Singapore Green Finance Centre

Managed by

SMU Lee Kong Chian School of Business

Imperial College Business School

Paper presented at the 12th Annual SKBI Conference &
1st SGFC Regional Conference on Greening Energy Infrastructure

Policy Note - Demystifying India's Accelerated Energy Transition

April 2023

Md. Tariq HABIB
Senior Analyst, Climate Policy Initiative

Saarthak KHURANA
Manager, Climate Policy Initiative

Vivek SEN
Associate Director, Climate Policy Initiative

Dhruba PURKAYASTHA
Director, Climate Policy Initiative

CLIMATE POLICY INITIATIVE

ACKNOWLEDGMENTS

The authors wish to thank Mr. Vijay Nirmal Gavarraju for valuable insights on Policy Note. The authors would like to thank and acknowledge contributions from Mr. Vivek Sen and Mr. Debal Mitra for their advice, internal review, and data analysis.

ABOUT CLIMATE POLICY INITIATIVE

CPI is an analysis and advisory organization with deep expertise in finance and policy. Our mission is to help governments, businesses, and financial institutions drive economic growth while addressing climate change. CPI has six offices around the world in Brazil, India, Indonesia, Kenya, the United Kingdom, and the United States.

DESCRIPTORS

SECTOR

Power/ Electricity Generation

REGION

India

CONTACT

Md. Tariq Habib
tariq.habib@cpiglobal.org

1 CONTEXT

India at Conference of the Parties (COP) 26 pledged to cut its emission to Net Zero by 2070. The pledge is backed by a five-point agenda called "**Panchamrit**" (five elixirs for sustainability in India) – focusing on clean energy to meet its growing energy needs. The target is to reach a non-fossil fuel capacity of 500 Giga Watt (GW) by 2030, which would be enough to meet India's 50% of energy requirement. This is a significant commitment considering conventional generation capacity comprises 55% of the current installed capacity, meeting almost 75% of the electricity requirements in the country. [1]

Conventional generation assets have been the backbone of India's power sector for a long time and have supported India's economic growth and energy security. The reliance on conventional power increased after liberalization of the Indian economy in 1990's and introduction of The Electricity Act, 2003. India has added around 150 GW of conventional capacity in this century itself– representing 77% of all the conventional generation assets installed in the country [2] . Set up either on competitive basis or on cost-plus norms (except captive power plants), their purpose was to meet the growing demand of electricity and to match the energy needs of a growing economy. Regardless, this was also a time when the renewables were picking up speed but were far from being economic as compared to conventional power generation.

However, due to lower-than-expected growth in power demand and rise of cost-competitive renewable alternatives, resulted in underutilization of these power plants impacting their financial profitability. With the growing financial stress for these conventional generation projects, Non-Performing Assets (NPA's) for the lenders grew significantly over the last five years and 34 plants with a cumulative capacity of around 40 GW have been categorized as stressed assets with issues such as inordinate implementation delays, absence of firm Power Purchase Agreements (PPA) and/or absence of Fuel Supply Agreements (FSA). [3] [4]

Considering the declining cost of Renewable Energy (RE), financial pressure faced by conventional power plants, climate change exigency and India's commitment to Net Zero, it is imperative to add adequate non-fossil fuel-based generation capacity to eventually transition inefficient and costly conventional generation capacity without endangering energy security of the country.

While the initiatives prioritize the development of cleaner generation capacity over new conventional generationcapacity, questions pertaining to eventual transitioning

of the existing conventional capacity remain. Reuse and repurposing of the existing conventional generation capacity with sustainable and greener sources of energy is of critical importance for ensuring energy security of India and limiting emissions. However, as cleaner cost-competitive generation grows, transitioning existing conventional power plants poses a challenge with regards to the investment locked in the existing fleet. Considering factors such as assured regulated returns, long term contractual obligations and varying ownership structures, it becomes essential to formulate a structured framework which takes due care of all the stakeholders (promoters, lenders, employees, shareholders, counterparties, and the Government). This framework would need to offer replicable compensatory solutions for the plants within each category (categories based on ownership, age profile and performance, and financing structures).

1.1 CURRENT GLOBAL APPROACHES TO ACCELERATED TRANSITION

Mechanisms for accelerated transition are being tried in multiple geographies across the globe. Some of these approaches are:

I. **Indonesia:** Energy Transition Model (ETM) focuses on early retirement of conventional generation assets of private sector (through debt restructuring) and reinvestment in green energy facilities, utilizing transition investment from Asian Development Bank (ADB). [6]

II. **Germany:** Germany has enforced act and other related amendments for providing financial aid to plant operators for early retirement of their plants. [7]

III. **South Africa:** ESKOM, South Africa's state-owned electricity utility, has formulated a 'Just Energy Transition' plan for early retirement of state-owned utility's conventional generation plants. This is expected to be funded through a partnership of developed economies including Germany, the UK, the US, France, and the EU. [8]

IV. **Vietnam:** Vietnam has signed a JETP agreement. This agreement with developed countries will enable Vietnam to access funds (mix of grant, debt, concessional loans) for transitioning to green energy.

Just Energy Transition Partnership (JETP) has emerged as a new funding model to support developing countries in transitioning from fossil fuel towards greener sources of energy. However, same model may not be portable to India considering complexities in Indian power sector.

While JETP, ETM and other steps taken in these countries are significant, they face relatively lower complexity than India due to a simpler ownership and operating structures of their power sector institutions. The ownership of conventional power

plants is typically in the hands of a limited set of owners in these countries; thereby reducing the number of stakeholders to be engaged and simplifying the process of accelerated transition.

In such scenario, India may require an entirely fresh approach considering the large size, rapidly growing demand, energy security needs, and systemic complexities. The Indian power sector is different from that in other geographies not only because of the sheer size of its conventional generation fleet but also because of the following factors:

I. **Ownership structure:** Unlike in other geographies, the ownership of conventional generation assets in India is complex, as shown in the figure below, with similar proportional contributions to the overall conventional generation assets from different owner classes. Central/ Federal generating stations (CGS), state generating stations (SGS) and private generating stations (PGS), respectively, account for 31.8%, 32.5% and 35.6% of conventional generation capacities. [9]

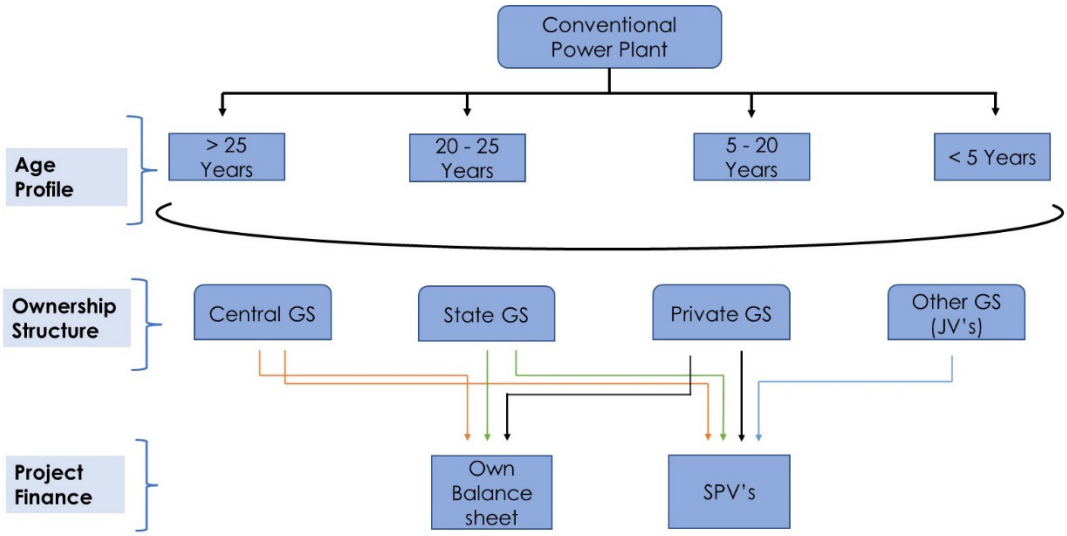


Figure 1: Power Sector

II. **Tariff Structure:** Most of the conventional power plants in India have long term power purchase agreements (PPAs) which work on either:

- Regulated tariff with assured cost-plus return to the owners (typically 15.5%). [10] The contractual parameters such as PPA and financial parameters such as debt servicing period, depreciation etc. are structured considering economic life of plants (25 years); or,
- Tariffs discovered through competitive bidding. Tariffs are often bid by promoters considering not just a PPA term/economic life of 25 years, but also useful life of plant (35 – 40 years). [11]

Two-Part Tariff Structure

Electricity Sector Regulators in India determine tariffs for plants that sell power on "cost – plus" basis. Tariff structure of these plants comprises two parts – fixed (capacity) and variable (energy) charges. Fixed charges represent fixed cost components – return on equity invested, debt service obligation, depreciation, and operation & maintenance cost. Energy charges represent fuel costs, which varies according to the market and actual generation achieved.

III. **Operational Parameters:** Older conventional generation plants that are past their economic life typically have higher station heat rates (SHR) and often do not fulfil the stipulated emission mandates. However, as these older assets are fully depreciated and have completed their debt repayments, they offer significantly low fixed costs and overall cost of power, and hence form an attractive proposition for the stakeholders to continue operating them.

IV. **Market conditions:** India has an energy-plus-capacity market design, meaning the actual electricity generated (output) and the generation capacity (means) are both compensated for. This makes the tariff structure – and hence, the investment recovery – an attractive proposition for stakeholders to continue operating the power plants even beyond the stipulated life.

The intent for this policy brief is to explain why a nuanced approach considering all India specific factors would be required to accelerate energy transition in the country.

This policy brief note also proposes an approach to solve the conundrum of accelerating the transition while enabling climate finance flow without endangering existing investment and energy security of India. This is attempted by identifying and evaluating pathways which include a mix of policy inputs, regulatory recommendations and proposed financial mechanisms. The roadmap of solutions has been devised based on age, ownership profile and financing structure of conventional generation assets in India.

It is important to note that Climate Policy Initiative (CPI) is purely looking at the acceleration of energy transition construct from the financial feasibility point of view and have not considered the socio-economic transition impacts which would also be critically important and would be a step further to this analysis.

2 ANALYSIS

CPI analysis mapped the entire fleet of conventional generation units (non-captive) in India with respect to age, size and variable cost (Figure 2) to provide a graphical view of unit level details of existing conventional generation capacity.

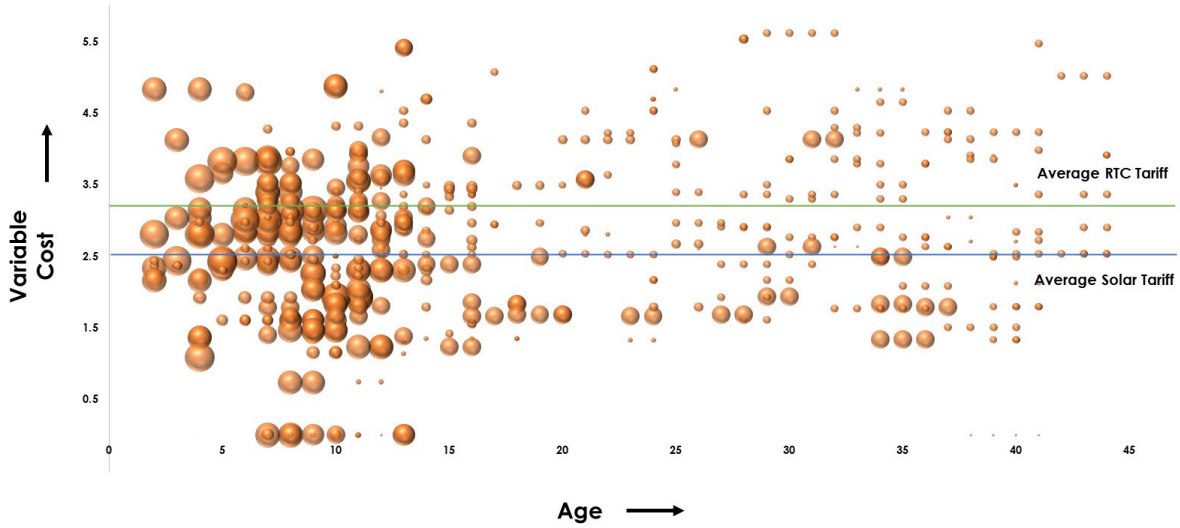


Figure 2: India's Conventional Power Capacity (Unit Wise)

India has an installed conventional power capacity (non-captive) of 210 GW as of January 2023, representing more than half of the total installed capacity in the country. For analysis and recommendations, plants have been categorized into two categories.

I. **Category I:** Units past economic life (age >25 years) and units nearing end of economic life (age between 20 and 25 years)

II. **Category II:** Units left with reasonable economic life (age < 20 years)

Category I:

- Units aged more than 25 years represent 19% of the total capacity and are predominantly owned by federal (15 GW) and state (20 GW) government entities. having completed their economic lives. These plants, therefore, are eligible for transition as per NEP 2018. However, they continue to operate due to financial benefits (fully depreciated, debt free, high return on equity, and low fixed cost) as well as socio-political (federal state) sensitivities.
- Units aged between 20-25 years and nearing the end of their economic life are dominantly owned by state generating companies (totaling 5 GW) followed by federal generating companies (totaling 2 GW). As these units are nearing the end of their economic life, NEP 2018 has envisioned their transition.

Category II:

- Around 69% of capacity falls in the age bracket of 5 -20 years and this segment is dominated by the private sector. The plants in this age bracket generally have larger unit size (> 500 MW) compared to vintage plants aged >20 years.
- Units aged less than five years represent 15 GW of operational capacity. These units were planned or approved prior to India's first commitments to Nationally Determined contributions (NDCs) at COP21 and promulgation of NEP 2018; but got commissioned in the last five years on account of the long construction periods typical of conventional generation assets and occasional project delays seen in some cases.
- Permissions for new conventional generation capacity have been limited after India's international commitments and NEP 2018, but it may be noted of the capacity approved prior to these commitments 34 GW are currently under different stages of implementation. [12] However, all this capacity may not get commissioned on account of sustained financial pressures due to limited financing available to conventional generation plants and cost competitiveness challenges from round-the-clock (RTC) renewable capacity.

2.1 CHALLENGES

Accelerating India's energy transition faces multiple challenges which are unique to the Indian context. These imminent challenges that could queer the pitch for attainment of India's climate goals have been discussed under four different heads in this sub-section.

2.1.1 ECONOMIC LIFE

The challenges pertaining to economic life of assets can be assessed for categories described in the previous section:

I. **Category I:** Part of units under this category are past their economic life but are still operating based on mutual agreements between beneficiaries and promoters. Lenders do not have any stake left in these plants as they have already recouped their investment. These units are also fully depreciated and typically have negligible capacity charges. Hence, they present an attractive financial proposition for beneficiaries as well as promoters to be persisted with.

   However, these older units are typically small, inflexible, and relatively inefficient, emitting more CO2 compared to their younger counterparts. Additionally, many of these are not fit for installation of the flue gas de-sulpherization (FGD) equipment needed to meet the SO2 emission norms due to technical and spatial constraints. However, in the absence of a stringent

implementation of emission norms and the requisite regulatory push, these plants have remained in operation so far.

The plants aged >20 years predominantly have characteristics similar to the older assets and are already in the NEP-2018 pipeline of transitioning.

Once plants past economic life (>25 years) are transitioned, diligent adherence to plan and regulatory push would be needed to ensure timely transitioning the plants currently aged between 20 - 25 years.

II. **Category II:** Nearly 150 GW conventional generation capacity in India is under 20-year age bracket with substantial economic life left in the assets**.** The common financial challenge with transitioning assets left with economic life is providing justifiable returns on investments made in the projects (return on equity and debt repayment), cost of transitioning, and mitigating impact on livelihood of workforce.

Of these, around 134 GW of India's conventional power plants fall within the age bracket of 5 – 20 years. The ownership of these assets is divided nearly equally between private sector (66GW) and public sector (68GW – 34GW state and 34GW federal Genco's). These assets have reasonable economic life left, have substantial outstanding debt obligations, have promoter expectations regarding Return on Equity (RoE) as well as ongoing contracts for fuel supply and power offtake. Keeping these financial factors in consideration, these assets would require specialized innovative financing solutions for enabling their phasing down prior to the end of their economic life.

Another 15 GW of plants are aged less than five years. These constitute the fleet of young assets which are typically efficient and flexible, therefore they may find value and applications such as grid balancing capacity in accelerating RE deployments in the coming years until storage technology matures.

2.1.2 OWNERSHIP STRUCTURE

The conventional generation assets in the country have been built over time by different sets of owners. The plant owners have their own distinct set of challenges:

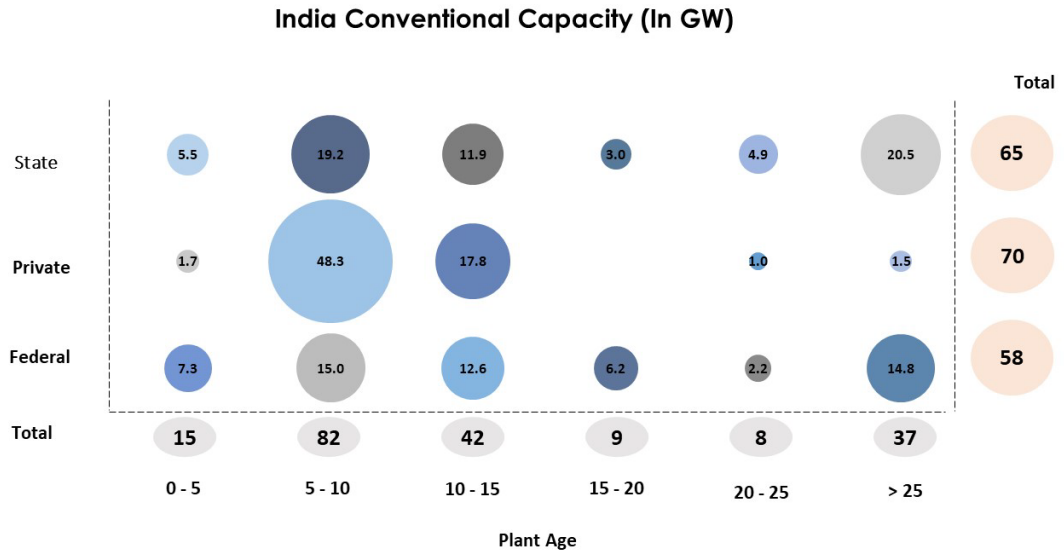


Figure 3: India's conventional capacity distribution

I. **State Government:** Power plants owned by state utilities have direct control of the State Government over them. This capacity, which is completely at disposal of respective states, provides energy security to the state, generates revenue for the state government and creates employment opportunities.

II. **Federal Government:** Power plants owned by federal entities typically have multiple beneficiary states. Therefore, any change in operating status of such plants would impact energy security of multiple states. Additionally, many of these plants were set up close to pit head in fossil fuel bearing region which acted as catalyst for local economy in absence of alternative source of income and transitioning them would adversely impact the socio-economic structures. These factors add another level of complexity requiring requisite planning.

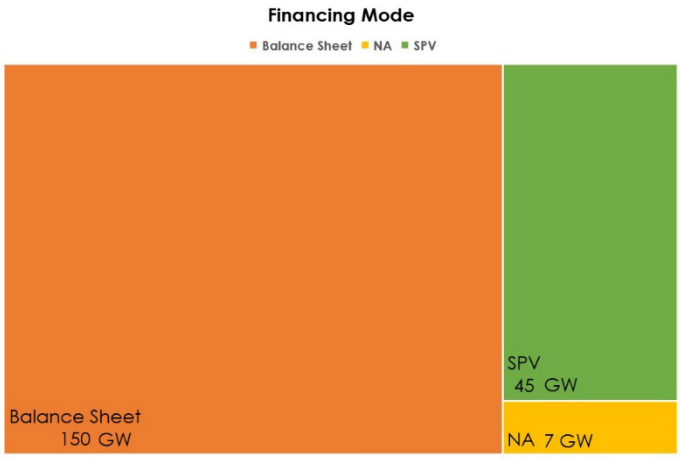
III. **Independent Power Producers (IPP's):** The plants built by IPP's are relatively new with significant economic life ahead of them. Many of these plants were built under competitive bidding routes – consequently, bidders may have considered a useful life greater than 25 years while submitting competitive bids. This leaves these plants with an even longer planned life ahead of them.

2.1.3 FINANCING STRUCTURE

Prior to India's economic reforms in 1991, most of the power plants were developed by entities controlled by either federal or state governments with minimum contribution of the private sector. The projects were predominantly funded through corporate finance based on the strength of the entities' balance sheets. The liberalization of the country's economy in 1991 resulted in rapid economic growth, in turn leading to a growing electricity demand. The sector saw substantial investment

by private entities for development of conventional generation assets. With increasing market maturity, a large number of the newer projects were funded on project finance basis through the special purpose vehicle (SPV) route. Government entities utilized the SPV route for building power plants. Thus, India has conventional assets with two types of debt structuring, one being financed on companies' balance sheets and others being financed through the SPV route.

I. **Balance sheet financing:** Companies with multiple power plants on the balance sheet often do not have clearly defined plant-wise financials. This represents a challenge in the case of refinancing since liabilities to be refinanced cannot not be earmarked to individual units. The problem may additionally be complicated by the balance sheet comprising of power plants of different ages, and of varying fuel/ technology types as well as inclusive of other assets. As only some of the balance sheet assets may warrant refinancing for phasing down, this would therefore require complex financial separation or carving out of the specific assets to be transitioned.



II. **Project financing:** Plants being built on SPV ownership model have clearly defined debt and equity on their balance sheets since they are funded on a project finance model. Debt refinancing is likely to be relatively easier for projects built on SPV models. Lenders could ensure ringfencing of the SPVs against utilization of the project cash flows for external objectives – climate lenders could specifically guard against channelizing the funds for climate-unfriendly businesses or applications. However, mechanisms for ringfencing of the future investments of not just the SPV but the SPV promoters or sponsors as well would be needed, to restrict the use of freed up capital for setting up of new emission-intensive businesses.

2.1.4 OPERATING PARAMETERS AND TARIFF

Operating parameters reflect upon plants' adherence to environmental norms and efficiency while tariff indicates generation cost and its implication on final electricity bill of consumers. For this policy note, CPI has considered station heat rate (SHR) and variable cost (VC) for available data.

The threshold for SHR has been considered at 2410 Kcal/Kg while for VC, it has been considered at INR 3.21/unit. [13] [14]

As evident from the adjoining figure, around 33 % of the capacity operate at low SHR and low tariffs (quadrant III) – two strong reasons for them to continue operating. The resistance to phasing down is likely to be highest from this category of plants.

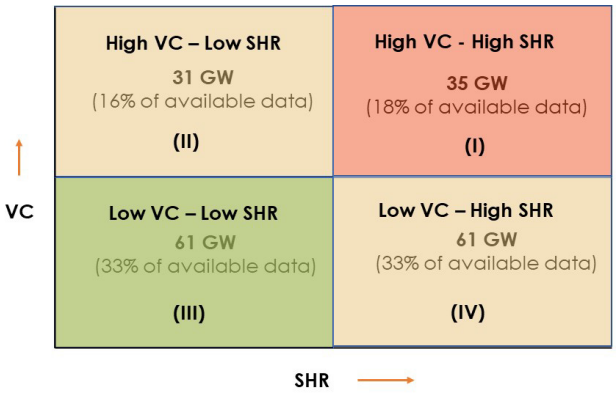


Figure 4: Operational Parameters

3 PATHWAYS TO ACCELERATE ENERGY TRANSITION IN INDIA

There is no single pathway for transitioning conventional generation assets. Rather, it would take asset-level financial structuring and transition planning to achieve this objective. That said, carbon finance has emerged as an indispensable tool worldwide to finance the transition journey of power sector. Development of the carbon market in India is on the anvil too. Assuming a carbon price at USD 5/tonne, every 500 MW of conventional capacity transitioned would generate an estimated USD 10 million in revenue from carbon market by abating 100% emission which would have been emitted in business-as-usual (BAU) scenario. This new revenue could become an incentive to transition at minimum incremental cost to that for the equivalent renewable capacity. Renewable sources generating energy will also maintain energy security of the country.

Table 1 and Table 2 below highlights emission reduction and revenue which can be generated by transitioning 500 MW of conventional generation capacity. Table 2 covers aspects of energy security by modeling equivalent capacity which needs to be installed to maintain the same energy output.

Table 1: Emission Reduction

Particulars	Value
Assumption	Transitioning 500 MW conventional generation plant running at 50% PLF
Electricity generated in BAU scenario (MWh/ year)	2,190,000
Grid Emissions Factor (CO_2/MWh)[1]	0.98
CO_2 generated / Potential of carbon abatement (tCO_2e/year)	2,146,200
Assumed Carbon Price($/tCO2)	5
Carbon Revenue (USD/year) for 500 MW capacity transition	10,731,000

[1] Emission factors as per CEA Combined Margin; transmission losses of 6% and operating hours based on 365 days of generation.

Table 2: Energy Security through equivalent RE capacity

Particulars	Value
Assumption[2]	Considering a 1GW solar wind hybrid (wind dominated) to replace conventional plant with Capacity Utilization Factor of solar at 18% and wind 28%.
Solar capacity (In MW)	300
Solar generation per year (in MWh)	473,040
Wind capacity (In MW)	700
Wind generation per year (In MWh)	1,716,960
Total RE based generation (MWh/ year)	2,190,000

The actual carbon revenue from conventional asset transition would depend on multiple factors including prevailing carbon price, size of the asset and balance life of the asset. Considering this variability and published literature on costs associated with phasing down, it would be important to note that the carbon revenue singularly may not always be adequate to cover all costs. Thus, a structured approach would be required to account for and duly compensate all stakeholders impacted by accelerated energy transition.

3.1.1 RESULT BASED FINANCING (RBF) FRAMEWORK FOR ACCELERATING INDIA'S ENERGY TRANSITION

The potential roadmap of accelerating India's energy transition would require support of government and international multilateral institutions; promoter and lender buy-in; availability of low-cost patient capital; creation of just transition funds and involvement of financial institutions and instruments.

[2] A combination of solar and battery storage could have been used however battery storage costs are still not yet commercially competitive. Alternatively Solar wind hybrid has been considered. The combined PLF for solar and wind hybrid plant at Kavithal, Raichur, is reported to be around 42%, nearly as firm as hydro output in India

The proposed structure has been broken into four blocks for ease of understanding:

1. Setting up of specialized SPV

- A Specialized special purpose vehicle (SPV) to be setup for overseeing the financing and phasing down of suitable assets.
- SPV would require financial support (may be in the form of callable capital) from government itself or government appointed institution providing a backstop arrangement.
- SPV would also need to be adequately backed up by credit enhancement mechanisms from Multilateral Development Banks (MDBs) and Development Finance Institutions (DFIs).

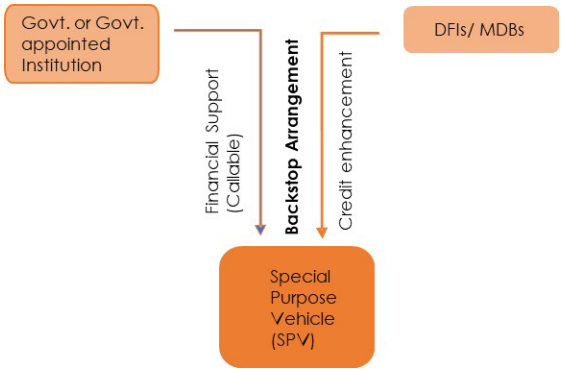


Figure 5: SPV Establishment

2. Transition Agreement and Capital Mobilization

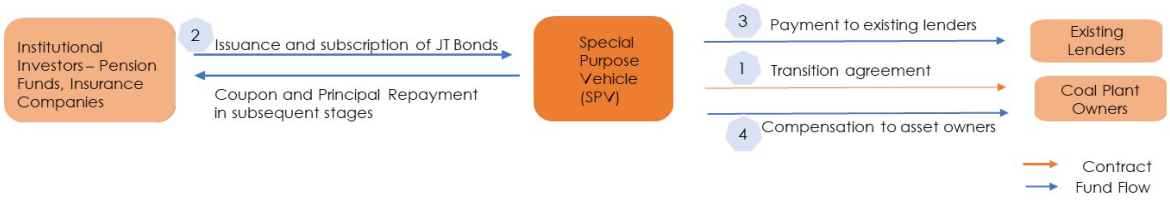


Figure 6: Capital Mobilization

1. Transition agreement: The SPV would sign a transition agreement with asset owners, whereafter the assets would be given a transition trajectory (say of five years) to wind up their existing operations. The payments would be tied to the asset owners achieving specific results on the transition trajectory. Also, the transition agreement would ringfence the use of proceeds from this mechanism against reinvestment in environmentally sensitive businesses.
2. Bond issuance: The SPV would require low-cost targeted capital (1–3%) to refinance existing high-cost debts (9-12%). For this purpose, SPV would issue bonds with potential subscribers being international institutional investors with access to low-cost patient capital and mandate to invest in decarbonization space, such as pension funds, impact investors and insurance companies.
3. Debt refinancing: The proceeds of bonds would be used to refinance existing debt. Existing lenders would be paid in full and refinanced debt at lower interest rate would be on books of SPV. This would significantly bring down interest burden of conventional generation asset.
4. Accelerated RoE: The savings accrued by refinancing the debt may be used to enhance the RoE of shareholders to ensure returns recovery in an expedited manner within the transition period. The value of bond issued would be equated such that SPV is able to repay existing debtors, and shareholders are able to

recoup their balance RoE within transition period. In lieu of the accelerated RoE, asset owners would relinquish their stake in asset and same would be transferred to SPV as per the transition trajectory with seizure of operations.

3. Phasing Down & Repurposing

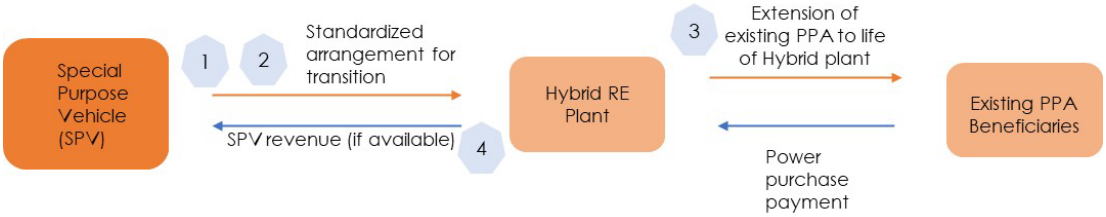


Figure 7: Phasing down & repurposing

1. Transitioning of conventional capacity: The transitioning activity would be carried out by the incoming developer selected through competitive bidding. The salvage value of existing asset would be available to incoming developer. Thus, cost quoted by incoming developer would take into consideration salvage value of the existing asset.
2. Repurposing of asset site: The site would be used by the selected developer to set up renewable hybrid plants utilizing existing power evacuation infrastructure. These hybrid capacities would have reduced but relatively firm generation.
3. PPA extension: Existing PPA could be extended for the useful life of hybrid capacity at ongoing PPA rate, or a preferential tariff enabled through regulatory intervention. The rate of such PPA may be higher than present cost of competitive hybrid plants to facilitate recovery for part of transitioning costs.
4. SPV revenue (if available): In case of positive difference in revenue generated from PPA extension and tariff quoted by incoming developer, the same would be transferred to the SPV as revenue over hybrid capacity's lifecycle. The SPV would utilize this for repayment of transition linked borrowings or as input capital for transition of other conventional generating assets (contribution to JT Fund).

Financing tied to Results

The capital released to asset owners will be in tranches and will be dependent upon milestone achieved. Indicative milestones for release of payments are:

I. Tranche I: Signing of contract between SPV and Asset owners
II. Tranche II: Closure of existing liabilities
III. Tranche III: Physical transition of asset (To be carried out by incoming developer)
    a. Dismantling of Boiler Turbine Generator (BTG)
    b. Dismantling of associated infrastructure
    c. Demolition of civil infrastructure
    d. Site Cleanup
IV. Tranche IV: Land Reclamation & Repurposing (To be carried out by incoming developer)

4. Capital Settlement

The capital raised for transitioning of conventional generation capacity through bond market would be settled using proceeds from carbon market, a Just Transition Fund and revenues from repurposed plant (if available).

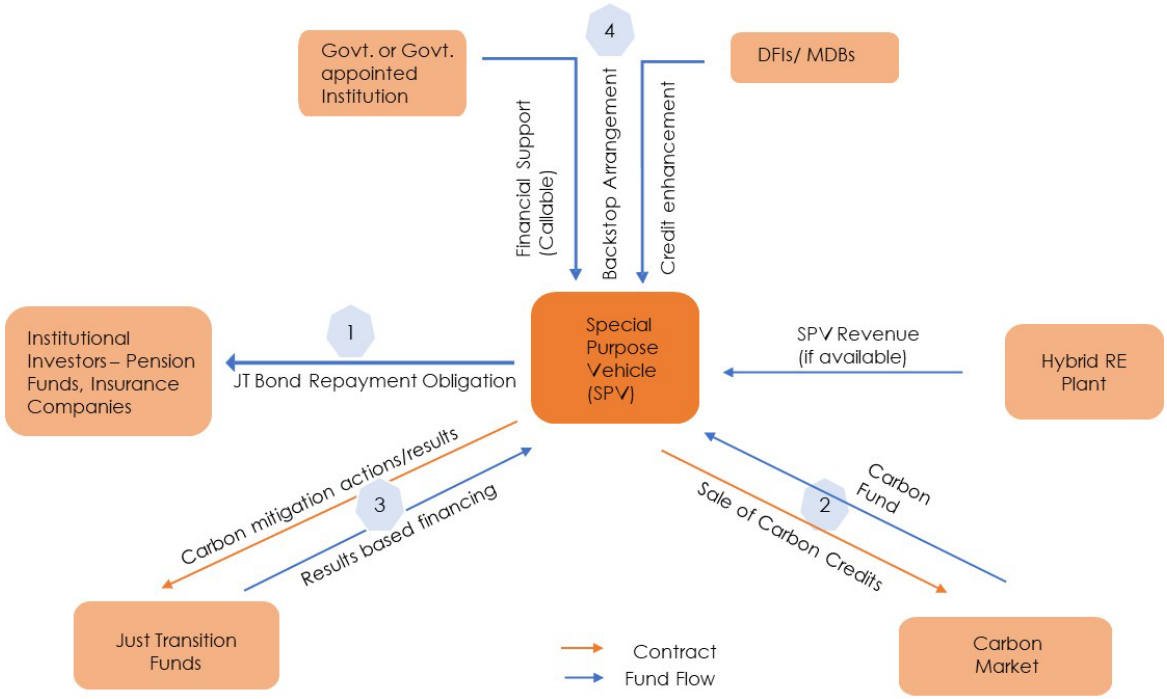


Figure 8: Capital Settlement

1. Repayment obligations: In line with the terms of the JT bonds, repayment obligations would accrue for the SPV in the form of coupon and principal repayment.
2. Carbon market: Transitioning of conventional capacity would generate carbon credits equivalent to avoided emissions over balance asset life, which can be monetized by the SPV. Proceeds from carbon market would help cover re-payment obligations (in part or full) in terms of coupon and/or principal. However, the returns from the carbon market would be contingent on the prevailing carbon prices and therefore additional avenues of revenue generation may be required to fulfil all repayment obligations.
3. Just Transition Fund (JTF): If the SPV is unable to meet its financial obligations from carbon markets and other SPV revenue sources (if available), additional commitments in form of a JTF would be required. The JTF would bridge the gap between total financial obligations of the SPV under this framework and funds raised through carbon market plus SPV revenue sources (if available). Financing through the JTF would be available only on demonstration of pre-defined results, thereby providing results-based financing mechanism. JT funds

would be capitalized through grants from philanthropies, governments, and institutions of global North etc.

4. Backstop arrangement: The Government or a government-appointed agency along with support from DFIs and MDBs would need to support the whole framework by providing a backstop arrangement. In case when phasing down process starts and fund sources mentioned above fail to provide adequate capital, the backstop arrangement would provide required capital for the process to continue and complete.
5. JT fund re-cycling: If at any stage the SPV accrues more revenue (from the carbon credit monetization and/or share of returns from repurposed plants) than its financial obligations, the additional revenue would be contributed towards growing JT Fund in due course, which may be used to support the transition of other conventional generation assets.

The RBF framework is most suited for projects financed on SPV model. However, for implementing this framework to transition assets which have been financed through the corporate balance-sheet, a financial carve-out of such assets into a separate SPV would be needed. Such a carve-out mechanism would make this RBF framework suitable for all conventional generation assets in the category.

The diagram below shows RBF framework in totality based on the result-based financing framework,

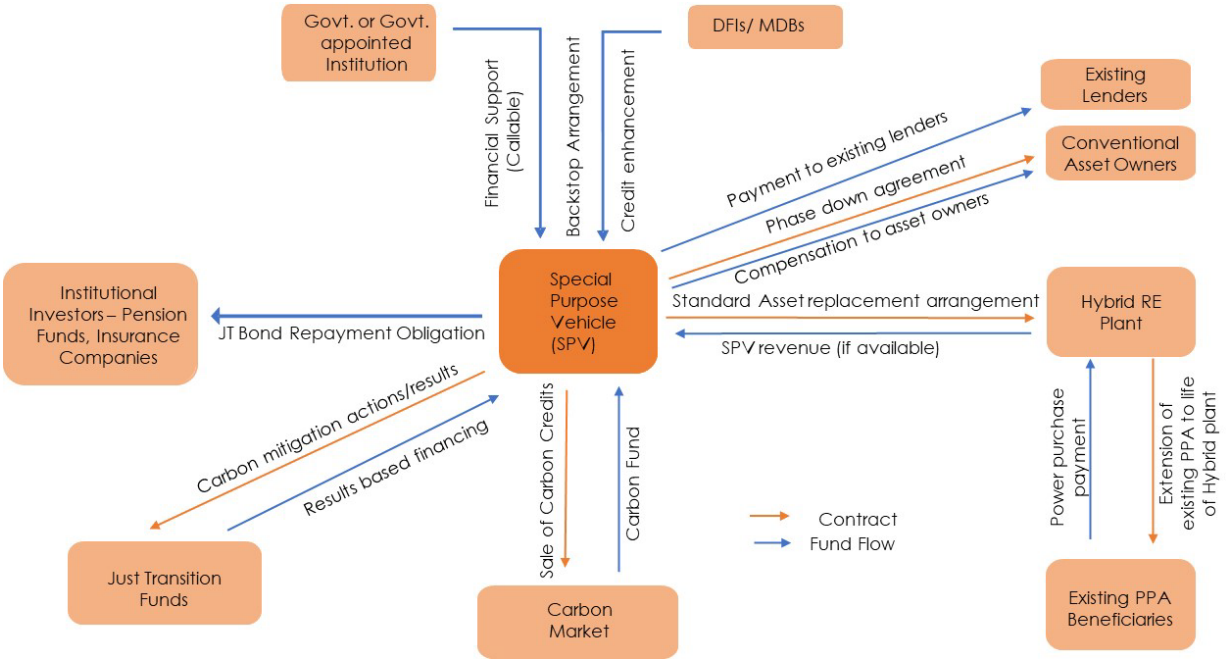


Figure 9: RBF Model

We have, in the next section tried to bucket India's conventional generation capacity to the kind of energy transition construct that would be best suited in given the context.

4 CLASSIFICATION OF UNITS FOR ACCELERATED ENERGY TRANSITION

4.1 CATEGORY I

Category I plants have typically higher Station Heat Rate (SHR) and are often not fit for FGD installation. As these plants have low to nil economic life left, benefits of carbon mitigation are marginal compared to efforts required.

These plants do not need implementation of RBF framework and they can be transitioned by enforcing stricter regulatory compliances. A critical measure in curtailing the financial attractiveness of these assets may be to restrict RoE on capex incurred after 25 years through regulatory intervention.

Indian Power sector is regulated and most of its capacity has been built based on regulated return approach. The tariff of power plant is determined by regulatory commission considering – Return on Equity, Debt Servicing Cost, Depreciation, Interest on Working Capital, Operation & Maintenance (O&M) expenses, and Fuel cost. Debt – Equity ratio considered for tariff calculation is 70:30. Owners of regulated return assets get a guaranteed return of 15.5 % on the equity investment for the entire economic life of 25 years (provided requisite asset availability criteria are met). Debt and depreciation are also calculated basis economic life of 25 years. Power plants tend to have a useful life longer than economic life and can usually run for 35 – 40 years after some Renovation & Modification (R&M). In assets which have completed their economic life and project debt repayments, the promoters continue to get guaranteed return on original equity thereby delivering a handsome returns for long durations.

4.2 CATEGORY II

Category II units are suitable for RBF framework as they are left with reasonable economic life to benefit from carbon mitigation mechanism. Additionally, India currently does not have a defined framework to accelerated transitioning of this category of assets.

4.2.1 UNITS AGED 5 – 20 YEARS

The units in this age bracket represents a significant chunk of conventional generation capacity in India (~134 GW). RBF framework would be best suited for this age bracket. The plants would have 5 years of transition trajectory to cease operations.

4.2.2 UNITS AGED 0 – 5 YEARS

The assets in this age bracket have typically units of higher capacity ratings, built on super critical technology, making them flexible & efficient compared to their older counterparts. These features make them suitable for niche services such as providing peaking capacity, ancillary services, grid flexibility to accommodate RE variability etc. Thus, it would be prudent to continue operating these assets while the assets in the aforementioned bracket (5 – 20 years) are transitioned. During this period these plants will be able to reduce their financial obligations as well as offer energy planners' firm yet flexible power to facilitate energy transition. RBF framework would become applicable for these assets once the grid reaches requisite stability and they cross the 5 year threshold becoming suitable for transitioning.

5 CONCLUSION

Indian power sector is characterized by intricacies unlike most other countries which makes prospects of accelerated energy transition complex. None the less - this is a crucial step that would help India to achieve its Panchamrit targets. This paper has attempted to identify challenges with transitioning conventional generation assets in distinct age brackets and ownership structures. The proposed framework of transitioning conventional generation assets through a result-based financing framework will achieve two distinct objectives. First, it provides a clear pathway for climate finance to flow into energy transition, making the investor community assured of actual results being achieved as the financing is linked to on-ground progress being achieved. Secondly, this mechanism will help policy makers lay down a roadmap to achieve accelerated transition in the power sector in a manner which is quick, ensures national energy security and is not detrimental to the existing investors in the sector. Further, the result-based financing framework will also help in unlocking capital blocked in existing conventional generation assets, which can be used for enhancing investment in sustainable forms of energy. This mechanism, therefore, presents a win-win proposition to all stakeholder categories, including the financiers and investors who are working on a strategic mandate to reduce the carbon intensity of power sector and foster growth of sustainable energy.

6 REFERENCES

[1] K. Shah, "New Coal-fired Power Plants in India," IEEFA, 2021.

[2] K. a. Danwant, "Coal Power's Trilemma," CEEW, 2021.

[3] P. Pandey, "PFC has $6.8 bn NPAs in thermal loan book," 2020.

[4] "Nineth Report, Standing Committee on Energy," 2021.

[5] C. E. Authority, "National Electricity Plan," 2018.

[6] Salinatri, "Indonesia Launched Energy Transition Mechanism Country Platform," em *G20 Indonesia*, 2022.

[7] "Germany: Law on Phasing-Out Coal-Powered Energy by 2038 Enters into Force," 2020.

[8] J. Burton, "Coal in 2022: South Africa's Just Energy Transition Partnership," 2022.

[9] C. E. Authority, "Executive summary on power sector," 2022.

[10] NPTI, "TARIFF DETERMINATION METHODOLOGY FOR THERMAL POWER PLANT".

[11] V. Angurana, "Jindal Power sets up first mega merchant power plant," 2009.

[12] K. V. Vanamali, "India is bidding adieu to thermal plants: What happens to coal demand?," 2022.

[13] P. Line, "Revised Tariff Norms," 2019.

[14] "India RE Navigator," 2022.

[15] M. o. Power, "Power Sector at a Glance ALL INDIA," 2022.

List of Abbreviations

Abbreviation	Definition
ADB	Asian Development Bank
BAU	Business-as-usual
BTG	Boiler Turbine Generator
CGS	Central generating stations
COP	Conference of the Parties
CPI	Climate Policy Initiative
CUF	Capacity Utilization Factor
DFI	Development Finance Institution
ETM	Energy Transition Model
FGD	Flue Gas De-Sulphurization
FSA	Fuel Supply Agreement
GW	Giga Watt
IPP	Independent Power Producers
JT	Just Transition
MDB	Multilateral Development Bank
NDC	Nationally Determined Contributions
NEP	National Electricity Plan
NPA	Non-Performing Asset
O&M	Operation & Maintenance
PGS	Private generating stations
PLF	Plant Load Factor
PPA	Power Purchase Agreement
R&M	Renovation & Modification
RE	Renewable Energy
RoE	Return on Equity
RTC	Round-The-Clock
SGS	State generating stations
SHR	Station Heat Rate
SPV	Special Purpose Vehicle
VC	Variable Cost