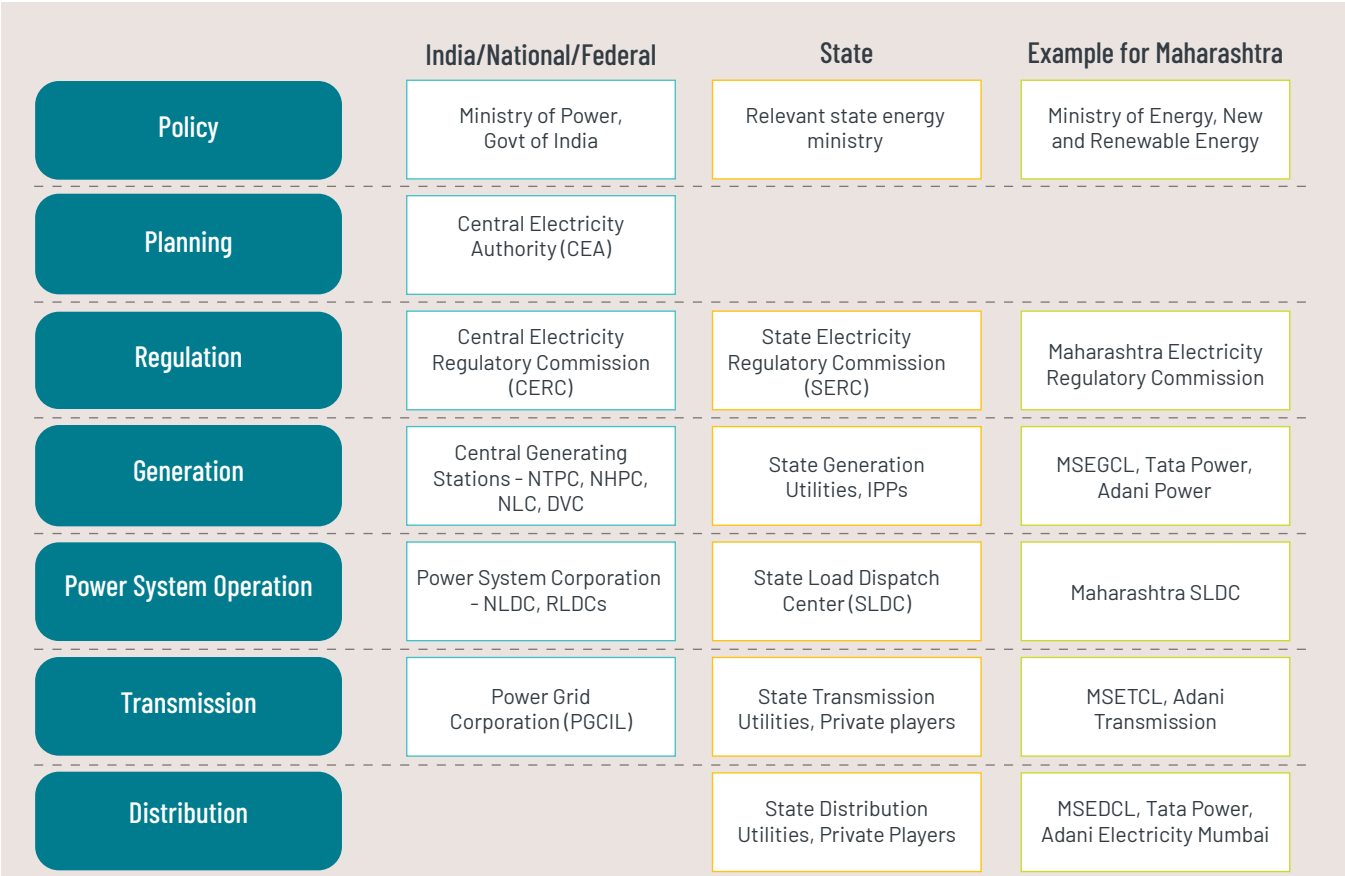


FIGURE 17. Overview of the Electricity Sector in India

Figure 17 summarizes the key market players and authorities in the electricity sector.

The power procurement process is undertaken by the distribution utility based on the demand identified in the Electric Power Survey. This procurement is typically done for one of three periods — short term (up to one year), medium term (between one and five years), and long term (more than five years; typically up to 25 years) — with the source of energy (for example, thermal, solar PV, and solar-wind hybrid) specified.

The procurement is done, based on a competitive bidding process. Separate guidelines have been set out for different power sources — solar PV and solar-wind hybrid by MNRE, and thermal and round-the-clock power by MoP. The bidding parameter may be a single or a two-part tariff, unindexed or indexed, or the required viability gap funding, depending on the source of power and at the discretion of the utility. For power procured through a process other than competitive bidding, the tariff is regulated by CERC or the respective SERC, as discussed above, and according to the principles laid out in the Tariff Policy. Further, even in the case of competitive bidding, change-in-law provisions exist to ensure that any material changes do not unduly benefit or harm either the power producer or the procurer.

As utilities in India are unbundled, it is pertinent to look at the mechanisms for the termination of a PPA. In most PPAs, the compulsory acquisition of the seller's assets by an Indian government instrumentality is included as a non-natural force majeure, and thus, the parties will be freed from the obligations to the extent caused by the force majeure. It must be noted that in the past six years, NTPC has taken over six power plants. Terminations, other than by a force majeure, can occur either in case of default

by one of the parties or by mutual agreement in writing. The exact provisions for damages/breakage costs vary for different PPAs. In any case, the breakage costs will have been clearly outlined in the PPA signed between the power producer and the off-taker. The off-taker, typically the distribution utility, may apply to the SERC to recover the costs through tariffs, but the decision will be taken by the commission.

In addition, some PPAs also include a provision for the off-taker to mandate the power producer to sign away its interest in the project to either the off-taker (or the off-taker's nominee) in case of a default by the producer. Further, in the case of private generation companies, the ownership of the assets after the termination of an agreement depends on the type of agreement that was signed, that is, DBFOO ("Design, Build, Finance, Own and Operate" [where ownership remains with the developer]) versus DBFOT ("Design, Build, Finance, Operate and Transfer" [where there is a compulsory buyout by the off-taker]).

Generation utilities in India do not require the approval of CEA in order to retire any power plant or a unit thereof for techno-economic reasons. However, once the decision has been taken, CEA who maintains the database of the country's installed generation capacity should be informed. CEA will also assess the impact of the retirement of the unit on the power system and take remedial measures, if required. Thus, beyond the contractual requirements, including the PPA, the Coal Supply Agreement, and employment contracts, the generation utility is free to take the decision to retire its plants. However, it must be noted that a concurrent retirement of significant coal-fired generation capacity in the same region may not have been envisioned or encountered so far by the policy. Further, given the multiple stakeholders in the electricity sector, it will be important to engage with the maximum number of stakeholders possible and try to obtain their participation.

Thus, it can be observed that the electricity sector in India is well-regulated. At the same time, constitutional arrangements to balance the country's federal structure have made the policy and regulatory environment complex. Authorities at the national level retain considerable influence in planning and policymaking, whereas regulatory bodies at the state level have a greater say on the retail tariff. The private sector owns nearly half of the total installed capacity and just over one-third of the coal-fired generation capacity. However, transmission and distribution ecosystems, which are amenable to natural monopolies, are dominated by publicly owned utilities.

PPAs underpin the relationship between the power generation and distribution utilities. While there is no provision for termination at will by either of the parties, other provisions available in the PPA can be utilized to terminate the agreement before its expiry. The provision for termination by mutual agreement allows both parties to negotiate a fair settlement that will cover their investments. However, if such an agreement is impossible to arrive at, one of the parties can default and have the agreement terminated by paying the damages, as specified in the PPA. As the final and least-favored option, the government can step in and take over the existing thermal power plants and retire them after compensating all the parties for their investments. Aligning the interests of multiple stakeholders and authorities will be crucial for transitioning away from coal.

Some other key influential stakeholders for the repurposing of CPPs are noted as follows:

- Central Pollution Control Board (CPCB): CPCB is a statutory body that regulates the pollution of industries and other sources in order to ensure air and water quality standards. Further, the body also collects data on the air and water quality standards and advises the central government on any matter concerning the prevention and control of water and air pollution.
- Coal India Limited: A coal producer owned by the central government, Coal India Limited accounts for over 80 percent of the total domestic coal output; as such, it is a major domestic supplier of coal to the thermal generation fleet.
- Power Grid Corporation of India (PGCIL): It governs the transmission of bulk power across the different states in India. The functions of PGCIL include developing transmission systems for central generating stations (CGS), IPPs, ultra-mega power plants (UMPPs), and renewable energy integration; inter-state and inter-regional links; high-capacity transmission corridors and green energy corridors; and international links with neighboring countries such as Nepal, Bhutan, and Bangladesh.
- Prayas Energy Group: This is an Indian research organization operating in the energy policy and electricity sector. Its scope of work includes research and intervention in policy and regulatory areas, as well as the provision of training, awareness, and support to civil society groups.
- Council on Energy, Environment and Water (CEEW): CEEW is a not-for-profit policy research institution that focuses on resource efficiency and security, water resources, renewable energy, sustainability finance, energy-trade-climate linkages, integrated energy, environment and water plans, and climate geo-engineering governance.

4.2.1.2. Vision and Policies for Low-Carbon Growth

The first NDCs submitted by India in 2016 were the latest available commitments in the UNFCCC repository at the time this review. In it, India's two key mitigation targets are: (a) to reduce the emissions intensity of its GDP by 33–35 percent by 2030 from the 2005 level; and b) to achieve a share of 40 percent installed generation capacity from non-fossil fuel sources by 2030, with the help of a transfer of technology and low-cost international finance, including from GCF. Further, at the COP26 held in 2021, the Prime Minister declared the country's updated commitments as follows:

- Achievement of 500 GW of non-fossil installed capacity by 2030;
- 50 percent of the country's installed capacity in 2030 to come from renewable sources;
- Cumulative emissions reductions of 1 gigaton (Gt) CO_2e between 2021 and 2030;
- Reduction of the carbon intensity of its economy by bringing it down to levels of less than 55 percent by 2030; and
- Achievement of the net-zero target by 2070.

The updated targets, especially the first two, underline the country's commitment to promoting the use of renewable sources for electricity generation. However, no targets specific to the use of coal have been declared in India's NDCs. Further, these updated NDCs are not available yet in the NDC repository maintained by UNFCCC.

The ambitious targets for renewables are backed by policy measures incentivizing their development. Some of these measures adopted at the national level include the following:

- Renewable Purchase Obligation (RPO) targets are set by the SERCs for their respective states, specifying the minimum proportion electricity distribution utilities should purchase from renewable sources. The implementation of these targets is supported through a system of tradable Renewable Energy Certificates (RECs) and financial penalties. Further, solar and wind power projects

have been afforded the status of must-run plants. This status proscribes the curtailment of power from these projects, except for technical or security constraints.

- The domestic manufacturing of high-efficiency solar modules has been sought, boosted by the Union Cabinet through its inclusion under a production-linked incentive scheme announced in 2020. Further, the government has also imposed the respective basic customs duties of 40 percent and 25 percent on the import of solar modules and solar cells, respectively; this is expected to come into effect from April 2022.
- In July 2020, MoP introduced rules on the procurement of round-the-clock power. Under this process, at least 51 percent of the electricity delivered by the project must be sourced from renewable energy sources while ensuring 85 percent availability across the year [86, 87]. Since the rules do not include new thermal capacity as a complementary source of power, it is expected that it will not lead to the development of new thermal projects. Further, this process also provides an alternative for already-commissioned thermal power stations. Although the policy has been amended to include sources of power from non-coal companies, this policy will still help to promote the growth of renewables in firm power.
- In November 2021, MoP allowed thermal / hydro-generating projects to procure and supply renewable power to meet its PPA commitments. Further, this renewable power can be used by distribution companies (discoms) to meet their RPOs.
- The government has allowed an accelerated depreciation rate of up to 40 percent on renewable sources of power production.
- Interstate transmission charges on electricity generated from solar and wind have been waived for 25 years for projects commissioned up to 30 June 2025. A partial waiver is also extended to BESS projects, if solar and wind together contribute to more than 70 percent of the charging electricity.
- In addition to the above measures, there are several state-level incentives and initiatives, such as exemptions from electricity duty, transmission charges for wheeling, the easing of clearances for purchase of land, and net-metering policies.
- The draft National Electricity Policy is focused on introducing market-based mechanisms that can support or supplant the existing RPO-backed regime. It also highlights the need for tariff policies that are aligned with the capital-intensive and variable nature of renewables like solar and wind. In addition to existing renewables, the policy separately highlights the potential of waste-heat recovery and microgrids. While battery storage and hydrogen are covered as a part of new technologies, a specific focus on both these technologies is missing in the policy.

4.2.1.3. Readiness Review

The graphic here presents the analysis of the 18 important parameters that have been identified for assessing a country's regulatory and policy readiness for transitioning away from coal power. Each of these 18 listed parameters lies within one of the quadrants, which are in the descending order of preparedness from a "transition ready — advanced" stage to a "transition — not ready" stage. In addition, these 18 parameters are further segregated into three functional areas: climate, regulatory, or power sector. This segregation is based on the relevant theme addressed by each of the parameters.

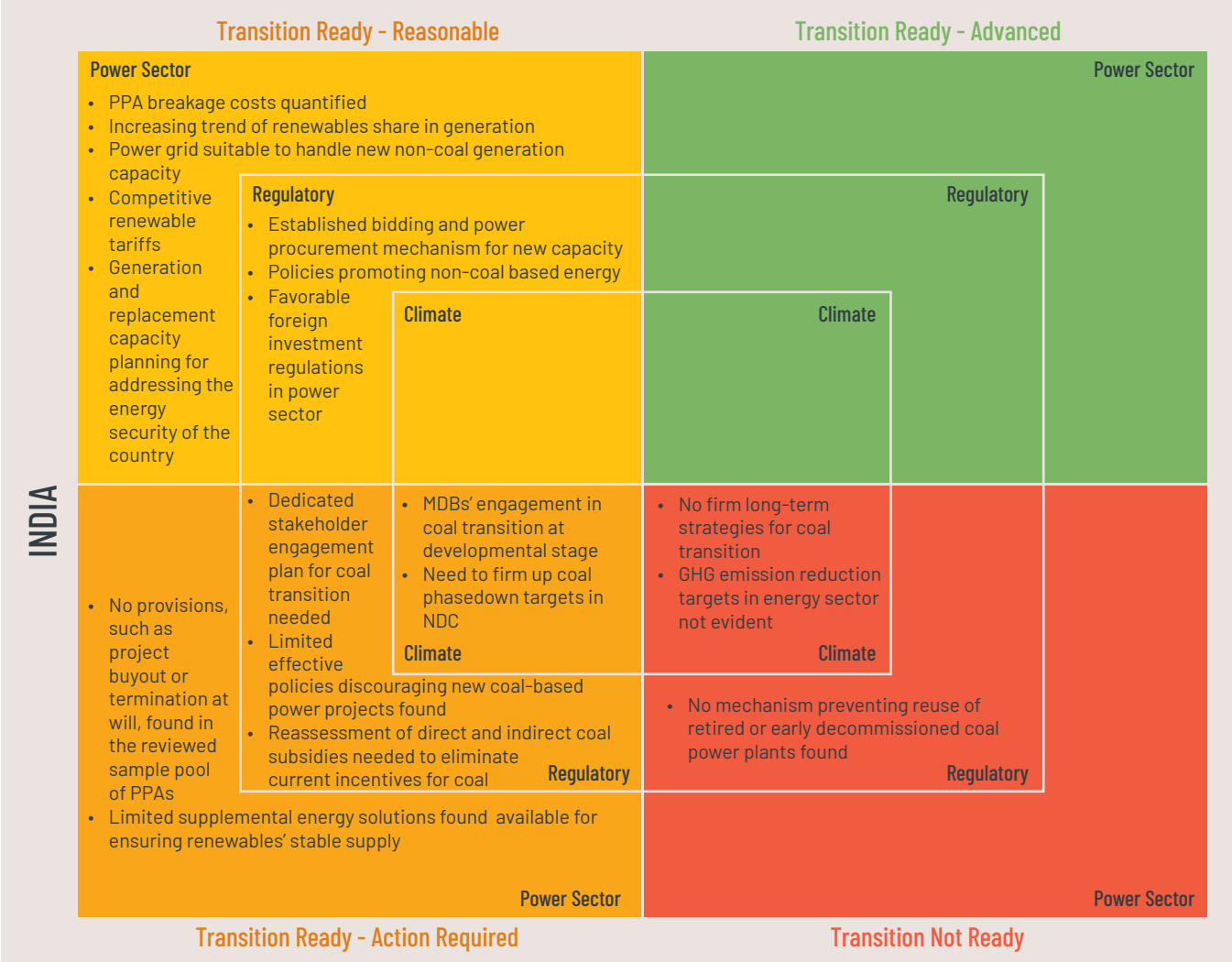


FIGURE 18. Transition Readiness Matrix of India

The findings and assessment evaluating the country's coal-transition readiness are presented as below.

TRANSITION READY — ADVANCED

For India, out of the total 18 parameters used for assessing the country's coal-transition readiness, none was found to be in the advanced stage compared with the expected ideal transitioning scenario or requirements.

TRANSITION READY — REASONABLE

The following parameters were found to be reasonable, in terms of their role in coal-transition readiness.

- **Favorable foreign investment regulations in power sector:** *(Parameter objective — Review of the country's foreign investment regulations in favor of funding being planned to aid the accelerated coal transition)*

  One hundred percent of foreign direct investment (FDI) in non-nuclear power is available through a direct route. Liberal rules governing foreign investment were observed, which can potentially attract investments toward the repurposing of coal assets.

- **Reasonable policies promoting non-coal-based energy:** *(Parameter objective — Assessing whether there are adequate policies in place for the promotion of alternative sources of energy other than coal)*

  In November 2021, MoP allowed thermal / hydro-generating projects to procure and supply renewable power to meet its PPA commitments. Further, this renewable power can be used by discoms to meet RPOs.

  In July 2020, MoP also set out rules for a tariff-based competitive bidding process for the procurement of round-the-clock power from grid-connected renewable energy power projects, complemented with power from coal-based thermal power projects.

  Also, it is noted that interstate transmission charges on electricity generated from solar and wind have been waived up to 30 June 2025. Ambitious targets for the growth of renewables were observed to be well-supported by policies and regulations. However, the imposition of import tariffs on solar modules may make PV-produced electricity more expensive, at least in the short run.

- **Reasonably established bidding and power procurement mechanism:** *(Parameter objective — Assessing whether there is a defined bidding and power procurement mechanism for the selection of new projects that can potentially replace existing coal assets.)*

  The power procurement process in the country is undertaken by a discom, based on the demand identified by the Electric Power Survey. The procedure for power procurement appears to be well-defined.

- **Reasonable quantification of PPA breakage costs:** *(Parameter objective — Assessing whether there is a mechanism outlined in the PPA for quantifying different breakage charges, such as a termination amount, a facility buyout price, and other forms of compensation)*

  The breakage costs were observed to be clearly outlined in the PPA signed between the project company and the off-taker. It is noted that the off-taker, typically the distribution utility, may apply to the SERC to recover the costs through tariffs, but the decision will be taken by the commission. A clear quantification of breakage costs was observed, thus reducing the chances of ambiguities and any legal challenges that could ensue.

- **Increasing trend of renewables share in generation:** *(Parameter objective — Assessing whether the share of renewables is increasing in the country's overall energy mix)*

  From 2011 to 2020, the share of renewables in utility-installed capacity has more than doubled from 10.6 percent to 23.5 percent. The share in the energy mix in the corresponding period increased from 4.6 percent to 10 percent. It was observed that there is a gradually increasing share of renewables in the electricity mix.

- **Power grid appears to be progressing toward handling new non-coal generation capacity:** *(Parameter objective — Assessing whether the power grids in the country are suitable for effectively handling new renewable capacity and non-coal-based electricity generation)*

  Although the whole country is connected to form a synchronous grid, the integration of renewables is addressed at the national, regional, and state levels. According to an analysis by IEA and the National Institution for Transforming India (NITI) Aayog, Gujarat, Tamil Nadu, and Karnataka already face challenges in the short-term frequency control and management of unpredictable challenges in supply-demand balance. This often leads to the curtailment of renewable power. However, several measures are being taken to ensure the integration of renewables:

  1 | Pilot testing of Automatic Generation Control;

  2 | 40 percent technical minimum;

  3 | Introduction of a reserve regulation market, including secondary reserves ancillary service (SRAS), tertiary reserves ancillary service (TRAS), and fast response ancillary service (FRAS) from hydro;

  4 | National Mission on BESS and development; and

  5 | Initiatives on other ancillary services frameworks.

  It is noted that, in order to fully exploit the ambitious target of renewable capacity, technical measures, such as increased storage, flexible generation capacity, transmission strengthening, as well as policy support through market design for ancillary services and demand response, are being developed in the country.

- **Competitive Renewable Tariffs:** *(Parameter objective — Assessing whether current renewable tariffs are competitive enough to disincentivize coal power projects)*

  While the variable cost of coal-generated power can be as low as INR1.40/kWh, the total cost can range from INR2/kWh to over INR5/kWh. UMPPs provide power at even lower rates, averaging INR 1.61/kWh. On the other hand, while older contracts have tied distribution utilities to buy renewable power at rates exceeding INR5/kWh, rates as low as INR 1.99/kWh have been found via reverse-bidding auctions in 2020. It is noted that even though standalone renewables have achieved grid parity costs, the incorporation of storage remains a challenge.

- **Reasonable generation and replacement capacity planning for addressing the energy security of the country:** *(Parameter objective — Assessing whether there is adequate planning and / or a mechanism present for addressing the energy security of the country and thus ensuring that the new generation capacity planned to replace the coal projects being decommissioned is achievable)*

  According to the current National Electricity Plan, a new generation capacity of 176.2 GW has been planned to come online between 2017 and 2022, with a further 165.2 GW of new capacity between 2022 and 2027. Of the new-capacity addition of 341.4 GW, 217.8 GW are set to come from renewables, while coal-fired capacity will account for 94.3 GW. Thus, in spite of the planned decommissioning of 48.3 GW of coal-fired assets between 2017 and 2027, the installed capacity is expected to significantly increase in the short-to-medium term to keep up with the demand.

Additionally, there is a significant excess of planned coal capacity vis-à-vis the demand for 2022, with only 6.5 GW of new coal actually required vis-à-vis the planned addition of 47.9 GW, according to the National Electricity Plan.

Further, while the target for coal appears on-track to be achieved, the country is likely to fall short of its ambitious targets for renewables-based generation, at least for 2022. It is observed that any shortfall in meeting the renewable capacity-addition targets may not lead to adverse impacts on the overall energy security due to the excess of coal capacity that will be achieved. However, there is a risk of locking in new coal capacity for the next three decades.

TRANSITION READY — ACTION REQUIRED

The following parameters were found to be near transition-ready, with some additional actions required.

- **Need to firm up coal phasedown targets in NDC:** *(Parameter objective — Review of NDCs for understanding country-level goals for coal transitioning.)*

  It is observed that no targets specific to the use of coal are declared in India's 2016 NDCs. Further, the updates to the NDCs, as declared by the government, are not available yet in the NDC repository. Clearly- defined targets and planning for the phasing down of coal, especially for power production, need to be incorporated in the NDC.

- **MDBs' engagement in coal transitions at developmental stage:** *(Parameter objective — Review of MDBs' activities in the region that are aiding in funding gaps for coal-transition strategies and accelerating the decommissioning or repurposing of CPPs)*

  MDBs appear to be active in the region, providing investments for various environmental initiatives. However, no apparent initiative aimed at CPP repurposing, other than the Climate Investment Funds' Accelerating Coal Transition (CIF ACT) investment program, are present. There may be a need for MDBs to engage with relevant stakeholders and build the case for the early retirement of CPPs.

- **Found limited effective policies discouraging new coal-based power projects:** *(Parameter objective — Assessing whether there are adequate policies and regulations in place for discouraging new coal project)*

  The Government of India has introduced a cess on coal in the year 2010 with the charge of INR50 per ton. At present, the charge has been increased to INR400 per ton. The revenue from the taxation of coal production is supposed to be accumulated under the National Clean Energy Fund (NCEF) for the purpose of various regional development projects. This increase in the tax may discourage coal projects in India.

  Furthermore, MoEFCC revised the emission standards of particulate matter (PM), SOx, NOx, mercury emissions, and water consumption for thermal power plants under the Environment (Protection) Amendment Rules in 2015. To comply with these revised standards, thermal power plants are expected to upgrade their emission control systems. These standards are supposed to be achieved by 2022; however, the timeline has been further increased by another three years. It is observed that despite bringing in stringent standards for air quality, the delay in the compliance timeline is rendering it ineffective. Further, no policy initiative to explicitly stop new coal-based power projects was observed. There appears to be a need to develop effective implementation plans to support the policies that discourage new coal projects.

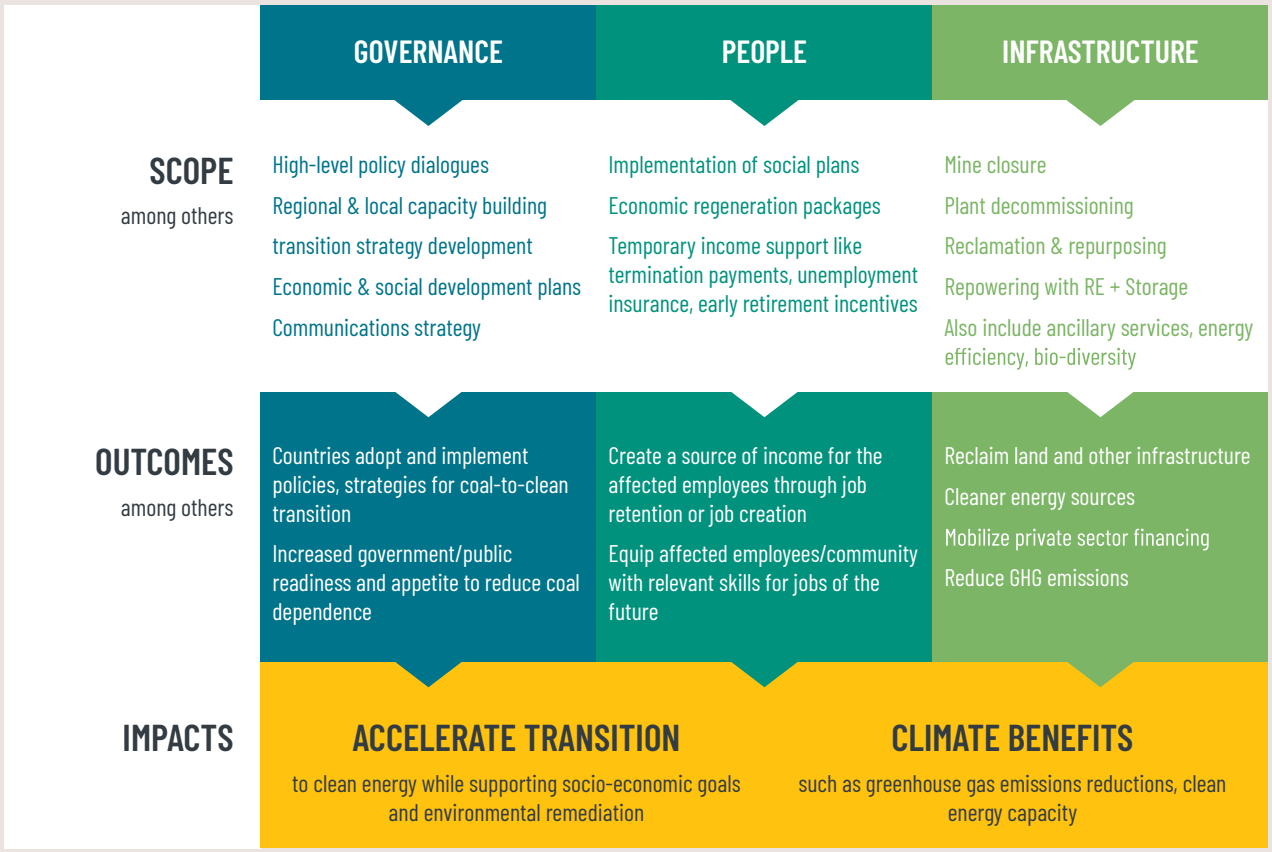
BOX 8. CIF ACT Investment Program

Coal carries climate, environmental and health costs. Global energy-related CO2 emissions have continued to rise, while CO2 emitted from coal combustion was responsible for over 0.3°C of the 1°C increase in global average annual surface temperatures above pre-industrial levels, making coal the single largest source of global temperature increase. On the other hand, renewable energy has been eroding the commercial viability of coal with share of uncompetitive coal plants estimated to rise in the coming years. On the other hand, the job growth in renewables is estimated to be greater than job losses in fossil fuels in the short-term as investments in a renewables-based energy transition is expected to kickstart economies. Finally, there is a wider appreciation of the socio-economic inter-dependencies in the coal dominated regions that make a just transition of communities transitioning away from coal a politically complex process.

Recognizing these challenges, the CIF ACT Investment Program aims to address key barriers through a holistic financial toolkit to support countries transitioning away from coal while tackling challenges linked to governance, people, and infrastructure. The program will offer support for policy and institutional reforms to support countries lay out and implement transition strategies, just transition of people and communities most affected by the transition, as well as retirement, decommissioning and repurposing of existing coal assets with climate-smart alternatives. The program would look to support both public and private sector entities with the relevant tools necessary to support the transition away from coal.

The following 4 countries have been selected for its first phase of implementation: *India, Indonesia, the Philippines,* and *South Africa,* with an indicative allocation of $200-500 million determined based on a needs assessment and strategic prioritization as expressed in the form of an investment plan. Additionally, the program is also exploring modalities to support remaining 10 countries[16] that expressed interest in participation but were not selected under the first phase of the program.

Recognizing the need to foster effective participation of women in the design and implementation of coal-to-clean transition strategies and plans, Women Led Coal Transitions (WOLCOT) Grant Mechanism was set up under ACT to support local communities and organizations working on the rights of women and other excluded groups.



- **Reassessment of direct and indirect coal subsidies required to eliminate current incentives for coal:** *(Parameter objective — Assessing whether coal used for power generation is being subsidized by the government)*

  According to multiple sources such as the International Institute for Sustainable Development (IISD), India provides considerable subsidies to the coal-fired power generation industry. The total quantity of subsidies in real terms has remained steady between INR15,660 crore (USD2.6 billion) in FY2014 and INR15,456 crore (USD2.3 billion) in FY2019. The major subsidies provided in FY2019 are as follows:

  1. Relaxation on the custom and excise duties (till FY2017) and GST (FY2018 onwards) vis-à-vis other minerals. Currently, GST is levied at a rate of 5 percent, instead of the benchmarked value of 18 percent for other minerals, thereby reducing the input costs for coal-based electricity generation by INR13,154 crore (USD2.0 billion).

  2. There is non-compliance with coal-washing regulations that would have reduced air pollution and translated into a financial benefit of INR1,027 crore (USD153 million).

  Given the volume of subsidies offered to the coal production industries, the incentives offered for renewable power should be carefully reviewed to support their scale up

- **Dedicated stakeholders' engagement plan for coal transition needed:** *(Parameter objective — Assessing whether there is a dedicated engagement plan present to involve the major stakeholders associated with coal assets repurposing and allow for the incorporation of their feedback in order to ensure effective regulatory processes)*

  While there is no specific stakeholder engagement plan for decommissioning, CERC — the main regulatory body in the electricity sector — follows the following consultation procedure. A consultation/staff paper is drafted about the regulation, which is publicized to invite comments from stakeholders. This is followed by open public hearings to elicit input on the draft regulations. These are again published for comments from stakeholders. Once these comments are received and addressed, the rules are published in *The Gazette of India* — a public journal printed by the government. A similar process is followed by MoP and MNRE when it engages in the process of framing policies.

  It is observed that the CERC guidelines for the formulation of regulations provides a blueprint that can be followed for the development of policies and regulations regarding the early retirement and decommissioning of CPPs. There is a need to bring out a general policy regarding the early retirement of CPPs following consultations with stakeholders, in accordance with CERC's guidelines. Further, there is a need to draft a procedure to engage relevant stakeholders, including coal workers and their communities, before the retirement of any plant.

- **No provisions, such as project buyout or termination at will, found in the reviewed sample pool of PPAs:** *(Parameter objective — Review of provisions for facilitating the early termination of PPAs or PSAs, without breaching the existing legal and regulatory framework)*

  In most PPAs, the compulsory acquisition of the seller's assets by an Indian government instrumentality is included as a non-natural force majeure. In the event of the force majeure, the parties are freed from the obligations to the extent caused by the force majeure. Over the past six years, NTPC has taken over six power plants. Terminations, other than by a force majeure, can occur either in case of default by one of the parties or by mutual agreement in writing.

  The exact provisions for damages change for different PPAs. In addition, some PPAs also include a provision for the procurer to mandate the seller

to vest their interest in either the procurer or its nominee in case of a seller default. Further, in the case of private generation companies, the ownership of the assets after the termination of the agreement depends on the type of agreement signed, that is, DBFOO (where ownership remains with the developer) and DBFOT (where there is a compulsory buyout by the utility).

It is noted that there is no provision for termination at will by either of the parties. However, other provisions available in the PPA can be utilized to terminate the agreement before its expiry. The provision for termination by mutual agreement allows both parties to negotiate a fair settlement to cover their investments. However, if such an agreement is impossible to arrive at, one of the parties can default and have the agreement terminated by paying the damages, as specified in the PPA. As the final and least-favored option, the government can step in and take over existing thermal power plants and retire them after compensating all the parties for their investments.

There is a need to ensure that irrespective of the process of termination of the PPA, the investments made by financiers, project developers, and off-takers are protected to the extent provided in law. Further, any mechanism should be supported by regulations that should highly disincentivize the contracting of new coal power capacity.

- **Limited supplemental energy solutions found available for ensuring renewables' supply stability:** *(Parameter objective — Assessing whether there are enough existing supplemental energy solutions available in the region to complement renewables, thus ensuring a stable power supply to meet the demand)*

  The utility-installed capacities of gas and large hydropower plants in India are 24.9 GW and 46.2 GW, respectively. However, due to the low availability of domestic natural gas and the high cost of importing fuel, the plants are run at an average PLF of less than 25 percent. Therefore, the government plans to increase the utilization of the current fleet, with no new gas capacity considered between 2022 and 2027. The Draft National Electricity Policy envisions modifying the gas power plants so that they can be used for peaking or balancing.

  Further, it is proposed that large hydropower projects be included as renewable sources for the purpose of meeting RPO targets. The National Electricity Plan identifies a potential of 96.5 GW of pumped hydro storage, of which less than 10 percent has been exploited. It is noted that the availability of gas and the commercial-scale implementation of storage solutions hold the key to India's renewables-led transition away from coal.

TRANSITION — NOT READY

The following parameters were found to be significantly lacking in transition readiness or completely missing it.

- **Found no firm long-term strategies for coal transition:** *(Parameter objective — Accessing what the country's long-term strategies are for coal transition)*

  At present, there are no policies or concrete planning in place to directly address a coal-transition process for the electricity market in India. It is observed that there is currently no clear and documented roadmap or timelines available for a coal-transition process in India. Thus, there is a need for the government to develop a comprehensive strategy and roadmap for a coal transition.

- **GHG emissions reduction targets in energy sector not evident:** *(Parameter objective — Review of the country's targets around GHG emissions reduction in the energy sector and assess whether there are any supporting policies around these targets)*

While India has committed to targets for renewable capacity in absolute terms as well as a share of the installed capacity, the country has refrained from any sector-specific mitigation obligation or action in its NDC. It is observed that India has yet to set targets in place to manage its GHG emissions, specifically with regard to the energy sector.

- **Found no mechanism preventing the reuse of retired or early decommissioned CPPs:** *(Parameter objective — Assessing whether there is a mechanism in place for avoiding the relocation or reuse of the decommissioned coal power generation facilities, which can potentially negate the impact of an accelerated coal transition)*

  No evident mechanism to avoid the relocation or reuse of coal power generation facilities was observed. As a part of the policy driving the early retirement of CPPs, there is a need to develop mechanisms to strongly disincentivize the reuse of coal to run the power plant.

4.2.2. Gap Analysis (Challenges)

This section presents the prominent challenges observed in the country, in relation to transitioning away from coal-based power, the penetration of substitute for conventional power such as renewables, or overall sectoral planning.

HEAVY DEPENDENCE ON COAL POWER

In its draft National Electricity Policy 2021, the government suggests technical and operational changes to existing CPPs so as to provide flexibility to the grid. The policy also acknowledges that there may be newbuild coal, subject to it being the most efficient state-of-art technology. The government also highlights the importance of coal in the third biennial update report to the UNFCCC, as it is the only "reliable source of energy that is available domestically in abundance" and can be exploited with indigenous technology. In the same report, it is further claimed that it will be unrealistic to expect the country to cease new coal commitments before the full post-COVID economic recovery is achieved.

Thus, although the government has set targets for the installation of renewable capacity and is working towards significant additions, it also intends to retain coal-fired capacity in the generation mix, at least in the short-to-medium term. This appears to be driven by two key factors — the apparent low cost of coal power generation and the domestic availability of both fuel and technology. It is imperative that the true cost of coal-powered generation be understood, including the impact of GHG emissions, local air pollution, water consumption, and water pollution.

COMPLEX REGULATORY ENVIRONMENT

The fragmented ownership of assets and the division of regulatory power between the union government and the state governments contribute to the complexity of introducing a new paradigm with respect to coal in the power sector, especially in terms of a larger number of stakeholders. However, this also provides an opportunity to target CPPs in the specific states that have significant potential for renewables and a supportive policy environment. The focus must be on identifying CPPs whose early retirement can serve as demonstration projects to attract interest and resources from a wider set of stakeholders. This must be done concurrently with investments in strengthening the grid and augmenting storage to ensure that the early retirement does not adversely impact the stability of the power system.

INADEQUATE PLANNING ON THE CLIMATE EQUITY FRONT

It is also important to ensure that the energy transition resulting from the early retirement of coal power is just. The Indian government has consistently spoken about the need for climate equity, highlighting the need for increased action and support from developed economies, based on the principle of "common but differentiated responsibilities" (CBDR). However, there has not been significant messaging on how the transition will have unequal impacts in the country, thus disproportionately affecting the coal-dependent economies in the central and eastern parts of the country.

4.2.3. Financing Landscape

India,[9] the third-largest economy in Asia, is one of the fastest-growing major economies in the world, with a GDP growth rate of over 5 percent between 2009 and 2018 and approximately 4 percent in 2019. India's GDP shrank by 7.3 percent in 2020 due to the COVID-19 pandemic, but is expected to rebound sharply. The government is expecting infrastructure investments worth USD1,480 billion to come in over a 5-year-period starting FY2021, with energy and road projects constituting the most significant part of the envisaged infrastructure project pipeline.

The public finance sources for undertaking a coal-repurposing initiative should include funds from the Indian government, NTPC, and other public sector generators.

The Government of India is financially constrained in directly supporting any large-scale coal- repurposing initiative, owing to its weak fiscal position and elevated debt levels. Subdued tax collections and delays in divestment receipts have led to lower revenues and further strained the fiscal balance.

NTPC, India's largest power utility, which accounts for over one-fifth of India's thermal generation capacity, is well-placed to lead a coal-repurposing initiative. This is based on (i) its sound credit profile, coupled with strong government linkages that will enable NTPC to access funding at attractive interest rates, (ii) a regulated business model that allows NTPC to earn an assured return on equity, and (iii) its robust operational performance.

While NTPC has done well over the years, the financial positions of other public-owned generation companies, notably those held by the state governments, have been rather challenging. These companies have high levels of debt, primarily driven by challenges in the collection of dues from discoms. Their weak balance sheets have forced these companies to rely on government-owned financial institutions for borrowings, which have resulted in lower credit ratings that are only supported by government linkages. These factors have resulted in the limited capacity of the state-owned generation companies to fund the coal-repurposing exercise.

Apart from the aforementioned sources, financial institutions should play an important role in financing coal-repurposing projects. PFC and REC — two such financial institutions majorly owned by the government — are focused on providing the capital to the power sector. Both companies have a strong credit profile backed by strong government linkages as well as a large asset base. Both PFC and REC are good candidates for supporting coal-repurposing activities in India, due to the sector experience gained over time and their capacity to borrow funds at favorable terms.

In addition to PFC and REC, India has a fairly developed financial system. Banks and non-banking financial institutions (NBFIs) in India are capable of financing large-scale coal-repurposing activities, due to their large asset base and proven track records in financing power projects in the country. However, these financial institutions are expected to face some challenges in mobilizing financing, due to increased non-performing assets, along with internal and regulatory sector exposure norms. Given that coal-repurposing initiatives are at a nascent stage currently, the involvement of DFIs is expected to be high in the initial stages, while participation from commercial financial institutions (particularly from the private sector) is expected to be low to moderate. However, these financial institutions are expected to become more active as the markets mature with ample precedent transactions. Participation from international commercial banks is expected to be limited, both in the short term and the long term.

TABLE 9. India: Summary of Key Financing tools

SOURCES	CAPABILITY TO FUND TRANSITION		COMMENTS
	Short Term	*Long Term*	
Government	Low 🔴	Low 🔴	• The government of India has limited fiscal room to fund the large-scale coal repurposing initiative as public finances are already stretched thin with a slowdown in the economy in recent years, further exacerbated by COVID-19. • Low government revenue driven by subdued tax collections and delay in divestments, high debt-to-GDP ratio, low credit rating and minuscule participation by foreign investors in the government bond markets limit the Government's ability to borrow additional capital to fund such repurposing.
NTPC	High 🟢	High 🟢	• NTPC is well placed to lead coal repurposing initiative driven by (i) sound credit profile coupled with strong government linkages which enables NTPC to access funding at attractive interest rates, (ii) regulated business model, which allows the NTPC to earn assured return on the equity, and (iii) robust operational performance. • While the leverage has increased over recent years, driven by capex to add new capacity, the company is still favorably placed among other utilities.
Other SOEs	Low 🔴	Low 🔴	• The majority of other generation companies, particularly state-owned companies, in the country are financially weak and continue to depend on Government support. • Weaker balance sheets and subdued credit ratings leave these companies with very little room to finance any coal repurposing initiative.
PFC and REC	High 🟢	High 🟢	• PFC and REC are highly active in the entire value chain of power sector. Further, given that they are majorly state owned and enjoy strong Government support, these institutions enjoy favorable credit ratings. Hence, funds can be mobilized via PEC and REC as long as Government mandates them to lead financing for coal repurposing projects.
SCBs and NBFCs	Medium 🟡	High 🟢	• India has a significantly developed banking sector having a large asset base, which is further supported by the presence of large NBFC segment specializing in micro credit. • SCBs and NBFCs may witness increased participation in coal repurposing projects in the India once precedent is established and risk allocation and commercial feasibility for such projects are set. However, their ability to finance such projects are constrained due to elevated level of non-performing assets in loan books (particularly in the infrastructure sector), rigid regulatory framework and sector or borrower exposure limits.
Capital Market	Low 🔴	High 🟢	• Though the corporate bond market has been growing in the recent few years, for coal repurposing projects to tap into this market, more active participation and liquidity is required from the investors. • Further, debt capital markets have traditionally been dominated by Government issuances, with the corporate bond market witnessing issuances only from top-rated corporate and Government-backed public sector companies which might act as a limiting factor. • Green bonds can be explored post addressing certain country specific challenges relating to high hedging costs, shorter tenor of issuances and unattractive yields in the long term.
Carbon Market	Low 🔴	Medium 🟡	• Currently, the ESCert markets are illiquid, with discovered prices being very low due to oversupply of certificates, and unable to provide any meaningful capital to fund the repurposing activity. • Moreover, trading platforms lack ample buyers that would be able to absorb the large number of certificates generated by any repurposed asset. • The carbon market will have to be further developed in the long term to generate any significant value for coal transition. The international carbon markets may provide a suitable financing alternative to undertake the coal repurposing activity.

Capital markets may also play an important role in financing coal-repurposing initiatives, especially over the long term. Indian debt capital markets, which feature a significant amount of credit outstanding, have witnessed growth in recent years. However, the markets are dominated by government securities, with public sector firms and financial institutions controlling a large chunk of the corporate bond markets. Indian debt capital markets will need to witness participation from a broader investor base and enhanced liquidity in the secondary markets before being able to provide meaningful capital to coal-repurposing activities.

India is the second-largest issuer of green bonds from emerging nations, after China. However, the markets are dominated by financial institutions and large corporations. Green bonds could be considered a viable source of funding in the long term, once several country-specific challenges, such as high hedging costs for international investors, the shorter tenor of issuances, and unattractive yields, are addressed.

Other than the various sources specified above, carbon markets may be a long-term source of finance for a repurposing initiative. While India does not have a formal carbon trading system in place as of now, the country has been running another market-based mechanism called ESCerts to promote energy efficiency since 2012. However, the utilization of ESCerts as a viable source of funding is expected to be limited, due to restrictions on the scope of the scheme that only allows for projects pertaining to the promotion of energy efficiency. Moreover, trading markets face challenges due to the oversupply of certificates, low prices, and subdued volumes. Although India's carbon market is in a development phase currently, there are other international developed markets that may prove to be a suitable financing avenue for a coal-repurposing activity.

4.3. Indonesia

Indonesia is the largest archipelago and the fourth-most populous country in the world. An active member of G-20, the country has the largest economy in Southeast Asia as well as the seventh largest global economy in terms of purchasing power. One of the largest coal exporters in the region, Indonesia caters to most of its electricity demand through coal and gas, thereby demonstrating a heavy dependence on conventional fuels as a primary energy source.

4.3.1. Readiness Analysis — Regulatory and Policy Environment

4.3.1.1. Overview of Regulatory Environment

- The President of Indonesia is the most influential and powerful stakeholder on the government side. He possesses the prerogative authority to determine the energy vision for the country. Furthermore, he also shapes the development and implementation of policies at the national and local levels. To achieve the President's energy vision, the National Energy Council (DEN), in collaboration with the Ministry of Energy and Mineral Resources (MEMR), conceptualizes the National Energy Policy (KEN) before submitting it to the national legislature for approval. At the central governmental level, the House of Representatives (DPR) is responsible for enacting laws on electricity.
- DEN was formed to address issues related to the energy management of the country. The main body responsible for cross-sector energy issues, it also oversees the implementation of national energy targets outlined in the National Energy General Plan (RUEN). Finally, it assists regional governments in the development of regional energy general plans (RUED) and supports provinces interested in developing clean energy.
- MEMR holds a critical position as compared with the other stakeholders in the regulatory setup, as it is the focal point for the energy sector. MEMR is a member of the National Advisory Group (NAG) whose aim is to improve multilevel governance and understand on-the-ground issues for developing a comprehensive policy addressing local issues. It is responsible for the development and issuance of energy policies and programs that are aligned with the energy vision stipulated in KEN and RUEN. It also oversees the implementation of policies at the national and local levels.
- The Ministry of National Development and Planning (BAPPENAS) plays an integral role in the conceptualization of energy programs related with the national development plan. BAPPENAS ensures that the energy programs developed by MEMR are accommodated and incorporated into the National Medium-Term Development Plan

(RPJMN). Its participation appears to be imperative for energy programs to be translated into action at the national and local levels.

- PLN is an Indonesian state-owned electricity company that dominates the power transmission, distribution, and sales market in Indonesia. It is also the biggest player in the power generation market in the country, contributing to more than 95 percent of total power generation in Indonesia. PLN also contributes to the development of RUEN in coordination with MEMR, along with relevant technical ministries and institutions.
- The Directorate General of New and Renewable Energy and Energy Conservation (DGNREEC) formulates and implements policies relating to geothermal, bioenergy, along with other renewable or new energies.
- Local government and district regulations also affect the development of energy sector projects at the regional level, along with the execution of the energy policy and plan at the provincial level, with impacts at the city and regency levels.
- The Coordinating Ministry for Economic Affairs (CMEA) is a government ministry in charge of planning and policy coordination, as well as the synchronization of policies in the field of Economics.
- The Ministry of Environment and Forestry (MoEF) is responsible for the national environmental policy and planning in the country. Its focus is to establish reliable and proactive institutional action for sustainable development and prosperity through the application of good environmental governance principles. MoEF coordinates policy implementation, provides technical guidance, and supervises the environmental management of sectoral ministries and provincial environment authorities. MoEF aims to build partnerships for the fair, efficient use of environmental resources and the protection of communities through pollution and resource damage prevention.
- The Ministry of State-Owned Enterprises (MSOE) is responsible for overseeing the development of state-owned enterprises in Indonesia. The SOEs in Indonesia comprises Perusahaan Umum (Perum), a public-owned company, and Perusahaan Perseroan (Persero), a joint-stock company.

The following figure provides an overview of the major participants in the electricity market in Indonesia.

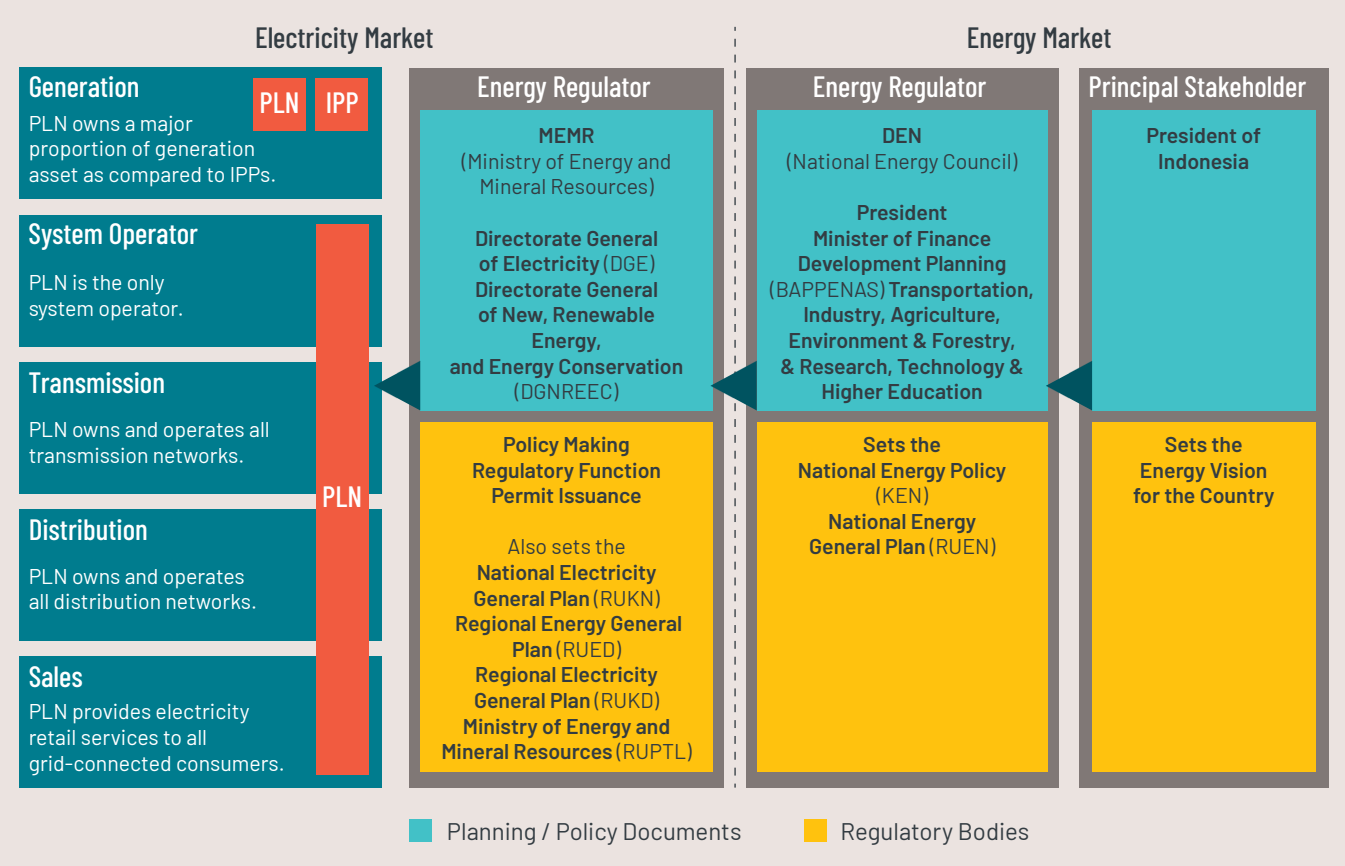


FIGURE 19. Overview of the Energy Market in Indonesia

As evident from the above figure, PLN as a state-owned entity is responsible for generation and has exclusive power over the transmission, distribution, and sale of energy.

- PLN is responsible for most of Indonesia's electricity generation, either itself or through its subsidiaries, for example, Indonesia Power and the Java-Bali Generation Company (PT Pembangkitan Jawa Bali). This is because under the Electricity Law, PLN has the right of first refusal for all business areas *(wilayah usaha)*.
- Private sector participation is legal for business areas not covered by PLN. This usually takes place through IPP agreements or PPPs.
- PLN has exclusive powers over the transmission and distribution of electricity. It is the sole owner of the transmission and distribution assets in Indonesia. IPPs have the right to construct transmission and distribution lines, but ownership is generally transferred to PLN upon completion.
- PLN is the sole entity responsible for the supply of electricity to all of Indonesia and thus monopolizes the sale of electricity to end-consumers.

In addition to the market participants discussed above in this section, some other key influential stakeholders for the repurposing of CPPs are noted as follows:

- The Ministry of Finance (MoF): It is responsible for the allocation of budgets to the "National Medium-Term Development Plan" (RPJMN) that consists of the energy programs. In addition, it is also responsible for the allocation of the necessary financial incentives in the energy sectors.
- The Ministry of Industry (MoI): It provides direction on the use of energy efficiency in industries; thus, it is involved directly in the energy issue.

- ICLEI — Local Governments for Sustainability: It is an international NGO that promotes sustainable development. ICLEI provides technical consulting to local governments to meet sustainability objectives.
- Vena Energy Arisudono Soerono: It is one of the largest independent renewable energy developers in the Asia-Pacific region. It owns the largest private solar plant in Indonesia.
- Masdar Clean Energy: An Abu Dhabi-based future energy company, Masdar is a leading developer and operator of utility-scale renewable energy projects and community-grid projects. It is the developer of one of the largest floating solar power plant (PLTS) projects in Cirata, West Java, with a capacity of 145 MW.

BIDDING MECHANISM FOR NEW CAPACITY ADDITION

After reviewing the project-bidding mechanisms for new projects, it was noted that the Government of Indonesia has a well-defined bidding mechanism for the development of power generation projects in the country. This includes meeting the prerequisites for the qualification of the deal, the selection of the project developer through the appropriate tender, or the direct appointment mechanism. The selection process is subject to plant technology, fuel, plant capacity, agreement on the tariff mechanism, and the ownership structure of the plant.

According to current regulations, the process of selecting a project is driven by direct allocation and direct selection (tender mechanism), depending on the technology and capacity of the plant. Power plants with intermittent power supply, using high-end and efficient technology, are considered under the direct selection process, based on "capacity quota," for PLN. Capacity quota is the maximum capacity of energy that PLN will buy from a renewable power generation plant of a specific type for a certain period of time and at a certain predetermined price. For example, hydro projects utilizing multi-function dams or irrigation channels can be appointed using direct appointment. They will be carried out through a separate procurement regime under the purview of the Ministry of Public Works and Public Housing. Waste-to-energy projects are usually selected according to the regulations of the local government. PLN is also permitted to appoint the IPP project developer through a direct appointment procedure in crisis and emergency situations.

According to existing regulations, all renewable projects were developed, using a "build, own, operate and transfer (BOOT)" scheme. This provision was amended in 2020, when the project ownership mechanism was converted to the "build, own, operate (BOO)" mechanism. Even the projects that were previously developed under the BOOT scheme were eligible for transfer to the BOO scheme.

In short, the process of the selection of projects in Indonesia's power generation sector is either via direct allotment by PLN or by direct selection / competitive bidding through the tender process. Direct appointment by PLN is limited to special circumstances.

POWER PURCHASE AGREEMENT (PPA) REVIEW

Sample PPAs of power plants of various capacities and technologies from Indonesia were reviewed carefully for the purposes of this study. It can be observed that the exit provisions, consequences of termination, and computations of penalties were clearly defined for both the parties in the PPA.

For the PPAs entered with PLN, an early facility buyout provision (before the expiry of the PPA term), under certain conditions, was noted. A buyout provision is also defined for post-PPA term expiry and a result of defaults by either party. In the event that the defaulting party happens to be PLN, PLN is usually obliged to buy out the plant. The purchase price was found to address multiple factors, such as senior debt outstanding at the calculation date, the sponsor's equity commitment, the contingent equity commitment, the sponsor's actual equity contributions, the age of the plant after the commercial operations date, the net dependable capacity, the agreed projected availability factor, capital cost recovery, the capital cost recovery charge rate for the transmission line, and the charge rate. Thus, it appears that the exit provisions for most of the PPAs entered with PLN are well-defined.

PREVAILING POLICIES AND LAWS

The energy policy framework in Indonesia is broadly segregated into two major branches:

- Policies related with the addition of fossil fuel and renewable energy generation; and
- Energy efficiency policies focusing on driving sustainability.

The two primary laws governing the electricity market in Indonesia are Energy Law No. 30/2007 and Electricity Law No. 30/2009. The implementation of the laws is regulated under Government Regulation No. 14 of 2012 on electricity supply business activities, as amended by Government Regulation No. 23 of 2014 (GR 14/2012). The laws are implemented at the presidential, ministerial, director general, and provincial government offices in alignment with the Energy and Electricity law. In addition to these two important laws, as discussed further in detail in the section below, there are several other miscellaneous laws that have some bearing on the country's electricity sector.

LAW ON ENERGY: ENERGY LAW NO. 30/2007

Based on the research conducted from sources such as IEA and Asia Pacific Energy, the law focuses on achieving energy security through the use of greener fuels and dictates energy mix planning. This law lays down the foundation for the development of renewable energy regulations and envisages the financial incentivization of renewables. This law also governs the areas of energy conservation and energy pricing to ensure fair pricing. Other areas covered under this law are related to rural electrification, domestic content level (with an emphasis on the use of domestic goods and services), the environment, and safety.

LAW ON ELECTRICITY: ELECTRICITY LAW NO. 30/2009

The highlight of this law appears to be PLN's plan of becoming vertically integrated in Indonesia's electricity market. PLN will be the main generation company and also hold a dominant position in the electricity transmission and distribution markets. The law provides PLN with the "right of first priority" to supply electricity to customers. Also, the law mandates the needs of licensing for private-owned businesses to provide electricity for public use (IUPTL). Additionally, this law regulates cross-border power purchases.

4.3.1.2. Vision and Policies for Low-Carbon Growth

NATIONALLY DETERMINED CONTRIBUTIONS (NDCS)

Indonesia's NDCs, issued in 2016 and amended in 2020, aim to achieve the target of decarbonization by restructuring the country's energy mix. It plans to gradually reduce the dependency on coal and oil, while emphasizing increases in renewables and gas power. The share of fuels in the energy mix, as observed in the NDCs, are presented as follows:

- Renewable energy share — at least 23 percent by 2025 and at least 31 percent by 2050;
- Oil — less than 25 percent by 2025 and less than 20 percent by 2050;
- Coal — minimum of 30 percent by 2025 and minimum of 25 percent by 2050; along with
- Gas — minimum of 22 percent by 2025 and minimum of 24 percent by 2050.

It is observed that while there is a cap imposed on oil's share in the total energy mix, there is no corresponding limit on coal.

Indonesia's NDC has set an emissions reduction target of 29 percent of the "business-as-usual" scenario by 2030. And if it receives international support for finance, technology transfer, and development, it is aiming at a targeted reduction of emissions of up to 41 percent.

LONG-TERM STRATEGY FOR LOW CARBON AND CLIMATE RESILIENCE (LTS-LCCR) 2050

The Long-Term Strategy Document, submitted by Indonesia in 2021, aims to contribute to the global goal, while also focusing on achieving national development objectives, by taking into consideration the balance between emissions reductions, economic growth, justice, and climate-resilient development. As per the new 2030 climate targets submitted, Indonesia has set an unconditional target to reduce

GHG emissions by 29 percent below the "business-as-usual" scenario or up to a 41-percent reduction target, contingent on the receipt of sufficient international financial support. Based on the long-term strategy submitted to UNFCCC, Indonesia indicated that its GHG emissions will decline by an average annual emissions rate of 30.7 MT CO_2e, ultimately reaching potential net-zero emissions by 2060.

This long-term strategy report suggests plans to use biomass and biofuels as a substitute for conventional fuels in the power generation and transport sectors, with an intention of minimizing the emissions of GHGs.

INCENTIVES ON BIODIESEL

The Indonesian government provides fuel subsidies for the cost differential between the diesel fuel and biofuels, as defined by the market index price. This is with the objective of absorbing the palm oil produced by the world's top producer and minimizing the import of diesel.

SUPPLEMENTARY ENERGY SOURCES FOR THE STABILIZATION OF RENEWABLES

In terms of supplementary energy sources that can aid stable power supply from renewables, it is noted that gas has been the most popular fuel other than coal, which can help maintain the energy security of the country. At present, gas contributes to more than 17 percent of the total power production, with hydropower being another dominant contributor of the electricity produced by renewable resources. It contributes to almost 8 percent of the total installed capacity in Indonesia and almost 53 percent of the total renewable installed capacity, along with almost 9 percent of the total electricity in Indonesia.

However, no evident dedicated planning for a battery storage system was observed. Based on some of the studies by external agencies, it was observed that a battery storage system might not be considered in the short term, as it would reduce the economic competitiveness of solar power plants by increasing the overall project cost.

INDONESIA TO DISCOURAGE NEW CPPs BEYOND 2023

The government has indicated that it will stop issuing approvals for the construction of new power plants beyond 2023. This decision is planned to be implemented in alignment with the net-zero vision set by the President of Indonesia. The government plans to meet the electricity requirement, predominantly through the development of renewable power generation plants.

However, this decision is not expected to cover the CPPs currently under development and have already received approval. The government intends to complete the construction of such approved CPPs by 2023.

CPP RETIREMENT

The process of CPP retirement is planned to be conducted as a gradual incremental process. The Indonesian government plans to retire all its coal-based power plants by 2055, except for the new power plants, cumulating to 21 GW in capacity. Their planned operation is up to approximately 2065.

PLN plans to retire 1.1 GW capacity of gasified CPPs by 2030 and 49 GW of CPPs by 2055. The micro-level retirement plan at a plant level is not recognized; however, RUPTL 2022—2030 indicates the availability of a retirement plan until 2030 for the regions of Sumatera, Sulbagut, Sulbagsel, Ambon, Jayapura, Sofifi, and Manokwari.

Indonesia's finance minister has also suggested the possibility of an early retirement of CPPs by the year 2040, subject to the receipt of desired financial assistance from the international community.

CARBON TAX REGULATION

The Indonesian government is planning to announce its first carbon tax and trade policy. The policy will follow a cap-and-trade system, where the pollution level is restricted and allowances could be traded by business entities within the country and across borders. Power plants with higher carbon emissions than the stipulated limit will be required to purchase the necessary offsets or pay a tax of IDR30,000/MT CO2e (i.e., USD 2.1). The details of the regulations will be finalized when this policy is implemented.

BIOMASS FOR CO-FIRING WITH COAL

PLN plans to use biomass as a complementary fuel for coal-based generating stations. PLN started co-firing 17 CPPs after the successful completion of a study conducted on 117 power plants in 2020. The total biomass capacity was identified to be around 189 MW.

FINANCIAL PROJECTIONS FOR THE NET-ZERO TARGET

Based on the research conducted by BAPPENAS, Indonesia will need a significant investment of approximately USD150–200 billion per year from 2021 to 2030, USD700 billion–1 trillion per year over the next decade, USD1.3–1.6 trillion per year from 2041 to 2050, and USD2.1– 2.2 trillion per year over the two decades thereafter to meet the necessary net-zero target.

4.3.1.3. Readiness Review

The graphic here presents the analysis of the 18 important parameters, identified for assessing the country's regulatory and policy readiness for transitioning away from coal power. Each of these 18 listed parameters lie within one of the quadrants that are in the descending order of preparedness from a "transition ready — advanced" stage to a "transition — not ready" stage. In addition, these 18 parameters are further segregated into three functional areas: climate, regulatory, or power sector.

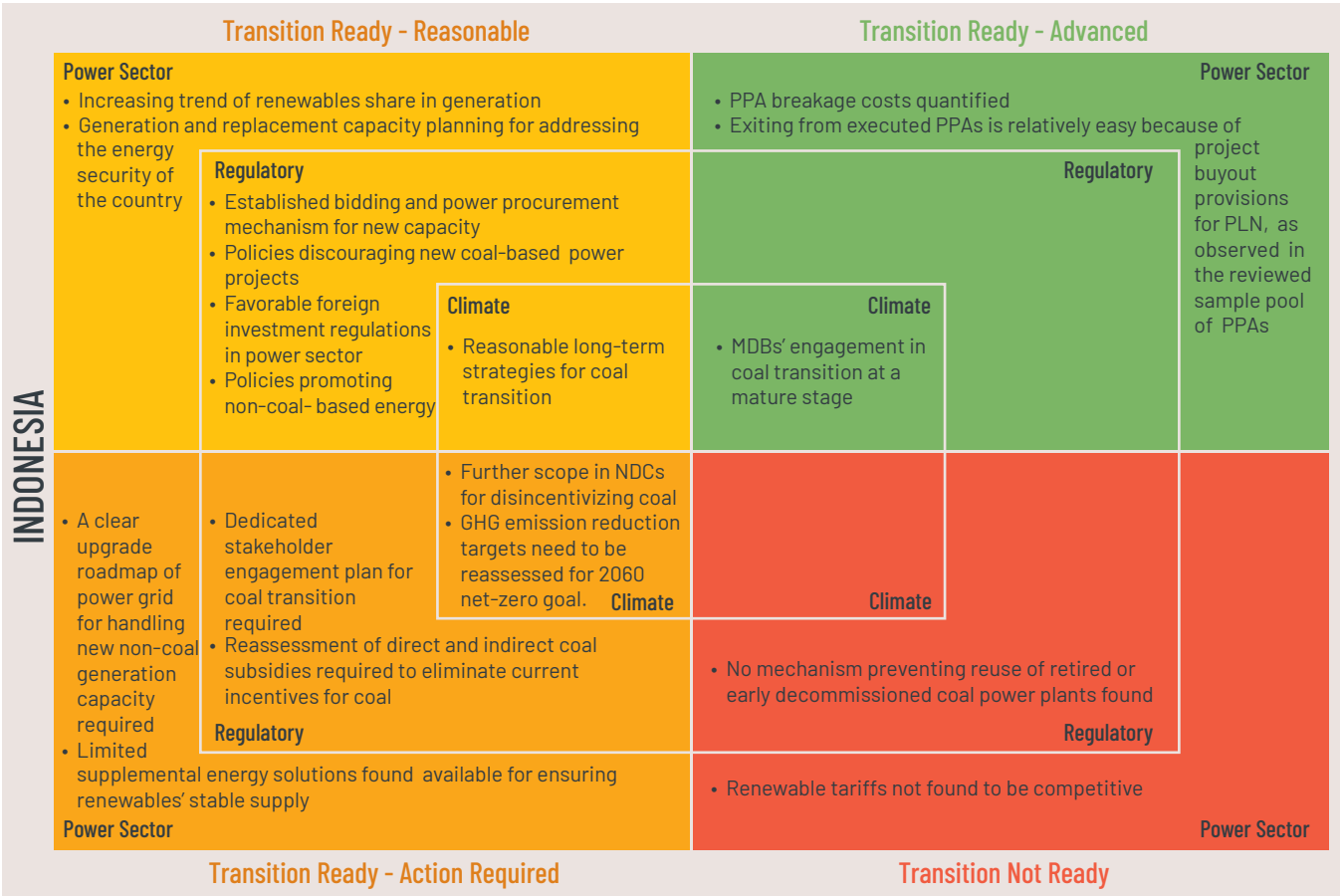


FIGURE 20. Transition Readiness Matrix of Indonesia

The findings and assessment evaluating the country's coal-transition readiness are presented below.

TRANSITION READY — ADVANCED

For Indonesia, PPA-related aspects appear to be mature and easy to engage, if PLN is onboard. The following section discusses the advanced parameters.

- **MDBs' engagement in coal transitions at a mature stage:** *(Parameter objective — Review of MDBs' activities in the region that are aiding in funding gaps for coal-transition strategies and accelerating the decommissioning or repurposing of CPPs)*

  MDBs are understood to be active in the region, providing investments for the development of clean technology. Certain transition mechanisms are under various implementation stages in the areas of the early retirement or repurposing of CPPs on an accelerated timeline and new clean-energy investments in generation, storage, and grid upgrades.

- **Exiting from executed PPA relatively easy:** *(Parameter objective — Review of provisions for facilitating the early termination of PPAs or PSAs without breaching the existing legal and regulatory framework)*

  Indonesian PPAs with PLN have the provision for the off-taker (PLN itself) to buy out the project during the contract term of the PPA and post termination of the PPA. Therefore, it appears that there are no major legal challenges for exiting a PPA from the off-taker's perspective.

- **Quantification of PPA breakage costs well-defined:** *(Parameter objective — Assessing whether there is a mechanism outlined in the PPA for quantifying different breakage charges, such as the termination amount, the facility buyout price, and other forms of compensation)*

  A facility buyout price was noted to be dynamic and dependent on multiple factors. However, these buyout prices were found to be well-defined in the PPAs.

TRANSITION READY — REASONABLE

The following parameters were found to be reasonable, in terms of their role in coal-transition readiness.

- **Reasonable long-term strategies for coal transition:** *(Parameter objective — Accessing what the country's long-term strategies for coal transitions are)*

  A long-term strategy for low carbon and climate resilience (LTS-LCCR) that presents a long-term national policy direction on climate change targets was available. It includes the development of three scenarios: (1) CPOS — extended unconditional commitment of the NDC/current policy scenario, (2) TRNS: transition scenario, and (3) LCCP — low-carbon scenario compatible with the Paris Agreement target.

  At present, Indonesia does not have a detailed coal retirement plan implemented; however, there are plans to shut down old operational CPPs by 2055. New CPPs, with a cumulative capacity of 21 GW, are planned to be operated until 2065.

  After reviewing LTS-LCCR, it is observed that, even in the pathway for net zero by 2060, coal is expected to be a major source of energy at least for the next decade, though it is expected to go down subsequently. Similarly, the planned proportion of coal in the electricity generation mix is expected to go down after 2030. However, the implementation of LTS-LCCR, post 2030, will be governed by future NDCs.

- **Favorable foreign investment regulations in the power sector:** *(Parameter objective — Review of the country's foreign investment regulations in favor of planned funding for aiding an accelerated coal transition)*

The Government of Indonesia has implemented Presidential Regulation No. 10/2021 under the Omnibus Law for stimulating economic growth through foreign investment. It is noted that its aim is to create opportunities for the private sector to participate in clean-technology transformations.

- **Reasonable policies promoting non-coal-based energy:** *(Parameter objective — Assessing whether there are adequate policies in place for the promotion of alternative sources of energy other than coal)*

  Key measures for promoting alternative sources of energy, which are evident in Indonesia, are MoF's regulations for the exemption on the import duty on the goods used in geothermal plants; tax incentives for renewable activities; its renewable energy purchase policy prioritizing plants under 10 MW of capacity and mandating a priority grid access under a "must-run" regime; its roadmap for the (application, installation, and licensing) requirements for rooftop solar PV; the promotion of biofuels by creating a biofuel development roadmap; along with the provision of feed-in-tariffs for biomass and municipal waste and mandates for PLN to buy electricity from these facilities. It is observed that there are regulations / policies in place to promote alternative sources of energies other than coal power.

- **Reasonable plans discouraging future new coal-based power projects observed:** *(Parameter objective — Assessing whether there are adequate policies and regulations in place for discouraging new coal projects)*

  Indonesia's government has committed to stop issuing approvals for new power plants and their construction beyond 2023. However, this decision was not found to be formalized in the form of a policy or regulation, and appears to be at a developmental stage. Also, this commitment is not expected to affect the approvals of the CPPs that have already been approved.

- **Reasonably established bidding and power procurement mechanism:** *(Parameter objective — Assessing whether there is a defined bidding and power procurement mechanism for the selection of new projects that can potentially replace existing coal assets)*

  It is observed that the process for selecting projects in Indonesia's power generation sector is defined. It takes place via the process of direct allotment by PLN or competitive bidding through a tender process. Direct appointment by PLN is limited to special circumstances. Further, the tariff at which power is purchased by PLN is governed by the BPP (biaya pokok produksi / production cost).

- **Increasing trend of renewables share in generation:** *(Parameter objective — Assessing whether the share of renewables is increasing in the country's overall energy mix)*

  The proportion of renewables in the overall electricity generation mix is observed to be increasing. Its generation share increased from 11.9 percent in 2011 to 18.2 percent in 2020 — corresponding to 21.7 terawatt-hour (TWh) to 53 TWh, respectively. According to the Electricity Supply Business Plan (RUPTL) 2021–2030, the target for the electricity generated using renewable energy is expected to increase to 23 percent by 2025 and 25 percent by 2030. The share of renewables has historically increased, with the trend expected to continue in the future.

- **Reasonable generation and replacement capacity planning for addressing the energy security of the country:** *(Parameter objective — Assessing whether there is adequate planning and / or a mechanism present for addressing the energy security of the country to also ensure that the new generation capacity planned to replace the coal projects being decommissioned is achievable)*

  It is observed that there are reasonable planning mechanisms in place, in the forms of the National Electricity Policy (KEN), National General Electricity plan (RUEN), National Electricity Plan (RUKN),

Regional Energy Plan (RUED), Local Regional Electricity Plan (RUKD), RUPTL, to address the energy security of the country. These national / regional-level energy planning documents are in alignment with the energy vision set by the President of Indonesia.

RUPTL is a detailed 10-year electricity development plan guiding PLN in the development of power projects in Indonesia. It takes into account the demand forecast analysis for the country to meet future demand. Also, it helps in defining the implementation roadmap and realigns the objectives of achieving the energy targets set by the government. RUPTL also draws out the PLN's action plan for new capacity additions and the decommissioning planning for the next 10 years until 2030.

It is observed that there is reasonable planning (long-term and short-term) in place to address the energy security of the country.

TRANSITION READY — ACTION REQUIRED

The following parameters were found to be near transition-ready, with some additional actions required.

- **Further scope in NDCs for disincentivizing coal:** *(Parameter objective — Review of NDCs for understanding country-level goals for coal transitioning)*

  The NDCs issued in 2020 aim to achieve the target of decarbonization by restructuring the energy-mix targets. It plans to gradually reduce the country's dependence on coal and oil. It is observed that while there is a cap imposed on the oil's share in the total energy mix, there is no corresponding limit on coal. In the updated NDCs, the government should consider putting a limit on coal's share in the total energy mix and not mandating a certain minimum contribution.

- **GHG emissions reduction targets need to be reassessed considering the 2060 net-zero goal:** *(Parameter objective — Review of the country's targets around GHG emissions reduction in the energy sector and to assess whether there any supporting policies around these targets)*

  Indonesia submitted LTS-LCCR 2050 in which emissions reduction targets are mentioned. Based on the new 2030 climate targets submitted, Indonesia has set an unconditional target of reducing GHG emissions by 29 percent below "business-as-usual" by 2030 or a 41-percent reduction target contingent on sufficient international financial support. Based on the long-term strategy submitted to UNFCCC, its GHG emissions should peak in 2030, followed by an average annual decline in emissions of 30.7 MT CO_2e, and reaching potential net-zero emissions by 2060. However, environmental research institutes, such as the Climate Action Tracker (CAT), have expressed concerns on the measures implemented to meet the 2060 targets. It appears that the 2030 targets are still too conservative in nature, which can potentially make the achievement of the 2060 net-zero target a challenge.

- **Dedicated stakeholders' engagement plan for a coal transition needed:** *(Parameter objective — Assessing whether there is a dedicated engagement plan present involving the major stakeholders associated with coal assets repurposing and allowing for the incorporation of their feedback to ensure effective regulatory processes)*

  It is observed that the general regulatory framework for Indonesia identifies and defines the responsibilities of the key stakeholders, as well as establishes a high-level engagement structure between them. However, no focused stakeholder engagement plan, with reference to early retirement procedures for CPPs and their repurposing, was found.

- **Reassessment of direct and indirect coal subsidies needed to eliminate current incentives for coal**: *(Parameter objective — Assessing whether the coal used for power generation was being subsidized by the government)*

  Indonesia provided over IDR9,702 billion (USD0.7 billion) of fiscal support per year to coal power production (2016–2017 average). The government decreed a maximum price of IDR991,592 per ton (around USD70/ton) for coal sold to power plants in 2018 and a minimum domestic allocation (20–25 percent) of production for 2018–2019 to PLN. This acts as a subsidy for PLN for the consumption of 114 million tons of coal in the domestic market, resulting in an approximate benefit of IDR20,000 billion (USD1.4 billion). Moreover, the government provided subsidies of IDR30,953 billion (USD2.3 billion) as fiscal support for coal power consumption per year (2016–2017 average). This subsidy increased from IDR47,700 billion (USD3.4 billion) in 2018 to IDR57,000 billion (USD4 billion) in 2019.

  There is a need to reassess the benefits provided to the coal power generation industry. The reduction or removal of existing subsidies to the coal industry will provide additional opportunities to repurpose existing CPPs and make non-coal-based technologies more commercially competitive.

- **A clear upgrade roadmap of the power grid for handling non-coal generation capacity is required:** *(Parameter objective — Assessing whether the power grids in the country are suitable for effectively handling new renewable capacity and non-coal-based electricity generation.)*

  The Indonesian government plans to reach a 100-percent electrification ratio by 2022 and modernize its grids by implementing smart grid technologies, an automatic dispatch system, a smart micro grid, advanced metering infrastructure technology, an advanced control center, an adaptive defense scheme, a digital substation etc. The government has recently started collaborating with MDBs on grid-strengthening programs in support of power generation expansion planning and providing sustainable energy services, including renewable energy sources such as solar and wind.

  These efforts are critical for moving away from coal power generation, as grids in the country already face issues of electricity distribution to islands (especially the rural communities), due to its complex geographical topography, the unequal distribution of natural resources, and environmental calamities. Curtailment issues and the challenges faced, due to its archipelago nature, need to be further studied.

  Nonetheless, programs for grid strengthening are either in its initial phase or have implementation roadmaps that are not clearly defined. A clear roadmap for upgrading grid technologies suitable for handling effective power distribution is needed.

- **Limited supplemental energy solutions available for ensuring renewables' supply stability:** *(Parameter objective — Assessing whether there are enough existing supplemental energy solutions available in the region to complement renewables, thereby ensuring the stability of the power supply for meeting demand)*

  According to RUPTL 2021–2030, natural gas will be the main source of fuel for electricity generation after coal and renewable energy sources. The proportion of electricity generation targets for natural gas for 2025 and 2030 remain constant at 15.6 percent and 15.4 percent of the total electricity generation, respectively.

  Currently, there isn't any dedicated planning for a battery storage system.

  At present, hydropower plants contribute to almost 8 percent of the total installed capacity in Indonesia, that is, almost 53 percent of the total renewable installed capacity.

It is observed that, at present, the supplementary energy sources are characterized by limited readiness for aiding the stability of the power supply from renewables. Measures in the direction of growth of a battery storage system and an improvement of the gas infrastructure will help in making renewable power more stable in terms of supply.

TRANSITION — NOT READY

The following parameters were found to be significantly lacking in transition readiness or completely missing it.

- **Found no mechanism preventing the reuse of retired or early decommissioned CPPs:** *(Parameter objective — Assessing whether there is a mechanism in place for avoiding the relocation or reuse of decommissioned coal power generation facilities, which can potentially negate the impact of an accelerated coal transition)*

  No evident mechanism to avoid the relocation or reuse of coal power generation facilities was observed. As a part of the measures driving the early retirement of CPPs, it is preferable to develop a mechanism for preventing the reuse of decommissioned plants.

- **Renewable tariffs not found to be competitive:** *(Parameter objective — Assessing whether current renewable tariffs are competitive enough to disincentivize coal power projects)*

  The power tariff in Indonesia is driven by BPP — the quantification of the cost of generation amount. The BPP reflects the cost of PLN in generating power and in procuring electricity supplies from third-party suppliers such as IPPs, but it does not include the cost of transmitting the electricity.

  For regions where the local BPP is higher than the national BPP, the maximum purchase tariff for the sale of electricity (to PLN) is equal to 85 percent of the local BPP. This indicates that developers will be engaged in a reverse-auction type bid, whereby the lowest price will win the capacity.

  Regions where the local BPP is equal to, or lower than, the national BPP, the purchase tariff will be the same as 100 percent of the local BPP. This indicates that there is no bidding competition on price, as the price is set precisely at the local BPP. A "first come-first serve" basis of selection is adopted by the government or PLN to determine which developer is to be awarded for the capacity being put on offer.

  The BPP for coal power generation in Indonesia is comparatively lower than renewable power generation. As the proportion of coal power generation is significantly higher in the energy mix, the average national BPP tends to be lower than the renewable BPP.

  This indicates that the present tariff mechanism does not provide a competitive advantage for renewable energy projects, making the projects less financially viable for renewable energy developers. Therefore, a mechanism for ensuring competitive tariffs for renewable power projects is needed.

4.3.2. Gap Analysis (Challenges)

This section presents the prominent challenges observed in the country, in relation to transitioning away from coal-based power, the penetration of substitutes of conventional power such as renewables, or overall sectoral planning.

NON-COMPETITIVE TARIFF MECHANISM FOR RENEWABLES

In Indonesia, tariff-related regulations (MEMR 50/2017 and MEMR 4/2020) for renewable energy projects mentions that the renewable tariffs in Indonesia are driven by the BPP. The BPP reflects PLN's cost in generating power and procuring the electricity supply from third-party suppliers such as IPPs; however, it does not include the cost of transmitting the electricity.

According to the study conducted by the multinational law firm Baker McKenzie, regions where the local BPP is higher than the national BPP, MEMR Reg 12 provides for a "maximum" price that is equal to 85 percent of the local BPP. This indicates that developers will be engaged in a reverse-auction type bid where the lowest price will win the capacity. When the BPP is equal to, or higher than, the local BPP, then the regulation requires the purchase price to be "the same as" 100 percent of the local BPP. A "first come-first serve" basis of selection is adopted by the government or PLN to determine which developer will be awarded the capacity being put on offer in the case where the local BPP is lower than the national BPP. The tariff mechanism for the power generated using biofuels are exempted from the BPP tariff structure. In situations of waste-to-energy projects, its tariff is fixed at a maximum of USD13.35/kWh for projects under 20 MW.

In Indonesia, the BPP for CPPs is comparatively lower than other power generation sources, as coal remains the most popular power generation technology and one of the cheapest forms of energy in Indonesia. As the proportion of coal power generation is significantly higher in the energy mix, the average national BPP tends to be lower than the renewable BPP. This indicates that the current tariff mechanism does not provide a competitive advantage for renewable energy projects, thus making these projects less financially viable for renewable energy developers.

4.3.3. Financing Landscape

The Republic of Indonesia,[10] the largest economy in Southeast Asia, has consistently grown at approximately 5 percent since 2014. The country has faced several economic challenges in recent years due to the COVID-19 pandemic. The country's National Development Planning Agency estimated that the country would require an infrastructure investment worth USD444.5 billion, equal to 6.1 percent of its GDP, between 2020 and 2024, to stimulate the economy. This will require significant private sector participation in infrastructure development.

The public finance sources, available for funding the coal-repurposing activity, comprise the government's funds and the funds from PLN. While the government's fiscal position is relatively better than its regional peers, it is constrained in its ability to fund any large-scale coal-repurposing exercise due to a lower tax base and a ceiling on the fiscal deficit that the country can run. Furthermore, the country has significant dependence on the external sector, with a considerable amount of borrowings denominated in foreign currency and held by foreign investors.

PLN, the country's state-owned utility company, accounted for approximately 75 percent of the country's total installed capacity as of June 2021. The entity faces certain challenges due to non-cost-reflective end-user tariffs, stagnating power demand, and significant dependence on foreign currency borrowings, amongst others. However, PLN is supported by low production costs (largely driven by the availability of cheap domestic coal) and financial monetary backing from the government. The aforementioned government support, coupled with a credit rating equivalent to that of the sovereign, should provide PLN with the ability to support coal-repurposing initiatives (even if in a limited capacity).

In terms of the strength of the financial institutions in the country, Indonesia's banking industry is robust and well-regulated. It allows the country to provide the requisite large amounts of funds to support coal-repurposing projects. Nonetheless, DFIs are expected to lead the coal-repurposing initiatives, in terms of financing initially by assisting in the establishment of a proof-of-concept. Nonetheless, the DFI participation is expected to be followed by commercial lenders in the long term.

The equity capital markets in Indonesia are underdeveloped, with low volumes in secondary markets, as compared to peer economies. While the debt capital markets are showing signs of growth, the depth and breadth are still lower than other economies in the region. More specifically, the debt capital markets are characterized by the dominance of sovereign issuances in the overall bond market. Similarly, the corporate bond markets are also dominated by a few large players and the market is characterized by limited liquidity. A sovereign rating of BBB is another issue that restricts the fundraising capacities of the Indonesian entities. These challenges are expected to constrain the Indonesian capital market's ability to mobilize a large amount of capital in the short to medium term.

TABLE 10. Indonesia: Summary of Key Financing tools

	CAPABILITY TO FUND TRANSITION		
SOURCES	***Short Term***	***Long Term***	**COMMENTS**
Government	Low 🔴	Low 🔴	• While the Government of Indonesia is comfortably placed in terms of overall debt levels, its capacity to provide capital might be limited due to fiscal constraints and high level of external debt.
PT PLN	Medium 🟡	Medium 🟡	• PLN faces issue related to non-cost reflective tariff and high foreign debt. However, continuous government support ensures a positive bottom line and sovereign level credit rating. • Given the above factors, PLN shall be to able mobilize capital (although limited) towards coal repurposing initiative.
Financial Institutions	High 🟢	High 🟢	• The banking sector of the country is well developed and better placed to provide the required capital compared to other potential financiers. The initial developmental effort shall be undertaken by the DFIs to establish a proof of concept. The commercial banks and ECAs are expected to follow suit in the longer run once the proof of concept is established.
Capital Markets	Low 🔴	Medium 🟡	• The equity capital markets are comparatively underdeveloped in the country and hence would find it difficult to support the large-scale repurposing exercise. • Debt capital markets are heavily dominated by the Government sector. Primary markets for corporate bonds are dominated by a handful of large corporates or by the financial sector, with shallow secondary markets which witness minimal trading volumes. The bond issuing capacity of the private entities is also restricted by the low credit rating of the country. • The green bond market is also dominated by the Government issuances (roughly two-thirds of the cumulative issuances). The underdeveloped corporate bond market, costly and illiquid hedging market and low sovereign credit rating are some of the issues prevalent in the green bond market.
Emission Trading Instruments	Low 🔴	High 🟢	• Carbon credit or emission trading markets are in nascent stage, with guidelines notified recently in October 2021. • The emission trading system is targeted to be operational by 2025.

Similar to the overall debt market, the green bond markets are highly concentrated and dominated by government issuances. Green bond markets are further constrained by a lack of knowledge of the bond market (due to its underdeveloped nature), costly and illiquid hedging markets, and the higher transaction costs of smaller issuances. The cost of borrowing is also higher due to the sovereign rating of Indonesia, which negatively impacts the green bond issuances.

Indonesia has yet to formally implement an emissions trading system, with guidelines for the development of a market issued in October 2021 and full implementation expected by 2025. While the finalization of the regulations and development of a trading system is expected to take a considerable amount of time, the mechanism can be deployed at a future stage for undertaking coal-repurposing initiatives.

Although the Indonesian carbon market is in a nascent stage currently, several developed carbon markets exist across the world, which may allow Indonesia to unlock this potential stream of financing. However, in a recent statement by the Finance Minister of Indonesia, it was announced that Indonesia will not allow the cross-border trading of carbon credits in order to meet its own GHG reduction targets.

5. ENVIRONMENTAL AND SOCIAL BENEFITS OF COAL TRANSITION

5.1. Social Impact

In most countries, the conversation around a coal transition is just beginning. To ensure a successful coal transition, it is imperative for these countries to lay down a plan that accounts for the technical, social, and economic transition of coal districts and states, as well as put the stakeholders at the center of this plan. To understand the impact of a coal transition, let us look at the example of the Hazelwood Power Station where the CPP was shut down due to various reasons and see how it affected the workforce involved in the CPPs.

The Hazelwood Power Station (1,600 MW) in Victoria's Latrobe Valley was the most carbon-intensive electricity generator in Australia. However, in late 2016, the plant closed due to commercial reasons. This sudden closure adversely affected the workers involved with this CPP.

Based on this case study, observations regarding the workforce involved in a CPP were identified as follows:

- The majority of the workforces have a lower level of tertiary-educated employees.
- The workers develop industry-related specific skills on the job site, despite a lack of formal qualifications.
- Given the lifespan of CPPs, the average tenure of workers is around 25 years.
- The workforce faced significant challenges in transitioning to well-paying jobs with a similar standing, quality, and location, given their specific (though informal) skill sets.
- The obvious consequences of closure were employment and financial security. Added to this, the workers also experienced considerable psychological and social impacts. The closure also affected local labor markets, businesses, the government, and other community service providers.

5.1.1. International Best Practices for Facilitating Coal Transitions and the Way Forward

The impacts mentioned above will be true in most cases of coal transitions. Many workers in the coal industry have spent their entire careers in it, with generations of their family also having worked in the electricity sector in similar roles. Therefore, it is of the utmost importance to mitigate the adverse effects of coal transitions. To understand how these issues can be addressed, Black & Veatch conducted a few case studies, and the findings are discussed below.

- **Philippines:** The moratorium on new CPPs, announced in 2020, is expected to provide an appreciable boost to the renewables sector and a corresponding increase in "green" jobs. The

Green Jobs Act of 2016 was passed to promote sustainable growth, create decent jobs for labor, and provide incentives to businesses-generating green jobs by building resilience against climate change. It highlights the key role of labor in sustainable development. The Act helps provide a 50-percent tax deduction on costs, incurred in the skill training of personnel in green jobs, and waives taxes and duties on the import of capital equipment, exclusively used for the promotion of green jobs. Further, the Act entrusts multiple government agencies, including those responsible for employment, finance, environment, education, trade, science & technology, and tourism, with specific responsibilities to plan for and bring green jobs in the mainstream economy. Thus, this Act serves as a foundation for implementing specific measures to retrain workers from CPPs for absorption in green industries.[11]

- **Spain:** Hunosa, a state-owned coal mining company in Spain, transformed existing coal mines into new ventures related to mining. The transformation was based on its expertise in natural resources through starting businesses related to mining consulting services, transforming old mines into museums, and expanding into mining-related areas such as the development of geothermal and biomass energies. In Spain, compensation was also offered to cover the technical and social costs of the coal mines affected by the reforms. Mining companies that had total costs close to the price of international coal markets got so-called "operational support" to close the cost/price gap. The most recent reforms included provisions for the environmental rehabilitation of old mines.[12]

- **Poland:** Based on the research conducted by the International Institute for Sustainable Development — a think tank group — in 2018, it was noted that "The Mining Social Package," that began in 1998, offered voluntary retirement to a wider set of miners with the inclusion of a variety of financial instruments. These instruments varied in their objectives from immediate-term cushioning (an unconditional redundancy payment) to long-term welfare (retraining courses). Policy instruments such as loans on preferential terms and special conditions for property acquisition, were also introduced for coal-dependent communities. In April 2021, the Polish government reached an agreement with the mining sector to phase out coal by 2049. The agreement provides for early retirement at 80 percent of their salary and a severance pay of up to USD32,000.

- **Greece:** Three main active labor market programs (ALMPs) — wage subsidies, entrepreneurship, and demand-responsive training (theoretical training and internship) — were included in a pilot program implemented across three municipalities — Elesfina, Asporpyrgos, and Mandra. The training programs were modular in nature and focused on skill gaps identified, based on the local labor market data. One of the lessons learned from the Elefsina pilot was that partnerships with key stakeholders, such as employer associations and social partners, can be harnessed to understand the general barriers to better employment opportunities and the individual needs of each jobseeker.[13]

- **South Africa:** The government is promoting a just transition to a low-carbon economy through the National Employment Vulnerability Assessment (NEVA) and sector job resilience plans (SJRPs). As stipulated in the National Climate Change Response White Paper (Department of Environmental Affairs 2011), the NEVA will "assess the impact on jobs of climate change and climate change responses by sector and location to understand what job-related interventions may be required and where they may be required," while the SJRPs will be developed by ministries to explore sectoral job creation opportunities.[14]

5.1.2. Alternative Livelihoods for Locals Impacted by a Coal Transition

In order to mitigate the impacts due to a coal transition, Black & Veatch reviewed various approaches adopted in developing countries, such as Indonesia, South Africa, and India.

- **South Africa:** South Africa's renewable energy procurement policy is unique globally in its emphasis on providing benefits to communities in the vicinity of the projects participating in the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) — an initiative by the South African government. Renewable energy projects are primarily located in rural communities, frequently categorized as "marginalized communities." The REIPPPP has created a legal framework to incentivize IPPs to channel benefits to communities near renewable energy project sites through a range of means, including local employment quotas, community ownership in renewable energy projects, as well as contributing a proportion of their revenue toward development spending, known as socioeconomic development (SED) and enterprise development (ED) spend.

  In this scenario, people losing jobs in the coal sector can have alternative livelihoods, based on their skills and training through education. Those unwilling to migrate to renewable energy sites and are unskilled can have access to benefit funds to initiate other livelihoods, such as agriculture, agroforestry (the coal companies or the government has the mandate to reclaim and refill the land and make it suitable for agriculture as much as possible), and the establishment of businesses. Those willing to migrate (unless renewable energy is established through coal mine or CPP repurposing) can move to construction, operation, and maintenance (depending on their skills and education given), work as cleaners and transport operators, or run catering services, etc. However, such significant changes require the political will of the government in implementing various plans, coordinating with various departments, engaging the trade union and civil society, as well as involving local communities.

  Based on a working paper published by the International Trade Union Confederation (ITUC), there have been varying degrees of involvement of various stakeholders in just transitions and paving the way for alternative livelihoods for workers losing coal mine or thermal plant jobs, as well as offsetting the adverse livelihood effects of the local communities. While federal and provincial governments are involved in transition planning, local municipal governments closest to the local communities have not been involved. Similarly, the national universities and research institutes in Mpumalanga, along with coal contractors, local communities, and contractual or unorganized labor (zama zama), have not been included, which is a challenge that South Africa needs to address.

- **India:** Currently, a growing number of people in India are working in renewable energy. The Skills Council of Green Jobs, set up by the Skills Ministry in India, estimates a total of 400,000 jobs in the renewable energy sector currently, with a projection of 1.8 million by 2030, if India achieves its 500-GW renewable energy target. Based on estimates by the International Renewable Energy Agency (IRENA), solar energy projects employed almost 164,000 people in India in 2020, with hydropower accounting for an even higher number of 320,000.

  According to the IRENA report 2021, there is huge potential in India's renewable energy sector for job creation. Other than the coal-induced energy sector, various alternative renewable energy sectors, namely solar PV, solar (heating/cooling), wind, biomass, biofuels, biogas, and small hydro, have enormous potential for generating employment to address the transition crisis. The chart below indicates various promising renewable energy sectors in India, with the prediction of potential job creation statistics according to IRENA's report.

Based on the analysis in Figure 21, solar PV has the potential to generate the highest number of jobs followed by the biogas sector. Developing the agroforestry, fishery, and ecotourism sectors could provide alternative sources of employment and economic opportunities to coal-dependent communities.

According to a study conducted by the United Nations Security General's Youth Advisory Group on climate change, it was found that the current pattern of investments in renewable energy are not focused on coal-dominant states. Instead, renewable investments tend to be in the western and southern parts of India, while coal tends to be found in the east and central regions.

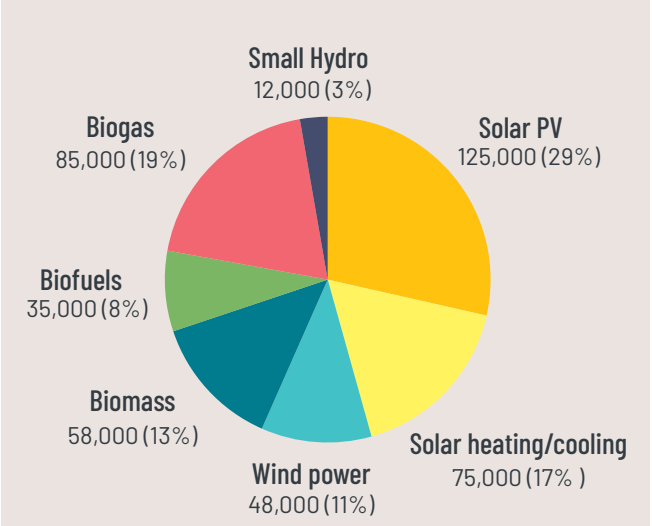


FIGURE 21. Job Creation in the Renewable Energy Sector in India

Source: IRENA 2021.

- **Indonesia:** According to the Ministry of Energy and Mineral Resources (MEMR), Indonesia has massive potential in hydropower (75,000 MW), micro / mini hydropower (1,013 MW), solar (4.80 kWh/m²/day), biomass (32,654 MW), and wind (3–6 m/s), along with 40 percent of the world's geothermal reserves (28,000 MW). These sectors will generate increased job opportunities in the scenario of CPP repurposing.

  In order to strengthen its transition toward a green economy, the Government of Indonesia has entered into the Partnership for Action on Green Economy. Five UN Agencies — the United Nations Environment Program (UNEP), the UN Development Programme (UNDP), the UN Industrial Development Organization (UNIDO), the International Labour Organization (ILO), and the UN Institute for Training and Research (UNITAR) — have initiated collaboration with the Government of Indonesia to support the government's translation of the principles of transitioning to a green economy into its national planning. The five UN agencies aim to mobilize social awareness and provide specialized training aimed at identifying critical bottlenecks, formulating and assessing policy options, and enabling policy implementation for greening the economy in Indonesia.

  However, a proactive approach from the government needs to be developed to create a roadmap for its employees and the locals who will be affected by the CPP repurposing.

5.1.3. Measures for a Just Transition

Designing a potential management plan is crucial to address any challenges of livelihoods faced by workers and the locals, owing to the closure of coal mines or thermal power plants. These plans/strategies should work towards creating more diverse and stable economies. The international case studies indicate that industrial reforms should include measures to strengthen the local economy, improve infrastructure and the environment, and promote community cohesion. In order to promote such strategies, three measures are broadly specified below.

5.1.3.1. Short-Term Measures

These measures include plans to alleviate poverty through direct payments to former miners in the form of welfare payments for early retirement. To understand these measures, the case study of Spain is briefly described below.

- Case study of Spain: To restructure the coal industry, reform packages were implemented in Spain, with the aim of transforming the sector by reducing production and the number of employees. Early retirement plans for coal miners were adopted. In this period, based on a research study, coal production decreased by 92 percent, the number of mining companies dropped by 93 percent, and the number of employees declined by more than 90 percent to less than 3,000 employees. It led to a reduction in the environmental footprint of the region, as well as the health impacts associated with respiratory and cardiovascular diseases due to the inhalation of the harmful emissions of coal-based plants.

  Spain's case also demonstrates that early retirement plans for the employees should be a short-term measure that should be complemented by a set of additional policies to support the early retired, prevent emigration, social exclusion, and incentivize job creation.

Employment reforms and direct support under short-term measures are summarized below:

- An employment vulnerability assessment should be carried out by the governments to understand the impact of climate change on jobs. A detailed study on the climate change response (sector- and location-specific) to understand which job-related interventions may be needed and where they may be needed.
- Wage subsidies, entrepreneurial skills, and demand-responsive training (theoretical training and internship), based on skill gaps identified for the local labor market, should be offered to concerned parties.
- Voluntary retirement can be offered to miners by giving them an opportunity for an unconditional redundancy payment.

5.1.3.2. Medium-Term Measures

These measures include job creation by establishing industries to capitalize on the existing skills of labor and providing support to reskill them by establishing skill development / vocational training workshops. The medium-term measures that can be taken are as follows:

- Starting businesses allied to coal mines and conventional power generation like mining consulting services, transforming old mines into museums, as well as expanding into mining-related areas such as the development of geothermal and biomass energies;
- Repurposing engineering works and transport-related businesses to cater to the alternative concepts being developed in place of the coal projects; and
- Reskilling the people by establishing short-term training programs imparted through workshops and training institutes, which can assist in rapidly training people in alternative concepts and making them employment-ready within a short period of time.

5.1.3.3. Long-Term Measures

These measures support education and innovation, identify and nurture the industries of tomorrow, as well as provide a workforce for these industries. This can be achieved by providing grants. These grants, which can be set up with the help of private companies and the national government, should be provided for the establishment of new businesses, professional training, along with incentives for research and development (R&D) and environmental projects. The long-term measures that can be taken are as follows:

- Establishment of educational institutes for imparting skills aligned with the industries of focus for the government;
- Loans on preferential terms and special conditions provided for property acquisition extended to coal-dependent communities;
- Tax deductions on costs incurred in the skill training for green jobs and the waiving of taxes and duties on the import of capital equipment exclusively used for the promotion of green jobs.
- Entrustment of multiple government agencies, including those responsible for employment, finance, environment, education, trade, science and technology, and tourism, with specific responsibilities to plan for mainstreaming green jobs in the economy. (Source: International Institute for Sustainable Development)

5.1.3.4. Social Inclusion Lens

Social impacts of power plant and mine closure extend beyond formal workers, to their families, workers in supply and service industries, and broader communities, with more negative impacts on the groups that are more likely to suffer from exclusion - women, persons with disabilities, minorities. Mechanisms to ensure equitable access for them to skills training programs, procurement processes and loans programs should be designed with their active participation.[15]

5.1.4. Socioeconomic Benefits of a Coal Transition

It is also vital to highlight the socioeconomic benefits that arise out of a coal transition. Black & Veatch studied the benefits that can be achieved in the three nations of South Africa, India, and Indonesia.

5.1.4.1. South Africa

Below are some of the key benefits that can potentially be realized in the country:

- **Land / agriculture / forestry-related benefits for communities:** For local community members directly or indirectly dependent on the coal economy, unwilling to rehabilitate elsewhere, or not being reskilled, returning to agriculture and other land-related activities will become a necessity.

  Based on a report published by the Center for Strategic and International Studies, in the Mpumalanga Province, about 24 percent of the provincial land is arable, while 14 percent of the land can be used for cattle grazing. The province is a leading producer of fruits and nuts, among other agricultural crops. Increased access to affordable food could help alleviate the high levels of food insecurity.

  However, the Government of South Africa needs to plan with all stakeholders to ensure the revival of agriculture as one of the co-benefits of a coal transition. Certain barriers need to be addressed, such as the low wages in the agriculture sector as compared with those in coal-related sectors, along with the severe degradation of the land where coal mining is / was practiced, thereby making agricultural expansion in these areas difficult. The agricultural sector will also be competing with coal mining sectors for water and land resources until the coal sector is phased out.

- **Health benefits of the workers and the local communities:** Communities within and outside the coal mines and thermal plants have been subjected to various types of health problems. Respiratory and cardiovascular diseases have been most prominent due to the pollutants present in coal and its by-products, such as SO_2, NO_2, mercury, and lead, depending on the types of coal. Asthma is most common among children. There are other unrecorded health issues, such as premature births and deaths, as well as absence from work or restricted activities, which have resulted in high health costs and production losses.

  In 2017, British air pollution expert Mike Holland calculated that the health impacts of Eskom's emissions alone cost South Africa USD2.37 billion every year. With the coal transition, health co-benefits play an important role for the communities as well as the workers who are rehabilitated.

  With the rapid decarbonization of South Africa, the health benefits will save the country about ZAR141 billion by 2050, which include public health, medical treatments, and hospitalizations. With proper policy implementation, the country can save ZAR31 billion in 2030 and ZAR98 billion in 2040 as interim achievements.

  Thus, a just coal transition needs to incorporate a proper health impact assessment, the costs and benefits of health financing, the awareness building of the community by the health personnel (on the harmful effects of fossil fuel and public health behavior), as well as the infrastructure improvement of the health system.

- **Increase in Employment:** Transitioning to a low-carbon economy will result in additional jobs being created, jobs being substituted, jobs being eliminated, and existing jobs being transformed. Based on a research publication in *Science Direct*, with transformation to renewable energy over the years, there will be a significant increase in direct employment in the renewable energy sector from the current 20 million to nearly 60 million across the globe, including South Africa. With a gradual decrease in carbon emissions, there will be job creation in the electrical transport, power, heat, and desalination sectors — both direct and indirect.

  Based on a research by COBENEFITS, there have been suggestions on various alternative sectors that could be nurtured in Mpumalanga, such as renewable energy and smart grids; IT in transport; agriculture and agroprocessing; and manufacturing. The number of jobs created is higher during the initial stages of setting-up infrastructure (63 percent of the total job) over the operation and maintenance of renewable energy installations where 66 percent of skilled workers are needed. This calls for developing skills among the less-skilled workers from the coal industry where they are high in numbers.

TABLE 11. Alternative Energy Sources in Mpumalanga

ENERGY SOURCES INSTALLED CAPACITY (PERCENT)	2018	IRP TARGET OF 2030
Fossil Fuels	79 percent	51 percent
Nuclear	3 percent	2 percent
Renewable Energies	11 percent	41 percent
Others	7 percent	6 percent

The table above shows a significant increase in the installed capacities of the renewable energy sector from 11 percent in 2018 to an anticipated 41 percent by 2030, with corresponding reductions in fossil fuels from 89 percent to 51 percent. This is in line with the aim of growing and shifting employment following the coal transition and coal repurposing. As part of the projected capacity of 41 percent, wind will contribute to 57 percent, while solar PV will make up 27 percent of the installed capacities.

- **Cleaner work environments, improved lifestyle of workers:** A coal transition can result in a cleaner work environment, where improved lifestyles would be guaranteed in the areas of job creation, health impact, and an upskilled workforce.

- **Workforce Upskilling:** As more skilled workers are required in the renewable energy sector compared to coal, the shift has the challenge of building up technical capacities through established training institutes and education.

  The number of jobs estimated to be created during the 2018–2030 period (IRP and CSIR models) will range between 580,000 and 1.2 million, depending on the expansion of the renewable energy options to produce electricity. This requires significant funding support to reskill the unemployed coal employees by the government. The funding support of USD2 billion over the period of 3–5 years will surely help in the focus on training and educating the coal and thermal power plant workers to get suitable employment in the alternative technologies (that is, solar, wind, Syncon, and BESS), in addition to other manufacturing sectors such as EVs.

5.1.4.2. India

Based on a research undertaken by the Council on Energy, Environment and Water (CEEW) in India and COBENEFITS, renewable energy technologies tend to be more labor-intensive than conventional energy technologies. Distributed renewables, such as small-scale hydro, rooftop solar, and biomass, create maximum employment for every MW of installed capacity. To construct and run a 1 MW plant, rooftop solar requires 24 employees, followed by biomass (16) and then by small hydro (13).

Biomass and solar energy will be major drivers of employment, with up to 2 million and 1.1 million employees, respectively, by 2050.

Listed below are some of the socio-economic co-benefits of a coal transition:

- **Skill-building training:** Skill intervention is an important component of any transition. However, it will require the convergence of efforts among the private sector, the district administration, and the public sector to meet the demand for employment and the development of the region. During a coal transition, programs boosting skill development will be undertaken as a priority. Additionally, the vocational training center of the coalfield is rolling out training to build the capacities of its existing workforce in the industry. Under the CSR program, it provides training to the local youth on welding, plumbing, nursing, stitching, etc. Amongst the courses offered in the non-mining sector, nursing is popular, as there are high employability chances within the hospitals.

- **Rise in green jobs:** India can significantly boost its employment by increasing the share of renewables. These technologies tend to be more labor-intensive than conventional technologies: by 2050, more than 3.5 million people could be employed in the renewable energy sector, that is, five times that of the entire Indian fossil-fuel sector (coal, gas, and nuclear) in 2020.

- **Reduces electricity prices from DERs:** Solar-powered mini-grids of high installed power capacity can remain economically viable and cost-competitive with the centralized grid in rural areas of India. Solar mini-grid systems greater than 100 kW, with interest rates as low as 8 percent and a 15 percent return on equity, can achieve grid parity and a low cost of electricity for the rural consumer.

- **Establishment of a new authority to reskill workers from the coal sector**: Creating a central authority / agency / body to train or reskill workers from the coal sector will support workers in benefiting from direct employment in the renewable energy sector. Skill development in India will be undertaken by the Ministry of Skill Development and Entrepreneurship, in close collaboration with other ministries and government departments.

- **Strengthening the infrastructure:** The promotion of renewable energy across India will aid in strengthening the infrastructure. Roads including feeder roads are needed to facilitate backward and forward linkages, especially for small and marginal farmers. From improved access to farm inputs and alternative markets for their produce, the importance of road connectivity is undeniable. Access to reliable and quality electricity, particularly through renewable sources of electricity in farm operations, as also promoted by the Prime Minister's Energy Security and Development Program for Farmers (PM-KUSUM), will go a long way in diversifying the economy of the place.

- **Promotion of low-carbon infrastructure and carbon sinks:** The public employment guarantee program — the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) — works on replanting the indigenous species and re-grassing the abandoned mines to create carbon sinks. In addition, works under drought-proofing, through developing on-farm micro-irrigation networks, rainwater harvesting, and watershed development, will also build up sustainable assets in the area.

- **Promoting micro-irrigation:** The financial resources from mining can complement the implementation of micro-irrigation under the National Mission on Sustainable Agriculture of the Ministry of Agriculture in order to address water depletion issue in water aquifers in coal mine-affected areas. With the help of mining industries and the local government, a micro-irrigation plan can be adopted to promote agricultural activity, if feasible, in a given context to promote livelihoods to locals.

- **Promotion of Agroforestry:** Agroforestry needs to be reprioritized, with the prioritization of the revival of the native species and medicinal plants such as *kullu, musli, chironjee,* and bamboo (*musli* is now an endangered medicinal plants). This will help to revive the area's biodiversity and supplement incomes amongst workers in the local community. Identifying sustainable linkages in a pharmaceutical supply chain through a cooperative of producers can be suggested as an alternative source of livelihoods for those workers and their households due to the closure of coal mines.

- **Promoting micro, small, and medium enterprises (MSMEs):** Considering that there are government policies for the promotion of the renewable energy sector in India, there is huge potential for employment opportunities under MSMEs in support of green products and services to promote green entrepreneurship in a coal-transition initiative. A combination of MSMEs will enable the local economy to be better prepared to face the current slump. Encouraging local procurement from these enterprises, particularly by the industry, will promote innovation, employment generation, and facilitate their scaling up.

5.1.4.3. Indonesia

Indonesia's energy policy and NDCs will lead to the development of renewable energy. Potential benefits that may come with such a plan are enhanced improvements in public health, increased employment opportunities, higher economic growth in industry, and the decline of renewables' costs in Indonesia. Those benefits could lead to cheaper and cleaner electricity that is aligned with public needs and government policies. According to an OECD economic survey conducted in Indonesia in 2018, the following co-benefits of coal transition are as follows:

- Shifting the job mix to high-quality, high-productivity positions in the formal sector will boost living standards and enable the sharing of the demographic dividend with future generations. Doing so will require tackling pervasive informality and skill deficiencies.
- Tourism has the potential to diversify the economy, boost regional development, and reduce inequalities. Tourist numbers in Indonesia are rising, but measures are needed to make this rapid growth consistent with environmental sustainability in the long run.
- Indonesia has huge reserves of gas and oil that can be considered as benefits for transitioning from coal to renewables sector. However, several factors will need to be instituted: modern infrastructure to ensure reliable and affordable energy access across all the islands for the import of oil and liquified petroleum gas (LPG); appropriate technology for renewable energy utilization, energy efficiency, and energy conservation requiring modern science; technology expertise; and a conducive ecosystem with support from the national energy reserve.

5.2. Environmental Benefits of a Coal Transition

There are significant environmental impacts associated with CPPs, coal mining, and the use of coal. Mining requires the removal of massive amounts of topsoil, which leads to erosion. This in turn leads to losses of habitats as well as causes pollution. The closure or transitioning of CPPs will thus produce the following benefits:

REDUCTION IN POLLUTION

- Transitioning toward the use of non-fossil fuels can help improve environmental conditions and subsequently reduce the pollution load. Reducing CO_2 emissions from electric power generation will simultaneously reduce the emissions of SO_2, NOx, and particulate matter such as PM 2.5. Reductions in GHGs will eventually limit global warming.
- Moving toward green and clean fuel will also help reduce the health-related impacts, leading to acute respiratory infections, tuberculosis, chronic respiratory diseases, lung cancer, cardiovascular disease, asthma, low birth weight, eye diseases, and adverse pregnancy outcomes, due to the inhalation of toxic emissions released from coal-based power plants. This will eventually help in saving costs on the health front.
- Major cities in developing countries have been grappling with the effects of pollution, leading to significant economic losses due to curtailed working hours, along with the interruptions of road, rail, and air transport. Transitioning away from coal could contribute to the reduction of this disruption, which will have significant economic benefits.
- Coal transportation by water, rail, and roads are responsible for pollution, congestion, high fuel consumption, road accidents, etc. Not having to transport coal could have a positive impact, with lesser marine pollution caused by ships transporting coal. It will also lead to the decongestion of the road and rail infrastructure that are already stressed in developing countries. Hence, decommissioning has the potential of reductions in the consumption of transportation fuel, which will lead to minimal vehicular emissions.

REDUCTION IN WATER CONSUMPTION AND GROUNDWATER DEPLETION

- The coal power generation sector is typically the largest industrial user of water within a country. Its cooling system accounts for the largest usage of water. Water consumption is not very high in the case of wind and solar PV to generate electricity.

DIVERSIFICATION AND ENERGY SECURITY

- Shifting from a reliable electricity source (such as coal) to renewables, such as wind, solar, geothermal, hydro energy (intermittent and distributed), will increase diversification. A diversified energy mix encourages technological competition among energy platforms, thus ensuring progressive innovation takes place and costs are minimized.

GREEN JOB CREATION

- Renewable energy technologies, such as wind and solar as well as distributed sources of energy, generate 3–10 times as many jobs per MW of installed capacity as fossil fuel or nuclear-based generation. Renewable power sources also contribute to local economic growth, and according to some, provide better jobs. The manufacturing of renewable power technologies involves a highly-skilled workforce and the modernization of the local industry base. The use of renewable energy makes local businesses less dependent on imports from other regions, frees up capital for investments outside the energy sector, and serves as an important financial hedge against future energy price spikes.

PREVENTION FROM DISASTERS AND CLIMATE CHANGE VULNERABILITIES

- Transitioning toward clean energy will minimize the eventual, severe impacts of climate change, as well as improve the country's resilience and adaptive capacity to natural disasters. The primary climatic benefits of clean energy stem from the fact that immediate efforts can stop the buildup of GHGs in our atmosphere. Clean-energy and transport investments can enhance adaptation and resilience, making it easier for physical or natural systems to cope with climate change.

ACCESS TO ENERGY

- According to IRENA, over one billion people lack access to electricity, while a further one billion have an unreliable supply. Improved reliability, rapidly falling technology costs, and supportive policies have made standalone and mini-grid renewable electricity solutions viable for the 80 percent of those without access in rural areas or small developing island states. Renewable energy sources are inexhaustible and can adapt to natural cycles, unlike conventional energy sources (coal, gas, oil, or nuclear energy). This makes them the key to creating a sustainable energy system for enhancing local development, without risking the future of the next generations.

ANNEX: VALUE FOR MONEY ANALYSIS

For undertaking public infrastructure and related service projects, Governments / public sector agencies typically conduct a Value for Money (VFM) analysis to determine whether such projects will be more accretive if handled by public sector entity (i.e., traditional procurement) or through private sector involvement (i.e., public private partnership or PPP). Value for Money is one of the several factors that drive procurement decisions in the case of partnership projects.

Given that the coal transition exercise may be undertaken either by the Government or a private sector entity for individual plants, a similar analysis shall help in assessing the ideal route to be taken for such exercise. The VFM analysis shall help in establishing the party responsible for running the coal repurposing process for each of the target plants in the target countries.

The VFM analysis is a tool for relative assessment and focuses on financial cash flows – it involves the assessment and comparison of traditional procurement options with PPP option(s) to identify the procurement option that offers the highest value (either the most cost efficient or the one that offers maximum revenue). VFM analysis tries to establish whether the PPP is "relatively more affordable" compared to traditional procurement.

The VFM analysis also:

- Offers a better understanding of lifecycle costs – VFM analysis considers the costs and benefits over the whole life of the project. This overcomes the tendency of public sector to consider the immediate or short-term decommissioning of plant / construction costs of a project, while ignoring the long-term operation and maintenance costs in their decision-making.

- Offers better understanding of risks retained and transferred – VFM analysis focusses on estimation of the risk adjusted costs for infrastructure assets and services. Traditional procurement decisions often ignore the cost of project risks or fail to consider the most efficient way to allocate such risks.

One of the key advantages of conducting a VFM analysis is that it is a comprehensive tool which involves conducting both qualitative and quantitative analysis for the project / asset as covered below.

Qualitative Analysis

The qualitative aspect of the VFM analysis primarily involves sense-checking the rationale for using the PPP Model, estimating socio-economic benefits, and confirming the presence of supporting conditions to achieve value for money. The qualitative assessment is important because the range of differences between the approaches compared are usually broader than only financial cash flows. A few key qualitative value drivers resulting from the choice of procurement model are explained below.

Direct Value for Money Drivers: The drivers of direct value for money impact – and ultimately the VFM analysis – are triggered by the differences in the governance structure and incentive mechanisms between traditional procurement options and PPP model(s).

- **Synergies through integration of different stages:** Integrating different stages of the project such as construction and maintenance can help create synergies for optimizing life cycle costs. This is often difficult under traditional procurement, where separate divisions within the public sector entity may be responsible for construction and maintenance. A PPP model, by integrating multiple stages (decommissioning, construction of a new facility / repurposing old facility and operation and maintenance of new or repurposed facility) under a single contract, following a competitive procurement process, creates incentives for the private sector to seek life cycle optimization and cost reductions to enhance the probability of being awarded the PPP project

- **Innovation:** Given that the focus of the procurement exercise in on output specifications, the PPP model provides flexibility for private sector to be innovative or creative with designs or use of new materials

- **Appropriate risk allocation and improved economics:** Under a PPP model, the combination of direct financial incentives, through payment mechanisms in the agreement and competition in the procurement through the bidding process, catalyzes the private sector to focus on active risk management and cost reduction; and

- **Expertise:** PPP agreements are more complex compared to other contracts used in the traditional procurement. The added complexity requires additional expertise from legal and financial experts which leads to the drafting and structuring of the projects in line with the international standards of excellence

Indirect Value for Money Drivers: These are benefits to end users and the wider society not captured in the quantitative VFM analysis. Sometimes, these benefits may be the direct result of delivering a proposed project as a PPP (i.e. they may not be realized if the project is delivered through traditional procurement).

- **Accelerated delivery:** Early availability of an asset and related services to end consumers (e.g. public utilities such as roads, power, water supply, hospitals etc.) may result in significant socio-economic benefits to end users (such as, early decommissioning resulting in lower CO2 emission). A PPP model may result in an accelerated delivery of the project due to the following key reasons:

  Contract incentives for on-time completion: Under the PPP model of procurement, services start without delay to their planned availability date since incentives are built in the contract to complete the underlying infrastructure on time; and

  Timely investment: The PPP procurement model typically involves timely investment of funds due to sufficient access to financing and earlier service delivery, than otherwise possible using a traditional delivery mode. The investment timeline is driven by the financing capability of the private partner involved in the project.

- **Enhanced delivery**: This refers to the expected higher quality of infrastructure assets and related services delivered under a PPP model. Enhanced delivery may be due to:

  Life-cycle approach and assured maintenance of a PPP project – The contractual commitment to minimum levels of maintenance means assets are kept in better condition and residual values are enhanced;

  Higher quality services – The contractual commitments and payment mechanism ensure minimum service performance standards are

maintained. This is likely to result in both better designed and higher quality services; and

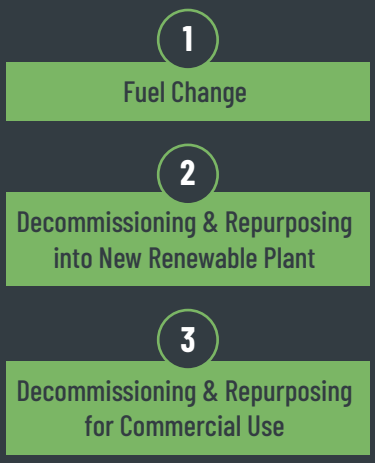
Clearly defined governance structure: including (i) strengthened external scrutiny and due diligence by lenders and investors (ii) better management of service delivery; and (iii) undivided focus of public sector entities on their core tasks

Quantitative Analysis

Quantitative VFM analysis determines how the NPV of risk-adjusted whole-of-life costs of traditional procurement approach differs from that of the PPP model to deliver the same set of service. The procurement option that is assessed as having the lower NPV (in terms of the cost to the government) is deemed to offer better value for money compared to the alternative option.

The possible activities under the coal transition exercise for an asset (either SOE owned or IPP) can be largely categorized under the following three categories:

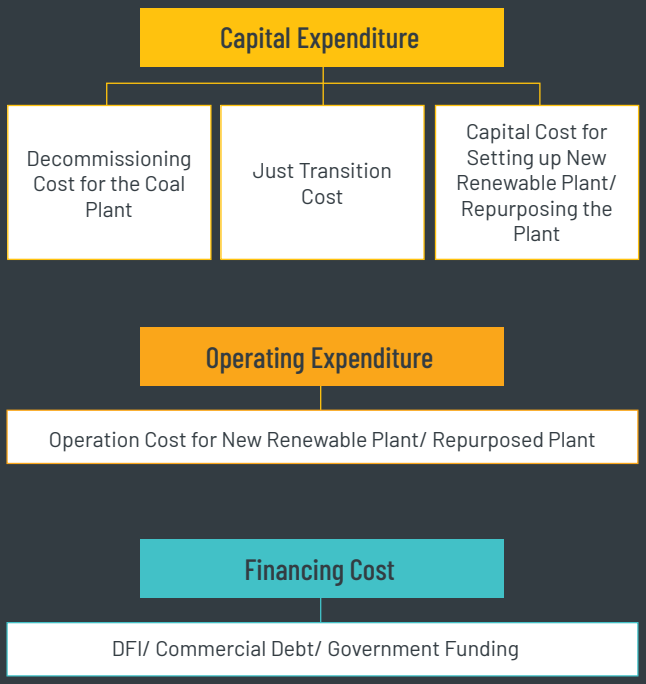
Key Activities Under Coal Transition



The repurposing / setting up of a new, renewables based powerplant shall involve significant cost including one-time upfront cost and periodic cost related to operation of the renewable /repurposed asset. These costs will be required to be identified and ascertained in relation to the transition solution considered for that asset. This shall assist in evaluating the possible route through which the asset can be transitioned. The figure below highlights the various cost categories to be considered while evaluating the possible transition.

There is certain cost associated with the decommissioning of the coal power plants apart from the rapidly increasing operational cost (as compared to the renewable energy). These costs clubbed with the social cost associated with operating coal power plants, given that it is a dirty source of fuel, are much higher than the overall cost of setting up and operating a renewables-based power plant.

Costs Associated with Coal Transition



The various costs mentioned above need to be evaluated on a risk adjusted basis under the traditional procurement methodology and the PPP model for a comparative assessment. The comparison of the costs will help ascertain the preferred method of procurement for the project. Below mentioned are the steps for such evaluation process.

STEP 1 - Developing the Traditional Procurement Model

This involves preparation of a risk-adjusted cash flow model for the traditional public procurement option. The cash flow model includes all project costs, the timing of these inputs, and an estimated cost for all the relevant project risks borne by the public sector entity. These inputs are adjusted to ensure neutrality between the public and private options, such as any difference in tax treatment.

STEP 2 - Developing the PPP Model

This is a financial model prepared for the alternative PPP model, delivering the same service outputs over the same period as the traditional procurement case. The model is used to estimate the expected availability and output-based payments under the PPP option. The PPP model reflects the best estimate of the public sector entity in estimating the costs utilized in the financial model prepared by the private sector to arrive at its bid.

This analysis might use many of the same cost assumptions used in the traditional procurement (such as construction cost) but adjusted for the cost of public sector entity risks that are now allocated to the private sector. It may also include any assumed benefits of using the PPP model (i.e. savings resulting from the innovation and efficiency gains derived from the private sector participation) and the costs of using private sector finance.

STEP 3 - Comparison of the net present values under the two models

The models prepared in the above two steps are compared on an NPV basis to find the absolute difference between the NPV values of the two models (including retained risk). The option which results in the least cost (or most revenue) to the public sector entity in absolute NPV terms is considered to offer better value for money and should be ideally selected.

ENDNOTES

CLICK ON ANY NOTE TO GO BACK TO THE REFERENCED PAGE

→ 1 https://cea.nic.in/wp-content/uploads/opm_grid_operation/2020/07/thermal_review-2018%20(1).pdf

→ 2 https://www.iea.org/articles/levelised-cost-of-electricity-calculator

→ 3 The table covers a comprehensive list of applicable repurposing solutions. Note that the selection of a repurposing solution for an asset in the target countries shall be driven by the Weighted Linear Combination.

→ 4 As the second-life use of EV batteries, gravity-based storage, flywheel, MGA technology thermal storage, direct air capture of CO_2, and nuclear SMR are pilot concepts with limited precedents, we have not covered these solutions in the table.

→ 5 The financial viability of the proposed solutions has been assessed, without taking into consideration concessional financing and grants from DFIs.

→ 6 The financial viability of the proposed solutions has been assessed without taking into consideration concessional financing and grants from DFIs.

→ 7 https://ukcop26.org/political-declaration-on-the-just-energy-transition-in-south-africa/

→ 8 The figures quoted in USD in this section have been calculated, using the USD/ZAR exchange rate of 14.75.

→ 9 The figures quoted in USD in this section have been calculated, using the USD/INR exchange rate of 75.0.

→ 10 The figures quoted in USD in this section have been calculated, using the USD/IDR exchange rate of 14,500.

→ 11 World Resource Institute

→ 12 International Institute for Sustainable Development

→ 13 World Bank

→ 14 Report published in 2019 by the Stockholm Environment Institute.

→ 15 Just Transition for All : A Feminist Approach for the Coal Sector.

→ 16 The ten countries include: North Macedonia, Morocco, Bosnia & Herzegovina, Namibia, Dominican Republic, Botswana, Colombia, Bangladesh, Ukraine and Kazakhstan.

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