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The 3Rs of DISCOM Recovery

Retirement, Renewables and Rationalisation

Discoms and state governments can save thousands of crores by retiring old power plants, tapping cheaper renewable energy and freezing expenditure on new coal plants

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About Climate Risk Horizons

Climate Risk Horizons' (CRH) work highlights the systemic risks that disruptive climate change poses to investors, lenders and infrastructure investments. Through a data-driven, research-oriented approach that incorporates a holistic understanding of climate policy, energy infrastructure and regulatory processes, CRH provides advice on risk management strategies to minimise stranded, non-performing assets and economic disruption in the face of climate change.

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01 Executive summary

Reviving India's electricity sector to meet its fundamental objectives—affordable and reliable power for households and industries—is impossible without addressing the financial crisis facing most state distribution companies (discoms). Getting discoms on a sound financial footing is also critical to India's ambitious energy transition plans. If renewable energy projects in the pipeline are not to suffer the same financial struggles as many coal generation plants today, discoms must be able to pay generators reliably.

The conventional narrative places the blame for discoms' woes at the door of politicised decision making—chiefly losses incurred due to free or subsidised power to sectors such as agriculture, as well as large-scale power theft. This however, is only part of the story.

Despite schemes like UDAY meant to address the financial plight of Discoms, their conditions have worsened. Apart from subsidy and theft issues, this is also due to excessive projections of electricity demand, leading to disproportionate fixed cost obligations.

Over the last five years, despite government schemes like UDAY meant to address the financial plight of discoms, their conditions have worsened. Apart from the subsidy and theft issues referenced above, this state of affairs is also due to excessive projections of electricity demand (by virtually all entities in the electricity space, governmental and non-governmental)—leading states to sign Power Purchase Agreements (PPAs) far in excess of actual requirements. This has resulted in huge over capacity in the electricity system, and disproportionate fixed cost obligations for many discoms. In conjunction with delayed payments from cash-strapped government entities and the requirement to provide free and subsidised power to significant segments of their customer base, this has been a recipe for disaster.

For example, the Maharashtra Electricity Regulatory Commission's (MERC) tariff order for FY 2021 dated March 30, 2020[1] projects that the state discom MSEDCL will pay ₹1,142 crores by way of fixed cost/capacity charges to power plants with zero scheduled dispatch in the current financial year. The order projects that the state will have approximately 15% surplus electricity available above requirement each year from FY 2021–25, at an average power purchase cost of approximately ₹10,000 crores a year. MERC advises that MSEDCL should "review its PPAs and explore options to optimise the impact of the fixed cost of the contracted capacity, including deferment in cases where no significant work execution has taken place so far." Other states with significant surplus contracted energy available and a disproportionate fixed cost obligation include Uttar Pradesh, Punjab and Tamil Nadu.

Even as the financial crisis plaguing discoms roils the power sector and the financial institutions exposed to it, India is also bearing the brunt of severe air pollution and an unfolding climate crisis. Coal-fired power plants play a significant role in all three situations. The financial costs from air pollution in India are now well-documented—an estimated 5.4% of GDP.[2] Public and judicial pressure to act on

pollution is growing. 'Natural' disasters like Cyclone Amphan[3] or the locust swarms[4] in May 2020, bear a clear climate imprint and cause huge suffering and loss of human life, apart from very significant economic losses.

In the budget speech in February 2020, Finance Minister Nirmala Sitharaman announced that utilities would be urged to shut down old and polluting power plants in order to meet air emission norms. While this would help tackle air pollution, shutting down older power plants can also have tangible financial benefits for discoms, state governments and consumers, apart from improving the overall utilisation rates of the rest of the (younger, more efficient) coal fleet. On the other hand, state governments generally fear losing 'backup' assets that might be needed to provide grid stability, and this fear has seen discoms continue to rely on old, inefficient plants.

This analysis attempts a guiding framework to identify which power plants can be phased out at a net benefit. These phaseouts have significant co-benefits: improving the financial condition of state governments and distribution companies, lowering the electricity purchase costs for consumers and ensuring better utilisation of newer, more efficient electricity generation assets, in addition to environmental and climate benefits. The objective of this work is to stimulate a discussion on the benefits that a planned phase out of old coal power plants can bring to a wide range of stakeholders, while suggesting additional analysis that needs to be done.

This report analyses 11 states for which recent tariff data was available: Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Tamil Nadu, Telangana, Uttar Pradesh and West Bengal.

This report analyses 11 states for which recent tariff data was available: Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Tamil Nadu, Telangana, Uttar Pradesh and West Bengal. Each of these states has a significant coal-fired generating capacity, and also purchases power across state lines. These 11 states also account for over 50% of discom dues across the country.

We enumerate the financial benefits that an accelerated phase out of old power plants can bring to discoms and consumers. These benefits are on account of high tariffs and avoided retrofit costs that would be needed to ensure compliance with air pollution laws. Secondly, we have assessed potential savings from freezing expenditure on new coal plants that are financially unviable and at early stages of construction. Lastly, we have also enumerated potential savings from a rationalisation of excessive fixed cost burdens on distribution companies, and from a more ambitious phase out of the most expensive coal power plants irrespective of age.

Utilising some combination of these cost reduction opportunities will benefit discoms, state governments and consumers. Cutting discom losses will also reduce the need for repeated bailouts of discoms by the central government, while improving the balance sheets of banks exposed to discoms and the power sector.

Key findings

- An accelerated shut down of plants 20 years and older can yield savings of **₹53,000 crores** over five years across the 11 states analysed (Table 5). Savings will accrue in two ways:

  → *Shutting down 36,536 MW of older, inefficient coal plants in these 11 states will save an estimated **Rs.18,800 crores** in terms of avoided retrofit costs for Flue Gas Desulphurisers and Low NOx Burners. A quick phaseout of these older plants is the most economical option as retrofits to make them legally compliant with emission standards would require additional capex and raise power tariffs.*

  → *If scheduled dispatch from these 36.5 GW of older plants were to be replaced with electricity from new renewables or the power exchange there would be a further net savings across these 11 states of approximately **Rs.7,000 crores** per annum based on current tariffs. Since coal power tariffs tend to escalate annually, the actual savings over a five-year tariff period would be over **Rs.35,000 crores**.*

- Despite the surplus generation capacity in the system and the onerous fixed cost obligations discoms are already under, an additional 60 GW of thermal power is officially under construction across the country, with another 29,000 MW in the proposal/permitting stage. Of this, 17,235 MW is likely to be completed by 2022 in the 11 states under discussion. Once commissioned, these plants will pose an additional fixed cost burden for state discoms while further depressing capacity factors across the coal fleet further, barring a huge increase in electricity demand—unlikely given the economic impacts of the COVID-19 pandemic.

- Freezing expenditure on 14.1 GW of early stage state and central sector projects under active construction can save over **₹92,000 crores** of public funds. (Table 7) If we include projects officially under construction but actually stalled (mostly private sector) this amount goes up to approximately **₹1,55,000 crores** in these 11 states (Table 8).

- If state discoms faced with surplus Power Purchase Agreements/generating capacity were to also renegotiate fixed cost obligations in light of lower than projected demand, there could be an additional savings of approximately **₹12,000 crores** per year (Table 9).

- If scheduled dispatch/ generation from all plants with tariffs at ₹4/kWh or higher (irrespective of age) were to be replaced with power from renewables or from the power exchanges at an average of ₹3/kWh, there would be a potential savings of approximately **₹55,000 crores** per annum (based on current power tariffs) in terms of reduced power purchase cost for just these 11 states (Table 10).

Diverting some or all of these savings to cheaper renewable energy, grid modernisation, efficiency and energy storage investments or to tackle the COVID-19 pandemic and its health and social impacts would be a more productive use of public money.

TABLE 1

Summary of potential savings for discoms and state governments (in INR)

Avoided retrofits by phasing out plants 20 yrs and older	18,000 cr
Replace lost generation from plants 20 yrs and older with renewable energy	7,000 cr (p.a.)
Rationalise under construction projects in the state/central sector, freezing expenditure on early stage plants	92,000 cr
Rationalise fixed cost obligations	12,000 cr (p.a.)
Phase out all plants with tariffs >4kWh & replace with =3/kWh	55,000 cr (p.a.)

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TABLE 2

Statewise summary of potential savings

STATES	DISCOM DUES	POTENTIAL SAVINGS				
		Avoided retrofits	RE replacement (only >20 years)	Rationalisation of under construction projects*	Fixed cost rationalisation	RE replacement (all >4/kWh)
Andhra Pradesh	3,687	890	1,423	—	331	7,092
Bihar	661	227	411	9,546	98	1,651
Chhattisgarh	52	1,617	–277	—	290	464
Gujarat	331	1,747	782	—	995	3,890
Karnataka	4,655	779	1,484	—	1,457	7,110
Madhya Pradesh	1,162	2,021	–322	—	277	5,103
Maharashtra	8,367	2,063	1,106	4,548	2,679	8,356
Tamil Nadu	15,885	1,854	1,724	26,647	1,139	6,097
Telangana	5,937	1,343	65	22,743	307	1,974
Uttar Pradesh	13,874	4,134	–490	28,993	5,067	11,141
West Bengal	84	1,938	1,167	—	20	2,125
TOTAL	**54,695**	**18,613**	**7,073**	**92,477**	**12,660**	**55,003**

All figures in INR crores; discom dues from www.praapti.in accessed July 7, 2020.

**Only early stage projects under construction; excludes stalled projects. CEA Broad Status Report, May 2020.*

Recommendations

Detailed discom plans developed at the state level that incorporate the four elements laid out below are required for any discom recovery to be successful and sustainable in the long run.

01

Accelerate the phase out of older, inefficient, polluting power plants

Almost all of these plants at or near the end of their life are owned by state governments, and many are significantly depreciated, with most capital costs paid off. Due to their age and general inefficiencies, the variable cost of power from many of these plants is high. Rather than incurring additional capex on retrofits for these plants to get them to meet the 2015 air emission norms and maintain their operational readiness, state governments could instead shut them down by 2022 (the deadline for compliance), and generate immediate savings and power purchase cost reductions.

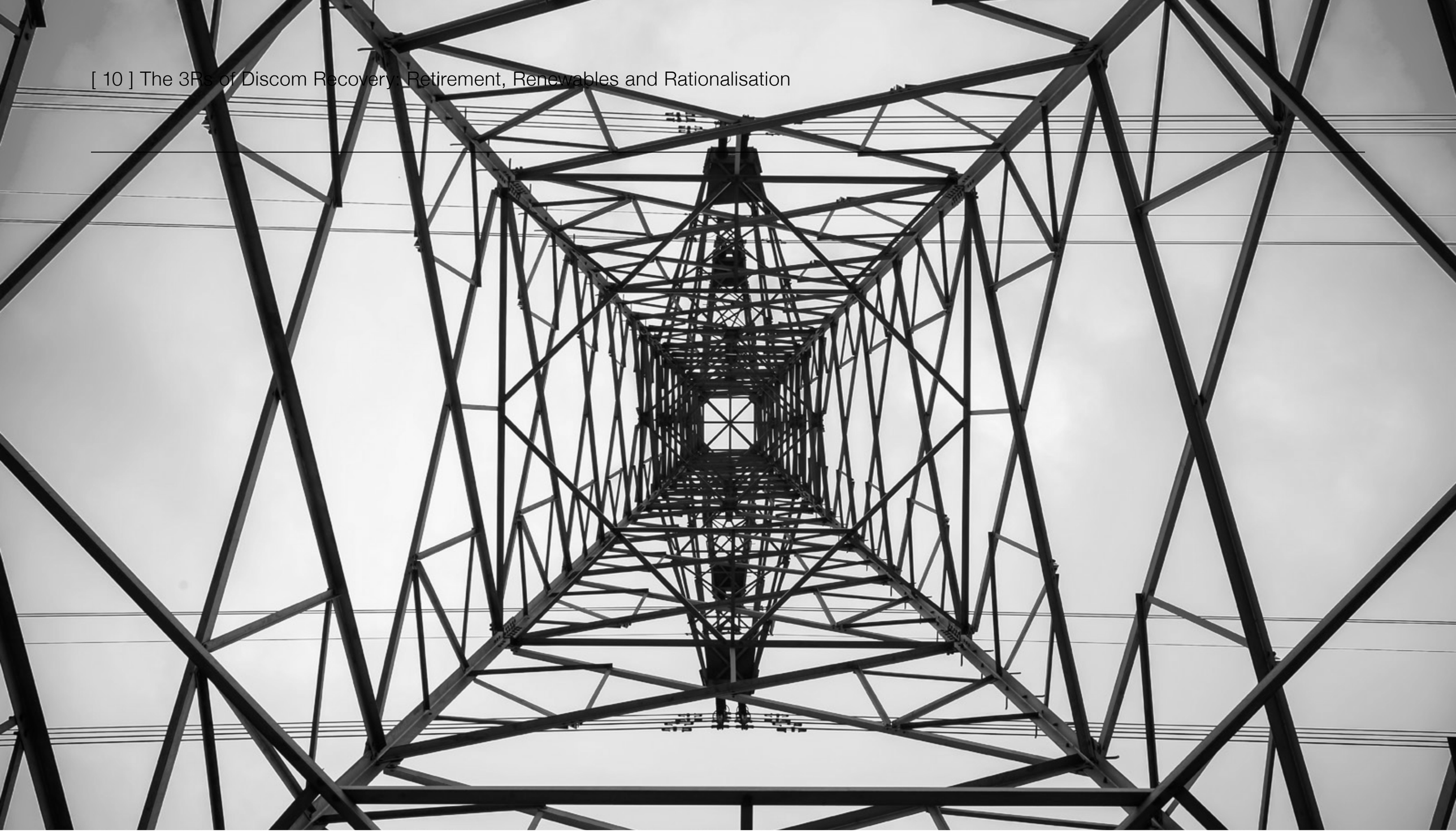
There is significant surplus generation capacity in the electricity system to compensate for the loss of generation and address fears of grid stability. Discoms can plan to replace lost generation with renewable energy/renewable and storage projects. Given recent price declines, new RE projects will provide electricity at cheaper rates than existing or new thermal power.

Over the longer term, there are even greater savings to be made by reducing power purchase costs through a planned phase out of power plants with tariffs above ₹4/kWh, irrespective of age of the plant, starting with the most expensive. This can be done on a case by case basis while upholding the sanctity of contracts, for example, at the end of current contract life. Where all parties are government entities, there could be a case for ending contracts prematurely given the savings that will be generated across the system. Alternatively, contracts can be reconfigured to reward generators with a premium for peaking power supply in exchange for lower generation when cheaper renewables are available.

02

Fresh expenditure on early stage under construction/proposed coal power plants should be halted

Any new coal power plant compliant with air pollution regulations will not be cost competitive with new renewable energy and is unlikely to be run at remunerative capacity factors given the



power demand scenario and the merit order dispatch benefits enjoyed by renewable power. Where plants are close to completion, the optimal choice might be to proceed, but any project that still requires an expenditure of thousands of crores is probably better off being shelved and the land freed up for more constructive purposes or returned to the original owners. If not, we envisage the creation of further stranded assets and stress in the discom and banking system.

03

Reducing onerous fixed cost obligations through negotiation and arbitration

Mitigating excessive fixed cost obligations is essential to tackling discoms' financial issues. While this is a tricky issue, a start can be made with state-owned plants. All options must be on the table—as has happened with other non-performing assets in the power sector, lenders might have to take a haircut and project owners could settle for a reduced Return on Equity, as opposed to continued non-payment or late payment of dues and the risk of debt defaults and general instability.

04

Incentivising community solar feeders to offset rural/agricultural demand

Removal of cross subsidies used to provide cheap or free power for agricultural use can be socially regressive and politically difficult. Meeting a growing proportion of this demand closer to source through solar feeders and the solarisation of pump sets are useful ways to reduce losses. Savings generated from pursuing the options above could be invested in meeting agricultural demand via solar, yielding a double benefit for discoms. More fundamentally, policy incentives to encourage regionally appropriate cropping are essential. There has been enough research on this,[5,6] so this report will not go further into this aspect, other than to say that adding decentralised, low-cost generation has a critical role to play in electricity sector reform and addressing the gap between cost of supply and actual revenue recovery. Done right, this will put discoms on a path to permanently eliminate this subsidy in a socially just manner.

02 Introduction

India's struggling discoms have plagued the electricity sector for years. The UDAY scheme launched in 2015 was supposed to help resolve the situation by transferring the bulk of discom debt to state governments' balance sheets, in exchange for discoms undertaking measures to improve financial sustainability such as reducing Aggregate, Technical and Commercial losses, and better metering.

However, given no success in reducing the rate of unfunded cross-subsidies, improvements have been short-lived. The Ministry of Power's PRAAPTI portal listed total overdues as of April 30, 2020 at over ₹1,00,000 crores, of which ₹54,695 crores is from the 11 states analysed in this report.

TABLE 3

Breakup of overdues of the 11 states analysed in this report

Andhra Pradesh **Total overdue** ₹3687 CR P.A.	*Bihar* **Total overdue** ₹661 CR P.A.	*Chhattisgarh* **Total overdue** ₹52 CR P.A.	*Gujarat* **Total overdue** ₹331 CR P.A.
Karnataka **Total overdue** ₹4655 CR P.A.	*Madhya Pradesh* **Total overdue** ₹1162 CR P.A.	*Maharashtra* **Total overdue** ₹8367 CR P.A.	*Tamil Nadu* **Total overdue** ₹15885 CR P.A.
Telangana **Total overdue** ₹5937 CR P.A.	*Uttar Pradesh* **Total overdue** ₹13874 CR P.A.	*West Bengal* **Total overdue** ₹84 CR P.A.	*Total* **₹54695 CRORES P.A.**

Source: www.praapti.in checked on July 7, 2020

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A look at India's economic and energy scenario shows that the country has an opportunity to make a decisive shift in its electricity system in a way that restores Discoms to financial health and also addresses the issue of power generation assets that are not being adequately utilised. This opportunity arises from the convergence of three factors:

Surplus generation capacity is here to stay

The coal power fleet in India has been experiencing low average Plant Load Factors (PLF) of ~60% for several years. Private generators have seen PLFs far below this average, with significant impacts on profitability and debt repayment and knock on effects on the banking system. This situation is likely to persist with new coal capacity still under construction and electricity demand falling short of anticipated levels, even before COVID-19 induced an economic contraction.

Actual electricity requirement in FY 2020 was 1,290 TWh,[7] whereas the National Electricity Plan released in 2018 anticipated FY 2020 electricity requirement at 1,389 TWh[8]—over 7.5% higher. Even at its original projection, the NEP warned of surplus generating capacity given the large number of plants under construction. Given economic projections for the rest of FY2021 for India, as well as the global economic slowdown in the wake of COVID-19, it is clear that surplus generation capacity will persist for the foreseeable future unless new build plans are shelved and older plants retired. Most recently, TERI has suggested that the impact of COVID-19 will mean an Indian economy that is between 7% to 17% below the pre-COVID trend in terms of Gross Value Added by 2025, translating into total electricity demand of anywhere from 75 TWh (optimistic scenario) to 258 TWh (pessimistic scenario) below the pre-COVID trend.[9]

This situation will be exacerbated by the fact that an additional 60GW of coal power is officially under construction across the country, with about 23 GW likely to be commissioned by 2022. Most of these plants require a tariff above ₹4/kWh for financial viability. A look at average Plant Load Factors of coal-powered plants in the states under discussion shows that there is ample surplus capacity in the generation system within states to absorb any shortfall arising from the phaseout of older plants. Given the significant surplus generation capacity in the system, keeping inefficient plants in service is probably not an optimal way to ensure grid stability.

TABLE 4

Average Plant Load Factors (PLFs), FY 2018–2020

Andhra Pradesh

Plant Load Factor

FY 2020 **55.91**
FY 2019 **55.28**
FY 2018 **59.29**

Bihar

Plant Load Factor

FY 2020 **65.84**
FY 2019 **73.42**
FY 2018 **67.08**

Chhattisgarh

Plant Load Factor

FY 2020 **58.72**
FY 2019 **62.50**
FY 2018 **63.00**

Gujarat

Plant Load Factor

FY 2020 **60.71**
FY 2019 **61.80**
FY 2018 **60.70**

Karnataka

Plant Load Factor

FY 2020 **28.62**
FY 2019 **37.35**
FY 2018 **44.89**

Madhya Pradesh

Plant Load Factor

FY 2020 **65.73**
FY 2019 **76.66**
FY 2018 **72.78**

Maharashtra

Plant Load Factor

FY 2020 **47.65**
FY 2019 **53.63**
FY 2018 **50.31**

Tamil Nadu

Plant Load Factor

FY 2020 **56.05**
FY 2019 **60.67**
FY 2018 **57.69**

Telangana

Plant Load Factor

FY 2020 **75.05**
FY 2019 **79.92**
FY 2018 **80.82**

Uttar Pradesh

Plant Load Factor

FY 2020 **60.53**
FY 2019 **64.04**
FY 2018 **66.11**

Bihar

Plant Load Factor

FY 2020 **57.01**
FY 2019 **62.00**
FY 2018 **62.20**

Source: CEA Generation Reports

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Renewable energy is cheap and getting cheaper

At the same time, new renewable energy (solar PV or wind) is available at less than ₹3/kWh, cheaper than a large segment of existing coal power generation. Recent bids for round the clock renewable energy (with storage) saw a combined tariff of ₹3.6[10] —below a significant proportion of existing coal generation. The Lawrence Berkeley National Laboratory has estimated that solar PV with Li-ion battery storage can deliver electricity at a tariff of ₹3.9 in 2020, dropping to ₹3.32 by 2025 and ₹2.83 by 2030.[11] Even if further cost declines do not materialise, these existing costs already question the competitiveness and financial viability of any new coal project. This brings into doubt the financial viability of the 35 GW of coal plants under active construction across the country, as well as the 29 GW in the proposal/permitting pipeline. Cumulatively, this represents an investment of approximately ₹430,000 crores/$60 billion (₹8 crore/MW)—a significant liquidity drain even at the best of times.

Existing costs of renewables with storage already question the competitiveness and financial viability of any new coal project, including the 35 GW under active construction.

Air pollution, legal regulations and blue sky thinking

Coal power generation makes a significant contribution to India's air pollution crisis. The Ministry of Environment, Forests & Climate Change requires emission controls on all power plants, progress on which has been slow, inviting legal censure and monitoring by the courts. COVID-19 has underlined the co-morbidity impacts of air pollution across the Indian population, while also showing people the pleasure of having "blue skies" and clean air.

The public and political pressure on institutions to tackle air pollution will grow if pollution levels once again rise to unhealthy levels as coronavirus restrictions are eased—which seems inevitable. It is inevitable that all coal power plants will have to install pollution control technologies, or face growing litigation and political pressure in the coming years.

In the case of power plants that are 20 years of age or older, incurring an additional financial burden to install Pollution Control Technology is not economical. Given the financial distress generators and discoms are facing and the reluctance of lenders to lend to a struggling sector, an accelerated phase out is the more economical choice. Shutting down older coal power plants would entail replacing lost generation either with new renewable energy, or allowing newer, more efficient coal plants to run at higher capacity factors—either option will most likely lead to lower power purchase costs.

03 Data and methods

This report analyses only 11 significant coal power states for which recent tariff data was available from regulators. In these 11 states, we identify specific coal power plants for retirement. We enumerate the financial benefits that could accrue, to serve as a starting point for more detailed plant and region-specific assessments.

We rely primarily on the most recent publicly available tariff orders issued by state regulatory commissions for data on total tariff, fixed costs and variable costs as well as scheduled electricity dispatch. For most of the states, this means reliance on FY 2020 figures, but for some states this is FY 2019 or FY 2021.

The CEA's National Electricity Plan 2018[12] has three lists of plants that should be retired. These lists are 1) those considered for retirement by 2022, 2) those >25 yrs by 1/1 2022 and without space for FGD, 3) those >25 years by 1/1/2022 that should be considered for shutdown during the 2022–27 period.

Lowering the threshold for retirement to plants above 20 years of age today (rather than 25 years by 2022) yields stronger system-wide financial benefits. It is important to note that the mere presence of a plant on CEA's retirement list does not itself mean it will be retired, especially as many of those plants are owned by state government entities. For this reason, all plants currently functioning were included in this analysis, including those on the CEA's retirement lists.

The CEA has provided indicative estimates of FGD capex costs,[13] ranging from ₹30–45 lakhs per MW, depending on unit size. The CEA has not provided estimates for units smaller than 210 MW. For such units, we have assumed costs similar to that of a 210 MW unit, though they are likely to be higher.

We have assumed that NOx standards for these older plants can be met through retrofitting units with Low NOx burners. We have used the estimate by IISD et al of ₹8 lakh per MW for installation of Low NOx burners.[14] Data on the status of retrofits to meet the 2015 emission norms is taken from the Central Electricity Authority's June 2020 quarterly implementation report.

Based on the latest available scheduled dispatch, we estimate likely net savings or loss per annum after replacing the lost generation from the plants being retired.

For an assessment of likely savings from retiring all plants supplying expensive power (irrespective of age), we have taken ₹4/kWh as a threshold for replacement, as electricity costing more than this is more expensive than alternatives available today.

This assumption is based on renewable energy and renewable energy and storage bids recorded over the last year. New solar/wind tariffs are uniformly in the ₹2.5–₹3/kWh, and solar and storage tariffs discovered in recent auctions range between ₹3.6–₹4.3/kWh. Bloomberg New Energy Finance estimates a continued cost reduction for new solar PV by 2025 and 2030 of 14% and 22% respectively, and a decline in costs for solar/wind and battery storage of about 40% by 2030.[15] The CEA also assumes a similar cost trajectory decline for battery energy storage systems by 2030.[16] Lawrence Berkeley National Laboratory estimates solar PV and Li-ion battery storage costs at ₹3.94 in 2020, falling to ₹3.32 by 2025.[17] Given both existing costs and projections of further declines, we have erred on the conservative side by adopting ₹4/kWh as a threshold above which power generation can be considered more expensive than competitive sources. Similarly, we err on the conservative side by

assuming a new renewable energy tariff of ₹3/kWh to replace lost generation from plants being retired. New solar PV and wind energy projects have reliably recorded tariffs below that level, and average power purchase on the power exchanges is also well below ₹3/kWh. In the few cases where plants being retired are providing electricity at below ₹3/kWh, we have deducted the added expense to arrive at a net power purchase cost.

Data on under construction coal power plants is sourced from the Central Electricity Authority's Broad Status Report (May 2020). The ownership of these plants is mixed; hence caution must be exercised when applying savings from avoided expenditure to any one entity. The estimation of savings from avoided expenditure has been included in this analysis to give a system-wide perspective of possible savings. However, it is also reasonable to expect that the ultimate burden of paying for under construction plants will fall on discoms, consumers and public sector banks.

Coal power plants were analysed on the following parameters:

1 Age (>20 years considered for retirement)

2 Costs in terms of total tariff per kWh, as well as fixed and variable components

3 Status of installing or tendering PCT to meet emission norms

To assess the case for why phasing out such plants is not just financially beneficial but could also yield other co-benefits, the following criteria were also assessed:

4 Is the plant within 150 km. of a CEPI pollution hotspot or a NAAQS non-attainment city?

5 What is the water stress level of the district where the plant is located?[18]

04 Findings

FINDING 1

Rs. 25,000 crore = savings from retiring coal plants 20 years and older

Phasing out coal power plants at or over 20 years of age can yield savings to state governments, discoms and consumers. Those savings will accrue in two ways:

i ₹18,800 crore in terms of avoided retrofit costs that need to be incurred to meet the 2015 emission standards.

ii ₹7,000 crore per annum in terms of replacement of scheduled dispatch with renewable energy. This is a recurrent annual saving—over the course of five years, this would translate to over ₹35,000 crore in savings.

FIGURE 1

Savings from retiring old TPPs; avoided retrofit cost and replacement of power with renewable energy (in crores)

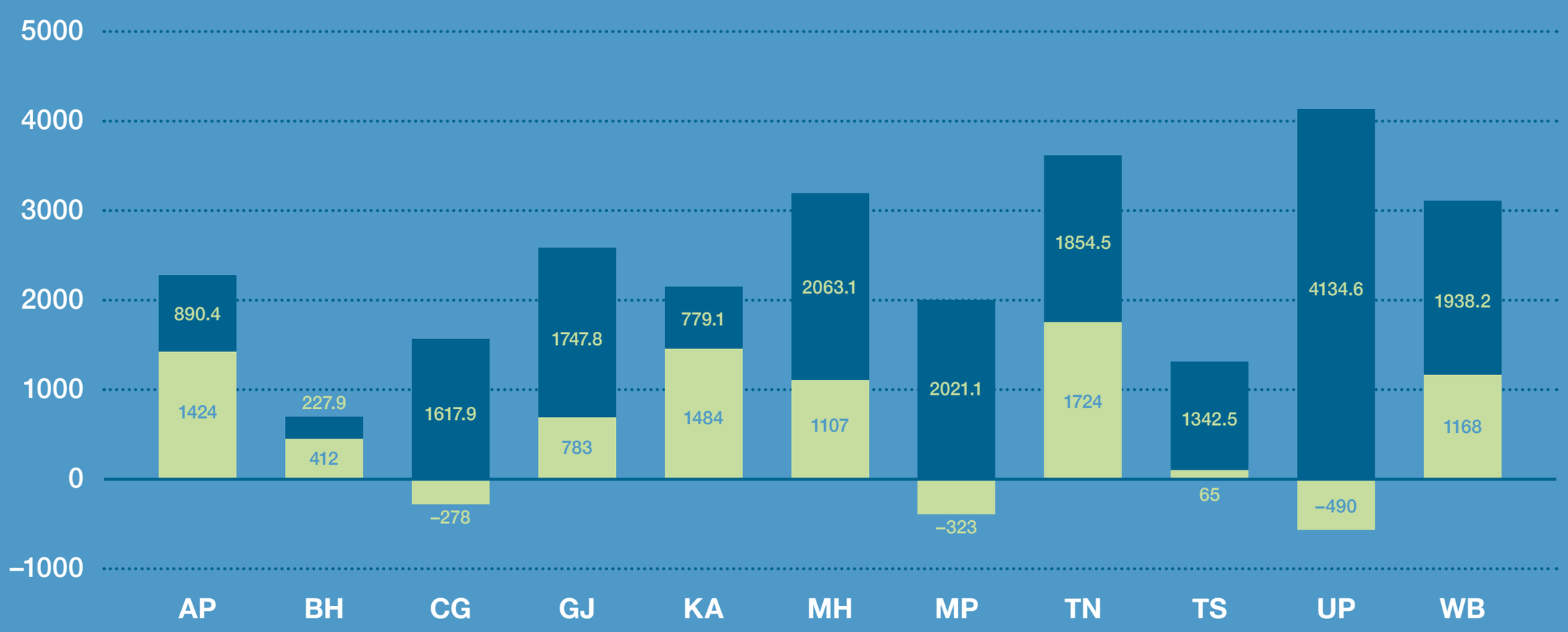

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FIGURE 2

Ownership of >20-year-old TPPs and annual savings from power replacement with renewable energy (in crores)

TABLE 5

List of coal plants 20 years or older that can be phased out with potential savings (in crores)

ANDHRA PRADESH			
01	**Power station/unit** NTTPS-I (Dr.Narla Tata Rao)	**Sector** State	**Age** 39–40 years
MW 420	**Scheduled dispatch (MU)** 2,413.11		**Tariff** ₹6.16/kWh
Water stress High	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹761.517 cr		**Savings from avoided retrofit (one-time)** ₹222.6 cr	
02	**Power station/unit** NTTPS-II (Dr.Narla Tata Rao)	**Sector** State	**Age** 29–30 years
MW 420	**Scheduled dispatch (MU)** 2,281.38		**Tariff** ₹3.34/kWh
Water stress High	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹77.566 cr		**Savings from avoided retrofit (one-time)** ₹222.6 cr	
03	**Power station/unit** NTTPS-III (Dr.Narla Tata Rao)	**Sector** State	**Age** 24–25 years
MW 420	**Scheduled dispatch (MU)** 2,111.57		**Tariff** ₹3.34/kWh
Water stress High	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹71.799 cr		**Savings from avoided retrofit (one-time)** ₹222.6 cr	

04	**Power station/unit** RTPP Stage I (Rayalaseema)	**Sector** State	**Age** 24–25 yrs
MW 420	**Scheduled dispatch (MU)** 1,653.38		**Tariff** ₹5.43/kWh
Water stress High	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹401.616 cr		**Savings from avoided retrofit (one-time)** ₹222.6 cr	
POWER FROM OTHER STATES			
Power station/unit NTPC Ramagundam Stage I & II		**Scheduled dispatch (MU)** 1,975.87	
Tariff ₹3.49/kWh	**Savings from replacement with RE (p.a.)** ₹97.279 cr		
Power station/unit NLC Stage I		**Scheduled dispatch (MU)** 264.99	
Tariff ₹3.53/kWh	**Savings from replacement with RE (p.a.)** ₹14.083 cr		
SUB TOTAL	**Savings from replacement with RE (p.a.)** **₹1,423.86 cr**	**Savings from avoided retrofit (one-time)** **₹890.4 cr**	

BIHAR			
05	**Power station/unit** KBUNL 1 (Muzaffarpur Kanti TPP)	**Sector** Centre	**Age** 33–34 years
MW 220	**Scheduled dispatch (MU)** 572.11		**Tariff** ₹4.75/kWh
Water stress High	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹100.13 cr		**Savings from avoided retrofit (one-time)** ₹116.6 cr	
06	**Power station/unit** Barauni Stage I	**Sector** Centre	**Age** 34–36 years
MW 210	**Scheduled dispatch (MU)** 1,110.26		**Tariff** ₹5.11/kWh
Water stress Medium–high	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹234.26 cr		**Savings from avoided retrofit (one-time)** ₹111.3 cr	
POWER FROM OTHER STATES			
Power station/unit Farakka—I & II		**Scheduled dispatch (MU)** 3,220.61	
Tariff ₹3.24/kWh		**Savings from replacement with RE (p.a.)** ₹77.29 cr	
SUB TOTAL	**Savings from replacement with RE (p.a.)** **₹411.69 cr**	**Savings from avoided retrofit (one-time)** **₹227.9 cr**	

CHHATTISGARH			
07	**Power station/unit** Hasdeo Thermal Power Station (Korba West Unit 1–4)	**Sector** State	**Age** 33–36 years
MW 840	**Scheduled dispatch (MU)** 4,942.28		**Tariff** ₹2.455/kWh
Water stress Medium–high	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹–269.284 cr		**Savings from avoided retrofit (one-time)** ₹445.2 cr	

08	**Power station/unit** Korba Thermal Power Station/ Korba East	**Sector** State	**Age** 33–34 years
MW 240	**Scheduled dispatch (MU)** 1,306.12		**Tariff** ₹4.321/kWh
Water stress Medium–high	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹172.534 cr		**Savings from avoided retrofit (one-time)** ₹127.2 cr	
09	**Power station/unit** Korba STPS (Unit 1–6) (Stage I and II)	**Sector** Centre	**Age** 30–36 years
MW 2100	**Scheduled dispatch (MU)** 1,507.71		**Tariff** ₹1.801/kWh
Water stress Medium–high	**<150km from pollution hotspot** Yes		**PCT status** Bid awarded
Savings from replacement with RE (p.a.) ₹–180.803 cr		**Savings from avoided retrofit (one-time)** ₹1045.5 cr	
SUB TOTAL	**Savings from replacement with RE (p.a.)** **₹–277.55 cr**	**Savings from avoided retrofit (one-time)** **₹1617.9 cr**	

GUJARAT			
10	**Power station/unit** GSECL Gandhinagar 5	**Sector** State	**Age** 21 years
MW 210	**Scheduled dispatch (MU)** 84		**Tariff** ₹6.19/kWh
Water stress Extremely high	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹26.8 cr		**Savings from avoided retrofit (one-time)** ₹111.3 cr	
11	**Power station/unit** GSECL Wanakbori 7	**Sector** State	**Age** 21 years
MW 210	**Scheduled dispatch (MU)** 1,341		**Tariff** ₹3.67/kWh
Water stress Extremely high	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹89.7 cr		**Savings from avoided retrofit (one-time)** ₹111.3 cr	
12	**Power station/unit** GSECL Ukai	**Sector** State	**Age** 34–40 years
MW 610	**Scheduled dispatch (MU)** 2,424		**Tariff** ₹4.47/kWh
Water stress Medium–high	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹356.8 cr		**Savings from avoided retrofit (one-time)** ₹332.3 cr	
13	**Power station/unit** GSECL Gandhinagar 3–4	**Sector** State	**Age** 28–29 years
MW 420	**Scheduled dispatch (MU)** 166		**Tariff** ₹16.02/kWh
Water stress Extremely high	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹216.2 cr		**Savings from avoided retrofit (one-time)** ₹222.6 cr	
14	**Power station/unit** GSECL Wanakbori 1–6	**Sector** State	**Age** 32–37 years
MW 1260	**Scheduled dispatch (MU)** 8,538		**Tariff** ₹3.81/kWh
Water stress Extremely high	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹695.6 cr		**Savings from avoided retrofit (one-time)** ₹667.8 cr	

15	**Power station/unit** GSECL Kutch Lignite 1–3	**Sector** State	**Age** 22–29 years
MW 215	**Scheduled dispatch (MU)** 867		**Tariff** ₹4.54/kWh
Water stress Extremely high	**<150km from pollution hotspot** No		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹133.9 cr		**Savings from avoided retrofit (one-time)** ₹111.7 cr	
16	**Power station/unit** Sabarmati TPS	**Sector** State	**Age** 31–41 years
MW 360	**Scheduled dispatch (MU)** 0		**Tariff** —
Water stress Extremely high	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) —		**Savings from avoided retrofit (one-time)** ₹190.8 cr	

POWER FROM OTHER STATES	
Power station/unit NTPC Vindhyachal I	**Scheduled dispatch (MU)** 1,613
Tariff ₹1.77/kWh	**Savings from replacement with RE (p.a.)** ₹–198.9 cr
Power station/unit NTPC Vindhyachal II	**Scheduled dispatch (MU)** 1,796
Tariff ₹2.23/kWh	**Savings from replacement with RE (p.a.)** ₹–137.8 cr
Power station/unit NTPC Korba	**Scheduled dispatch (MU)** 2,651
Tariff ₹1.55/kWh	**Savings from replacement with RE (p.a.)** ₹–385.3 cr
Power station/unit NTPC Korba II	**Scheduled dispatch (MU)** 717
Tariff ₹2.8/kWh	**Savings from replacement with RE (p.a.)** ₹–14.1 cr

SUB TOTAL	**Savings from replacement with RE (p.a.)** **₹782.9 cr**	**Savings from avoided retrofit (one-time)** **₹1747.8 cr**

KARNATAKA			
17	**Power station/unit** Raichur TPS 1–7	**Sector** State	**Age** 20–33 years
MW 1470	**Scheduled dispatch (MU)** 7,970.6		**Tariff** ₹4.77/kWh
Water stress Low–medium	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹1,410.74 cr		**Savings from avoided retrofit (one-time)** ₹779.1 cr	

POWER FROM OTHER STATES	
Power station/unit NTPC Ramagundam Stage 1 & 2	**Scheduled dispatch (MU)** 2,600
Tariff ₹3.18/kWh	**Savings from replacement with RE (p.a.)** ₹47.49 cr
Power station/unit NLC TPS–II Stage I	**Scheduled dispatch (MU)** 819.24
Tariff ₹3.32/kWh	**Savings from replacement with RE (p.a.)** ₹26.11 cr

SUB TOTAL	**Savings from replacement with RE (p.a.)** **₹1,484.34 cr**	**Savings from avoided retrofit (one-time)** **₹779.1 cr**

MADHYA PRADESH			
18	**Power station/unit** NTPC Vindhyachal Stage I	**Sector** Centre	**Age** 28–30 years
MW 1260	**Scheduled dispatch (MU)** 3,059		**Tariff** ₹2.62/kWh
Water stress High	**<150km from pollution hotspot** Yes		**PCT status** Bid awarded
Savings from replacement with RE (p.a.) ₹–115.351 cr		**Savings from avoided retrofit (one-time)** ₹667.8 cr	
19	**Power station/unit** NTPC Vindhyachal Stage II	**Sector** Centre	**Age** 20 years
MW 1000	**Scheduled dispatch (MU)** 2,202		**Tariff** ₹2.41/kWh
Water stress High	**<150km from pollution hotspot** Yes		**PCT status** Bid awarded
Savings from replacement with RE (p.a.) ₹–130.044 cr		**Savings from avoided retrofit (one-time)** ₹485 cr	
20	**Power station/unit** Satpura Phase II and III	**Sector** State	**Age** 35–40 years
MW 620	**Scheduled dispatch (MU)** 2,844		**Tariff** ₹4.03/kWh
Water stress High	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹293.97 cr		**Savings from avoided retrofit (one-time)** ₹423.1 cr	
21	**Power station/unit** Sanjay Gandhi TPS Ph–I and II	**Sector** State	**Age** 20–26 years
MW 840	**Scheduled dispatch (MU)** 4,506		**Tariff** ₹2.94/kWh
Water stress High	**<150km from pollution hotspot** No		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹–27.236 cr		**Savings from avoided retrofit (one-time)** ₹445.2 cr	

POWER FROM OTHER STATES	
Power station/unit NTPC Korba Stage I &II	**Scheduled dispatch (MU)** 3,427
Tariff ₹2.01/kWh	**Savings from replacement with RE (p.a.)** ₹–340.518 cr
Power station/unit NTPC Firoz Gandhi Unchahar Stage I	**Scheduled dispatch (MU)** 3
Tariff ₹3.75/kWh	**Savings from replacement with RE (p.a.)** ₹0.224 cr
Power station/unit NTPC Firoz Gandhi Unchahar Stage II	**Scheduled dispatch (MU)** 9
Tariff ₹3.75/kWh	**Savings from replacement with RE (p.a.)** ₹0.672 cr
Power station/unit NTPC Rihand Stage I	**Scheduled dispatch (MU)** 16
Tariff ₹2.15/kWh	**Savings from replacement with RE (p.a.)** ₹–1.366 cr
Power station/unit NTPC Singrauli	**Scheduled dispatch (MU)** 32
Tariff ₹2.02/kWh	**Savings from replacement with RE (p.a.)** ₹–3.13 cr
SUB TOTAL	**Savings from replacement with RE (p.a.)** **₹–322.78 cr**	**Savings from avoided retrofit (one-time)** **₹2021.1 cr**

MAHARASHTRA			
22	**Power station/unit** Bhusawal TPS Unit 3	**Sector** State	**Age** 37 years
MW 210	**Scheduled dispatch (MU)** —		**Tariff** ₹3.92/kWh
Water stress Low–medium	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹144.29 cr		**Savings from avoided retrofit (one-time)** ₹111.3 cr	
23	**Power station/unit** Chandrapur Unit 3–4	**Sector** State	**Age** 33–34 years
MW 420	**Scheduled dispatch (MU)** 2,291.10		**Tariff** ₹4.0/kWh
Water stress Low–medium	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹229.93 cr		**Savings from avoided retrofit (one-time)** ₹222.6 cr	
24	**Power station/unit** Chandrapur Unit 5–7	**Sector** State	**Age** 22–28 years
MW 1500	**Scheduled dispatch (MU)** 8,182.53		**Tariff** ₹3.15/kWh
Water stress Low–medium	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹126.321 cr		**Savings from avoided retrofit (one-time)** ₹727.5 cr	
25	**Power station/unit** Khaparkheda TPP Unit 1–4	**Sector** State	**Age** 20–30 years
MW 840	**Scheduled dispatch (MU)** 4,467.20		**Tariff** ₹3.81/kWh
Water stress Medium–high	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹362.28 cr		**Savings from avoided retrofit (one-time)** ₹445.2 cr	
26	**Power station/unit** Koradi TPS Unit 6	**Sector** State	**Age** 37 years
MW 210	**Scheduled dispatch (MU)** 584.43		**Tariff** ₹4.73/kWh
Water stress Medium–high	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹101.121 cr		**Savings from avoided retrofit (one-time)** ₹111.3 cr	
27	**Power station/unit** Koradi TPS Unit 7	**Sector** State	**Age** 36 years
MW 210	**Scheduled dispatch (MU)** 584.43		**Tariff** ₹4.73/kWh
Water stress Medium–high	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹101.121 cr		**Savings from avoided retrofit (one-time)** ₹111.3 cr	
28	**Power station/unit** Nashik TPS Unit 3	**Sector** State	**Age** 40 years
MW 210	**Scheduled dispatch (MU)** 777.01		**Tariff** ₹5.45/kWh
Water stress Extremely high	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹190.407 cr		**Savings from avoided retrofit (one-time)** ₹111.3 cr	
29	**Power station/unit** Nashik TPS Unit 4	**Sector** State	**Age** 39 years
MW 210	**Scheduled dispatch (MU)** 680.07		**Tariff** ₹5.74/kWh
Water stress Extremely high	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹186.589 cr		**Savings from avoided retrofit (one-time)** ₹111.3 cr	

30	**Power station/unit** Nashik TPS Unit 5	**Sector** State	**Age** 38 years
MW 210	**Scheduled dispatch (MU)** 550.58		**Tariff** ₹6.3/kWh
Water stress Extremely high	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹181.486 cr		**Savings from avoided retrofit (one-time)** ₹111.3 cr	
POWER FROM OTHER STATES			
Power station/unit Vindhyachal STPS Stage I (Unit 1–6)		**Scheduled dispatch (MU)** 2,778.1	
Tariff ₹2.74/kWh		**Savings from replacement with RE (p.a.)** ₹–72.15 cr	
Power station/unit Vindhyachal STPS Stage II (Unit 7–8)		**Scheduled dispatch (MU)** 2,226.82	
Tariff ₹2.44/kWh		**Savings from replacement with RE (p.a.)** ₹–124.66 cr	
Power station/unit Korba STPS (Unit 1–6)		**Scheduled dispatch (MU)** 4,222.49	
Tariff ₹2.24/kWh		**Savings from replacement with RE (p.a.)** ₹–319.987 cr	
SUB TOTAL	**Savings from replacement with RE (p.a.)** **₹1,106.74 cr**	**Savings from avoided retrofit (one-time)** **₹2063.1 cr**	
TAMIL NADU			
31	**Power station/unit** Tuticorin TPS	**Sector** State	**Age** 28–40 years
MW 1050	**Scheduled dispatch (MU)** 5,811.71		**Tariff** ₹4.58/kWh
Water stress Extremely high	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹918.47 cr		**Savings from avoided retrofit (one-time)** ₹556.5 cr	
32	**Power station/unit** Mettur TPS	**Sector** State	**Age** 29–32 years
MW 840	**Scheduled dispatch (MU)** 5,386.35		**Tariff** ₹4.09/kWh
Water stress Medium–high	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹586.38 cr		**Savings from avoided retrofit (one-time)** ₹445.2 cr	
33	**Power station/unit** North Chennai TPS	**Sector** State	**Age** 23–25 years
MW 630	**Scheduled dispatch (MU)** 7,694.78		**Tariff** ₹2.77/kWh
Water stress Extremely high	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹–180.62 cr		**Savings from avoided retrofit (one-time)** ₹333.9 cr	
34	**Power station/unit** NLC TS–I	**Sector** Centre	**Age** 49–56 years
MW 350	**Scheduled dispatch (MU)** 2,628.25		**Tariff** ₹4.31/kWh
Water stress Extremely high	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹345.67 cr		**Savings from avoided retrofit (one-time)** ₹185 cr	
35	**Power station/unit** NLC TS–II Stage 1	**Sector** Centre	**Age** 31–32 years
MW 630	**Scheduled dispatch (MU)** 1,189.45		**Tariff** ₹4.13/kWh
Water stress Extremely high	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹134.95 cr		**Savings from avoided retrofit (one-time)** ₹333.9 cr	

POWER FROM OTHER STATES			
Power station/unit NTPC Ramagundam Stage 1 & 2		**Scheduled dispatch (MU)** 3,727.40	
Tariff ₹2.78/kWh		**Savings from replacement with RE (p.a.)** ₹–80.6 cr	
SUB TOTAL	**Savings from replacement with RE (p.a.)** **₹1,724.25 cr**	**Savings from avoided retrofit (one-time)** **₹1,854.5 cr**	

TELANGANA			
36	**Power station/unit** Kothagudam V (Unit 9–10)	**Sector** State	**Age** 21–22 years
MW 500	**Scheduled dispatch (MU)** 2,792.97		**Tariff** ₹3.05/kWh
Water stress Low	**<150km from pollution hotspot** No		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹13.89 cr		**Savings from avoided retrofit (one-time)** ₹265 cr	
37	**Power station/unit** Ramagundam Thermal Station B	**Sector** State	**Age** 48 years
MW 62.5	**Scheduled dispatch (MU)** 386.44		**Tariff** ₹3.89/kWh
Water stress Low	**<150km from pollution hotspot** No		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹34.318 cr		**Savings from avoided retrofit (one-time)** ₹33 cr	
38	**Power station/unit** NTPC Ramagundam Stage 1 & 2	**Sector** Centre	**Age** 30–36 years
MW 2100	**Scheduled dispatch (MU)** 2,447.09		**Tariff** ₹2.99/kWh
Water stress Medium–high	**<150km from pollution hotspot** No		**PCT status** Bid awarded
Savings from replacement with RE (p.a.) ₹–1.327 cr		**Savings from avoided retrofit (one-time)** ₹1045.5 cr	

POWER FROM OTHER STATES			
Power station/unit NLC TPS II Stage I		**Scheduled dispatch (MU)** 387.58	
Tariff ₹3.47/kWh		**Savings from replacement with RE (p.a.)** ₹18.266 cr	
SUB TOTAL	**Savings from replacement with RE (p.a.)** **₹65.146 cr**	**Savings from avoided retrofit (one-time)** **₹1,343.5 cr**	

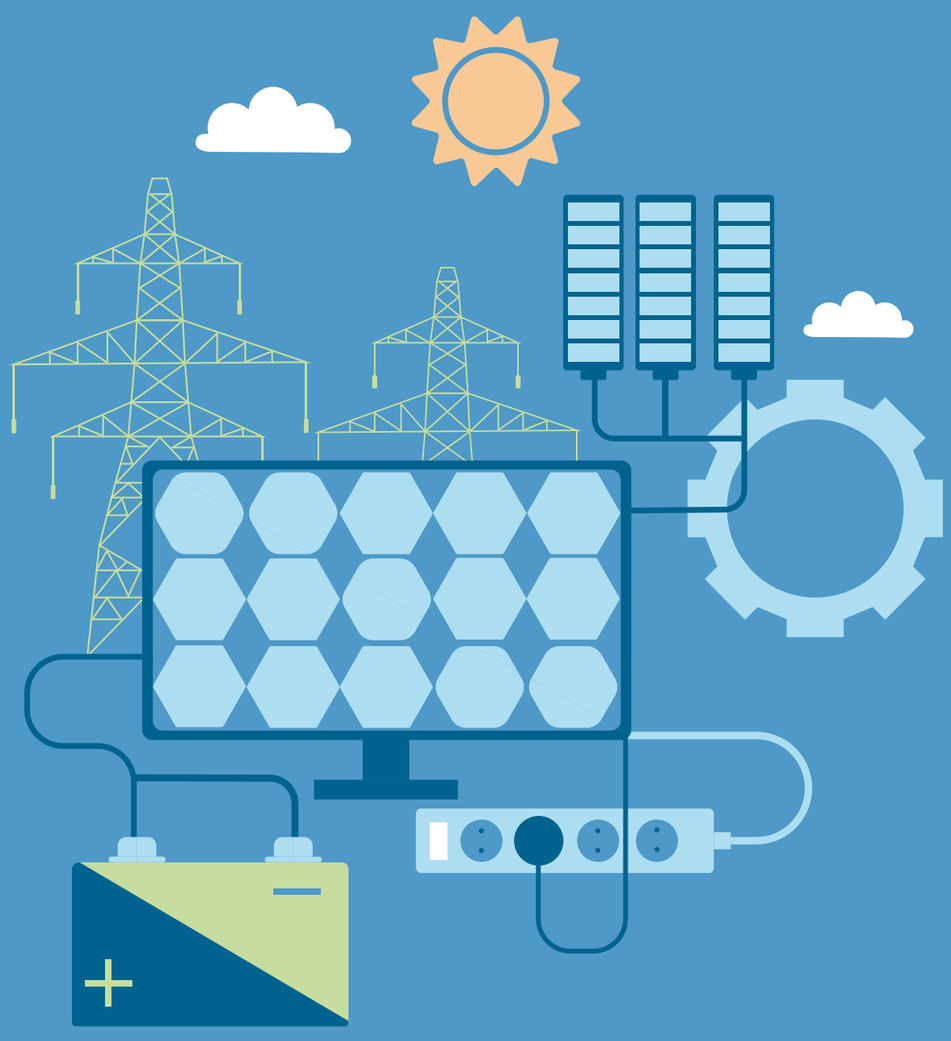
UTTAR PRADESH			
39	**Power station/unit** Anpara–A	**Sector** State	**Age** 31–33 years
MW 630	**Scheduled dispatch (MU)** 3,560		**Tariff** ₹2.79/kWh
Water stress High	**<150km from pollution hotspot** Yes		**PCT status** Bid awarded
Savings from replacement with RE (p.a.) ₹–79 cr		**Savings from avoided retrofit (one-time)** ₹333.9 cr	
40	**Power station/unit** Anpara–B	**Sector** State	**Age** 20 years
MW 1000	**Scheduled dispatch (MU)** 6,901.14		**Tariff** ₹2.18/kWh
Water stress High	**<150km from pollution hotspot** Yes		**PCT status** Bid awarded
Savings from replacement with RE (p.a.) ₹–570.992 cr		**Savings from avoided retrofit (one-time)** ₹485 cr	

41	**Power station/unit** Parichha	**Sector** State	**Age** 30–31 years
MW 420	**Scheduled dispatch (MU)** 0		**Tariff** ₹0/kWh
Water stress Extremely high	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹64.53 cr		**Savings from avoided retrofit (one-time)** ₹222.6 cr	
42	**Power station/unit** Obra–B	**Sector** State	**Age** 37–42 years
MW 1000	**Scheduled dispatch (MU)** 3,440.49		**Tariff** ₹2.74/kWh
Water stress High	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹–93.297 cr		**Savings from avoided retrofit (one-time)** ₹530 cr	
43	**Power station/unit** Harduaganj	**Sector** State	**Age** 41 years
MW 105	**Scheduled dispatch (MU)** 319.39		**Tariff** ₹4.51/kWh
Water stress Extremely high	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹46.763 cr		**Savings from avoided retrofit (one-time)** ₹55.65 cr	
44	**Power station/unit** FGUTPS–1 (Unchahar I)	**Sector** Centre	**Age** 30–31 years
MW 420	**Scheduled dispatch (MU)** 927.54		**Tariff** ₹4.2/kWh
Water stress Extremely high	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹211.408 cr		**Savings from avoided retrofit (one-time)** ₹222.6 cr	
45	**Power station/unit** FGUTPS–2 (Unchahar II)	**Sector** Centre	**Age** 20 years
MW 420	**Scheduled dispatch (MU)** 474.45		**Tariff** ₹4.06/kWh
Water stress Extremely high	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹106.445 cr		**Savings from avoided retrofit (one-time)** ₹222.6 cr	
46	**Power station/unit** NCTPS-1 (Dadri)	**Sector** Centre	**Age** 25–28 years
MW 840	**Scheduled dispatch (MU)** 184.36		**Tariff** ₹4.96/kWh
Water stress Extremely high	**<150km from pollution hotspot** Yes		**PCT status** Installed, bid awarded
Savings from replacement with RE (p.a.) ₹75.062 cr		**Savings from avoided retrofit (one-time)** ₹256.2 cr	
47	**Power station/unit** Tanda (Unit 1–4)	**Sector** Centre	**Age** 21–31 years
MW 840	**Scheduled dispatch (MU)** 2,514.65		**Tariff** ₹4.55/kWh
Water stress Extremely high	**<150km from pollution hotspot** Yes		**PCT status** Bid awarded (1,2) and not installed
Savings from replacement with RE (p.a.) ₹382.265 cr		**Savings from avoided retrofit (one-time)** ₹256.2 cr	

48	**Power station/unit** Obra A	**Sector** State	**Age** 45 years
MW 94	**Scheduled dispatch (MU)** 0		**Tariff** ₹0/kWh
Water stress High	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹0		**Savings from avoided retrofit (one-time)** ₹49.82 cr	
49	**Power station/unit** Rihand–1	**Sector** Centre	**Age** 30–31 years
MW 1000	**Scheduled dispatch (MU)** 2,456.62		**Tariff** ₹2.29/kWh
Water stress High	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹–174.306		**Savings from avoided retrofit (one-time)** ₹485 cr	
50	**Power station/unit** Singrauli	**Sector** Centre	**Age** 32–37 years
MW 2000	**Scheduled dispatch (MU)** 5,377.99		**Tariff** ₹2.17/kWh
Water stress High	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹–454.847		**Savings from avoided retrofit (one-time)** ₹1,015 cr	
POWER FROM OTHER STATES			
Power station/unit Vindhyachal STPS Stage I (Unit 1–6)		**Scheduled dispatch (MU)** 17.98	
Tariff ₹2.74/kWh		**Savings from replacement with RE (p.a.)** ₹–0.964 cr	
Power station/unit Vindhyachal STPS Stage II (Unit 7–8)		**Scheduled dispatch (MU)** 13.66	
Tariff ₹2.44/kWh		**Savings from replacement with RE (p.a.)** ₹–1.088 cr	
Power station/unit Korba STPS (Unit 1–6)		**Scheduled dispatch (MU)** 20.81	
Tariff ₹2.24/kWh		**Savings from replacement with RE (p.a.)** ₹–2.103 cr	
SUB TOTAL	**Savings from replacement with RE (p.a.)** **₹–490.124 cr**	**Savings from avoided retrofit (one-time)** **₹4,134.57 cr**	
WEST BENGAL			
51	**Power station/unit** Kolaghat TPS	**Sector** State	**Age** 26–29 years
MW 1260	**Scheduled dispatch (MU)** 3,911		**Tariff** ₹4.44/kWh
Water stress Low–medium	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹563.18 cr		**Savings from avoided retrofit (one-time)** ₹680.4 cr	
52	**Power station/unit** Bakreswar TPS Stage I	**Sector** State	**Age** 20 years
MW 630	**Scheduled dispatch (MU)** 4,381		**Tariff** ₹3.72/kWh
Water stress Low	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹316.57 cr		**Savings from avoided retrofit (one-time)** ₹333.9 cr	
53	**Power station/unit** Bandel TPS	**Sector** State	**Age** 37–54 years
MW 330	**Scheduled dispatch (MU)** 1,176		**Tariff** ₹4.46/kWh
Water stress Low–medium	**<150km from pollution hotspot** Yes		**PCT status** Not installed
Savings from replacement with RE (p.a.) ₹172.2 cr		**Savings from avoided retrofit (one-time)** ₹120.9 cr	

54	**Power station/unit** Farakka STPS Stage I & II	**Sector** Centre	**Age** 25–33 years
MW 1600	**Scheduled dispatch (MU)** 1,176		**Tariff** ₹3.18/kWh
Water stress Low	**<150km from pollution hotspot** No		**PCT status** N.A.
Savings from replacement with RE (p.a.) ₹62.57 cr		**Savings from avoided retrofit (one-time)** ₹803 cr	
POWER FROM OTHER STATES			
Power station/unit Kanti Bijli Utpadan U1–4		**Scheduled dispatch (MU)** 192	
Tariff ₹5.77/kWh		**Savings from replacement with RE (p.a.)** ₹53.16 cr	
SUB TOTAL	**Savings from replacement with RE (p.a.)** **₹1,167.68 cr**	**Savings from avoided retrofit (one-time)** **₹1,938.2 cr**	
TOTAL	**Savings from replacement with RE (p.a.)** **₹7,076 cr**	**Savings from avoided retrofit (one-time)** **₹18,429 cr**	

climate risk horizons



Looking at the fixed cost and variable cost breakup of the tariff of these plants we can see that there are a significant number of plants in this age cohort with variable costs alone above ₹3/kWh.

Retiring these plants first and replacing their scheduled dispatch with electricity at ₹3/kWh (either renewable energy or from the exchange) yields a savings of approximately ₹2,155 crores p.a., through reduced power purchase cost, even assuming fixed costs for these plants continued to be paid.

TABLE 6

Plants 20 years and older with variable cost above Rs.3/kWh; savings from replacing only VC component of tariff with RE

Plant	Scheduled dispatch (MU)	Variable cost (₹/kWh)	Savings p.a. from replacement with RE at ₹3/kWh (crores)
NTTPS–I (Dr. Narla Tata Rao)	2,413.11	₹3.34	₹82.05 cr
NTTPS–II (Dr. Narla Tata Rao)	2,281.38	₹3.34	₹77.57 cr
NTTPS–III (Dr. Narla Tata Rao)	2,111.57	₹3.34	₹71.79 cr
RTPP Stage I (Rayalaseema)	1,653.38	₹3.86	₹142.19 cr
KBUNL 1 (Muzaffarpur Kanti TPP)	572.11	₹3.45	₹25.74 cr
Barauni Stage I	1,110.26	₹4.00	₹111.03 cr
GSECL Gandhinagar 5	84	₹3.50	₹4.20 cr
GSECL Wanakbori 7	1,341	₹3.21	₹28.16 cr
GSECL Ukai	2,424	₹3.39	₹94.54 cr
GSECL Gandhinagar 3–4	166	₹3.74	₹12.28 cr
GSECL Wanakbori 1–6	8,538	₹3.29	₹247.60 cr

Plant	Scheduled dispatch (MU)	Variable cost (₹/kWh)	Savings p.a. from replacement with RE at ₹3/kWh (crores)
Raichur Thermal Power Station 1–7	7,970.6	₹3.78	₹621.71 cr
Koradi TPS (Unit 6)	584.43	₹3.14	₹8.18 cr
Koradi TPS (Unit 7)	584.43	₹3.14	₹8.18 cr
Nashik TPS (Unit 3)	777.01	₹3.39	₹30.30 cr
Nashik TPS (Unit 4)	680.07	₹3.39	₹26.52 cr
Nashik TPS (Unit 5)	550.58	₹3.39	₹21.47 cr
Tuticorin TPS	5,811.71	₹3.11	₹63.93 cr
NLC TS–I	2,628.25	₹3.36	₹94.62 cr
FGUTPS–1 (Unchahar I)	927.54	₹3.09	₹8.35 cr
FGUTPS–2 (Unchahar II)	474.45	₹3.10	₹4.74 cr
NCTPS-1 (Dadri)	184.36	₹3.76	₹14.01 cr
Kolaghat TPS	3,911	₹3.67	₹263.99 cr
Bandel TPS	1,176	₹3.78	₹92.23 cr
TOTAL	**48,955.24**		**₹2,155.38**

FINDING 2

Rs. 92,000 crores = savings from pausing early stage projects under active construction

The surplus generation capacity in the Indian electricity system has led to record low Plant Load Factors of ~60% across the coal fleet. The problem is particularly acute for private power generators which account for the bulk of newer, more efficient plants. This has led to significant stressed and non-performing assets across the power sector. Despite this problem of over-capacity, low PLFs and non-performing/stressed assets, lenders, discoms and project proponents continue to sink money into a large number of projects under construction. There are 60 GW officially under construction across the country and about 23 GW is likely to be commissioned in the coming two years. In the 11 states included in this analysis, the CEA's May 2020 Broad Status Report lists 47 GW of projects officially under construction. These can be divided into three categories:

- **Nearing completion and likely to be commissioned by 2022 = 17.2 GW**
  Given the excess generation capacity already in the system, this additional capacity will result in sustained low capacity factors, while also driving up discoms' dues through the substantial fixed cost payments required by new plants.

- **Stalled, uncertain, stressed or non-performing assets = 15.7 GW**

The prevalent national discourse for the last several years around these mostly privately-owned plants has revolved around ways in which they can be 'rescued' or made financially viable either through debt restructuring, buyouts, forcing states to sign Power Purchase Agreements or trying to arrange coal linkages. It is increasingly clear that such an exercise is unlikely to be viable. Most, if not all of these plants will require a tariff of at least ₹4.5/kWh. Cash-strapped discoms will not purchase power at these rates and coal linkages/supplies are still not assured for many of these plants. Even if they could be completed, they will no longer be financially competitive given the rapid changes in the electricity system over the last five years and the cost advantage enjoyed by solar, wind and increasingly renewables and storage. This raises the very real threat of a fresh round of NPAs/ stressed assets if further resources are expended to bring these plants to completion. Rather than wasting good resources trying to complete these projects, writing off these investments would free up space for fresh lending.

The 35 GW of new coal under active construction across the country is not competitive, raising the very real threat of more stressed assets, onerous fixed costs and expensive power purchase obligations for discoms.

While further expenditure to revive stalled private power projects does not directly impinge on state government finances, they will represent a threat to the financial system as long as the asset remains fundamentally uncompetitive. Any Power Purchase Agreements or Letters of Intent on the basis of which these plants secured financial closure and commenced construction represent a threat to

discom finances if the discom is contractually bound to power purchase or fixed cost payments. Discoms should ascertain if they need to revoke any existing PPAs or Letters of Intent issued to such stalled private power projects, in order to protect themselves from future claims.

- **Early stage projects under active construction = 14.1 GW**

  These are all state or central sector projects, and as such, will be selling power primarily to state discoms. They are unlikely to be commissioned for at least 3–4 years and at that time will be neither required (due to surplus generation capacity in the system) nor competitive with cleaner energy sources. These plants seem destined to lie unused or operate at very low capacity factors, perpetuating additional fixed costs on their respective discoms.

Freezing further expenditure on these 14.1 GW at early stages of construction could cumulatively save over ₹92,000 crores of public funds, based on official figures for projected costs and expenditure already incurred. A list of these projects and status of expenditure as of May 2020 is in Table 7. A list of all projects officially under construction is in Table 8.

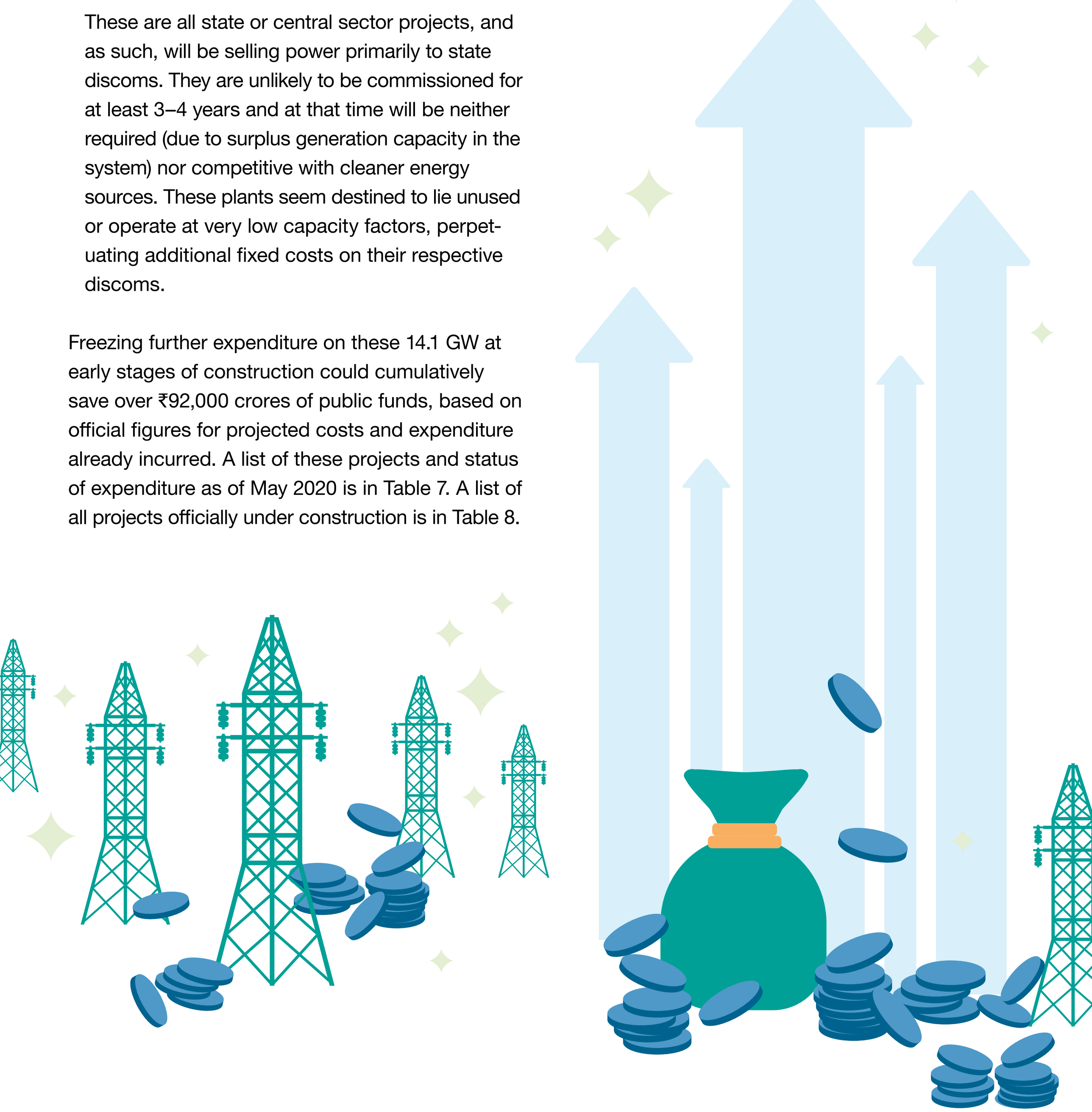


FIGURE 3

Savings from freezing early-stage projects under active construction (in crores)

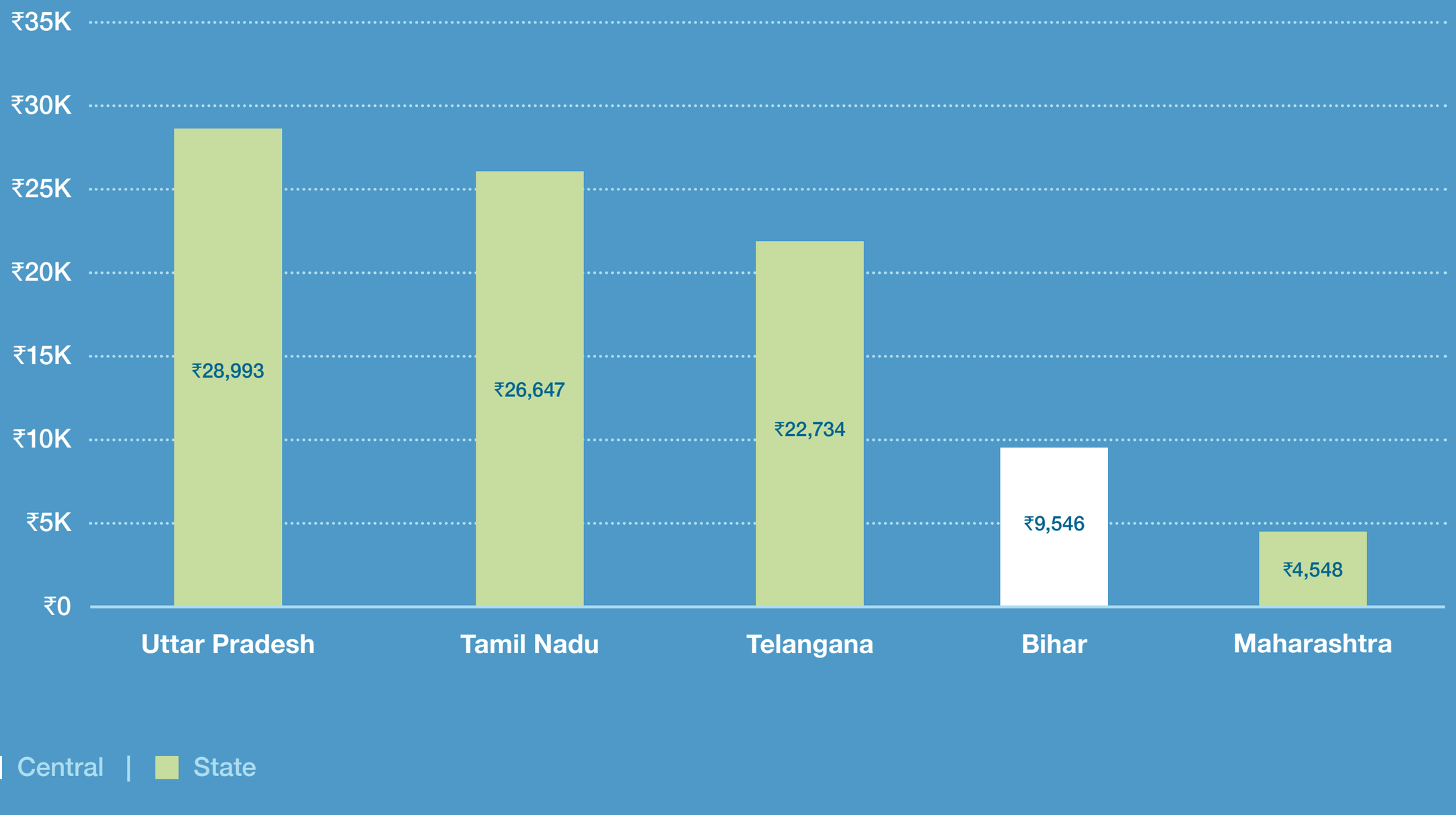


TABLE 7

Details of expenditure and potential savings from early stage projects under active construction (in crores)

Plant	Promoter	MW	Expenditure incurred	Total expenditure projected	Avoided expenditure if shelved
Buxar Unit 1-2	Satluj Jal Vidyut Nigam Ltd.	1320	₹893 cr	₹10,439 cr	₹9,546
Bhusawal Unit 6	Mahagenco	660	₹549 cr	₹5,097 cr	₹4,548
Ennore Exp.	TANGEDCO	660	₹791 cr	₹5,421 cr	₹4,630
Uppur Unit 1-2	TANGEDCO	1600	₹2,844 cr	₹12,778 cr	₹9,934
Udangudi Unit 1-2	TANGEDCO	1320	₹993 cr	₹13,076 cr	₹12,083
Yadadri Unit 1-5	TSGENCO	4000	₹7,222 cr	₹29,965 cr	₹22,743
Jawaharpur Unit 1-2	UPRVUNL	1320	₹4,063 cr	₹10,566 cr	₹6,503
Khurja Unit 1-2	UPRVUNL	1320	₹928 cr	₹11,089 cr	₹1,0161
Obra C Unit 1-2	UPRVUNL	1320	₹3,571 cr	₹10,416 cr	₹6,845
Panki Unit 1	UPRVUNL	660	₹16 cr	₹5,500 cr	₹5,484
Total		**14,180**	**₹21,870 cr**	**1,14,347 cr**	**₹92,477 cr**

Expenditure figures taken from CEA's Broad Status Report, May 2020

TABLE 8

All under-construction projects in the states under discussion

ANDHRA PRADESH			
01	**Plant** Damodaran Sanjeevaiah TPP St–II	**Promoter** APGENCO	**MW** 800
Expenditure incurred ₹6,071 cr		**Total expenditure projected** ₹6,841 cr	
Avoided expenditure if shelved ₹770 cr			
02	**Plant** Dr. Narla Tata Rao TPS St–V, U8	**Promoter** APGENCO	**MW** 800
Expenditure incurred ₹4,935 cr		**Total expenditure projected** ₹5,515 cr	
Avoided expenditure if shelved ₹580 cr			
03	**Plant** Thamminapatnam TPP stage–II, U3–4	**Promoter** Meenakshi Energy Pvt. Ltd.	**MW** 700
Expenditure incurred ₹5,414 cr		**Total expenditure projected** ₹5,005 cr	
Avoided expenditure if shelved —			
04	**Plant** Bhavanapadu TPP Ph–I, U1–2	**Promoter** East Coast Energy	**MW** 1,320
Expenditure incurred ₹3,785 cr		**Total expenditure projected** ₹9,343 cr	
Avoided expenditure if shelved ₹5,558 cr			
SUB TOTAL	**MW 3,620**	**Expenditure incurred ₹20,205 cr**	
Total expenditure projected ₹26,704 cr		**Avoided expenditure if shelved ₹6,908 cr**	
BIHAR			
05	**Plant** Buxar U1–2	**Promoter** SJVN Ltd.	**MW** 1,320
Expenditure incurred ₹893 cr		**Total expenditure projected** ₹10,439 cr	
Avoided expenditure if shelved ₹9,546 cr			
06	**Plant** Barh I, U1–3	**Promoter** NTPC	**MW** 1,980
Expenditure incurred ₹17,444 cr		**Total expenditure projected** ₹21,312 cr	
Avoided expenditure if shelved ₹3,868 cr			
07	**Plant** Nabi Nagar U4	**Promoter** NTPC/IR	**MW** 250
Expenditure incurred ₹8,209 cr		**Total expenditure projected** ₹10,556 cr	
Avoided expenditure if shelved —			
08	**Plant** New Nabi Nagar U2–3	**Promoter** NTPC/BSPGCL	**MW** 1,320
Expenditure incurred ₹14,634 cr		**Total expenditure projected** ₹17,304 cr	
Avoided expenditure if shelved ₹2,670 cr			
09	**Plant** Siriya U1–4	**Promoter** Abhijeet Group	**MW** 2,640
Expenditure incurred —		**Total expenditure projected** ₹11,120 cr	
Avoided expenditure if shelved ₹11,120 cr			

SUB TOTAL	**MW** 7,510	**Expenditure incurred** ₹41,180 cr	
Total expenditure projected ₹70,731 cr		**Avoided expenditure if shelved** ₹27,204 cr	

CHHATTISGARH			
10	**Plant** Singhitarai U1–2	**Promoter** Athena Chhattisgarh	**MW** 1,200
Expenditure incurred ₹6,408 cr		**Total expenditure projected** ₹8,443 cr	
Avoided expenditure if shelved ₹2,035 cr			
11	**Plant** Akaltara/Nariyara U4–6	**Promoter** KSK Energy	**MW** 1,800
Expenditure incurred ₹18,730 cr		**Total expenditure projected** ₹27,080 cr	
Avoided expenditure if shelved ₹8,350 cr			
12	**Plant** Lanco Amarkantak U3–4	**Promoter** Lanco Infratech	**MW** 1,320
Expenditure incurred ₹9,537 cr		**Total expenditure projected** ₹10,815 cr	
Avoided expenditure if shelved ₹1,278 cr			
13	**Plant** Lara U2	**Promoter** NTPC	**MW** 800
Expenditure incurred ₹13,573 cr		**Total expenditure projected** ₹12,739 cr	
Avoided expenditure if shelved —			
14	**Plant** Binjkote U3–4	**Promoter** SKS Ispat	**MW** 600
Expenditure incurred ₹3,828 cr		**Total expenditure projected** ₹7,940 cr	
Avoided expenditure if shelved ₹4,112 cr			
15	**Plant** Salora U2	**Promoter** Vandana Vidhyut	**MW** 135
Expenditure incurred ₹2,386 cr		**Total expenditure projected** ₹1,458 cr	
Avoided expenditure if shelved —			
16	**Plant** Deveri/Visa U1	**Promoter** Visa Power	**MW** 600
Expenditure incurred ₹2,077 cr		**Total expenditure projected** ₹6,190 cr	
Avoided expenditure if shelved ₹4,113 cr			
SUB TOTAL	**MW** 6,455	**Expenditure incurred** ₹56,539 cr	
Total expenditure projected ₹74,665 cr		**Avoided expenditure if shelved** ₹19,888 cr	

MADHYA PRADESH			
17	**Plant** Gadarwara U2	**Promoter** NTPC	**MW** 800
Expenditure incurred ₹13,119 cr		**Total expenditure projected** ₹12,865 cr	
Avoided expenditure if shelved —			
18	**Plant** Gorgi U1	**Promoter** Diligent Power	**MW** 660
Expenditure incurred ₹475 cr		**Total expenditure projected** ₹3,941 cr	
Avoided expenditure if shelved ₹3,466 cr			

SUB TOTAL	**MW 1,460**	**Expenditure incurred ₹13,594 cr**	
Total expenditure projected ₹16,806 cr		**Avoided expenditure if shelved ₹3,466 cr**	

MAHARASHTRA			
19	**Plant** Bijora Ghanmukh U1–2	**Promoter** Gayatri Energy Ventures	**MW** 600
Expenditure incurred ₹422 cr		**Total expenditure projected** ₹3,450 cr	
Avoided expenditure if shelved ₹3,028 cr			
20	**Plant** Lanco Vidarbha U1–2	**Promoter** Lanco Infratech	**MW** 1,320
Expenditure incurred ₹5,338 cr		**Total expenditure projected** ₹10,433 cr	
Avoided expenditure if shelved ₹5,095 cr			
21	**Plant** Nashik TPP Ph–2, U1–5	**Promoter** Rattan India	**MW** 1,350
Expenditure incurred ₹711 cr		**Total expenditure projected** ₹6,789 cr	
Avoided expenditure if shelved ₹6,078 cr			
22	**Plant** Amravati Ph–2, U1–5	**Promoter** Rattan India	**MW** 1,350
Expenditure incurred ₹763 cr		**Total expenditure projected** ₹6,646 cr	
Avoided expenditure if shelved ₹5,883 cr			
23	**Plant** Nardana Vaghode U2	**Promoter** Shirpur Power	**MW** 150
Expenditure incurred ₹2,383 cr		**Total expenditure projected** ₹2,413 cr	
Avoided expenditure if shelved ₹30 cr			
24	**Plant** Bhusawal TPP U6	**Promoter** Mahagenco	**MW** 660
Expenditure incurred ₹549 cr		**Total expenditure projected** ₹5,097 cr	
Avoided expenditure if shelved ₹4,548 cr			
SUB TOTAL	**MW 5,430**	**Expenditure incurred ₹10,166 cr**	
Total expenditure projected ₹34,828 cr		**Avoided expenditure if shelved ₹24,662 cr**	

TAMIL NADU			
25	**Plant** Tuticorin TPP U1 (Ind Barath)	**Promoter** IndBarath	**MW** 660
Expenditure incurred ₹2,000 cr		**Total expenditure projected** ₹3,595 cr	
Avoided expenditure if shelved ₹1,595 cr			
26	**Plant** Neyveli New U2	**Promoter** Neyveli Lignite Corp.	**MW** 500
Expenditure incurred ₹6,587 cr		**Total expenditure projected** ₹7,080 cr	
Avoided expenditure if shelved ₹493 cr			
27	**Plant** Tuticorin St IV U1	**Promoter** SEPC Pvt. Ltd.	**MW** 525
Expenditure incurred ₹3,175 cr		**Total expenditure projected** ₹3,514 cr	
Avoided expenditure if shelved ₹339 cr			

28	**Plant** Ennore Expansion U6	**Promoter** TANGEDCO	**MW** 660
Expenditure incurred ₹791 cr		**Total expenditure projected** ₹5,421 cr	
Avoided expenditure if shelved ₹4,630 cr			
29	**Plant** Ennore SCTP U1–2	**Promoter** TANGEDCO	**MW** 1,320
Expenditure incurred ₹4,142 cr		**Total expenditure projected** ₹9,800 cr	
Avoided expenditure if shelved ₹5,658 cr			
30	**Plant** North Chennai St III	**Promoter** TANGEDCO	**MW** 800
Expenditure incurred ₹5,462 cr		**Total expenditure projected** ₹6,376 cr	
Avoided expenditure if shelved ₹914 cr			
31	**Plant** Uppur U1–2	**Promoter** TANGEDCO	**MW** 1,600
Expenditure incurred ₹2,844 cr		**Total expenditure projected** ₹12,778 cr	
Avoided expenditure if shelved ₹9,934 cr			
32	**Plant** Udangudi U1–2	**Promoter** TANGEDCO	**MW** 1,320
Expenditure incurred ₹993 cr		**Total expenditure projected** ₹13,076 cr	
Avoided expenditure if shelved ₹12,083 cr			
SUB TOTAL	**MW 7,385**	**Expenditure incurred ₹25,994 cr**	
Total expenditure projected ₹61,640 cr		**Avoided expenditure if shelved ₹35,646 cr**	

TELANGANA			
33	**Plant** Bhadadri U1–4	**Promoter** TSGENCO	**MW** 1,080
Expenditure incurred ₹6,715 cr		**Total expenditure projected** ₹9,268 cr	
Avoided expenditure if shelved ₹2,553 cr			
34	**Plant** Ramagundam St IV U1–2	**Promoter** NTPC	**MW** 1,600
Expenditure incurred ₹7,143 cr		**Total expenditure projected** ₹11,811 cr	
Avoided expenditure if shelved ₹4,668 cr			
35	**Plant** Yadadri U1–5	**Promoter** TSGENCO	**MW** 4,000
Expenditure incurred ₹7,222 cr		**Total expenditure projected** ₹29,965 cr	
Avoided expenditure if shelved ₹22,743 cr			
SUB TOTAL	**MW 6,680**	**Expenditure incurred ₹21,080 cr**	
Total expenditure projected ₹51,044 cr		**Avoided expenditure if shelved ₹29,964 cr**	

UTTAR PRADESH			
36	**Plant** Jawaharpur U1–2	**Promoter** UPRVUNL	**MW** 1,320
Expenditure incurred ₹4,063 cr		**Total expenditure projected** ₹10,566 cr	
Avoided expenditure if shelved ₹6,503 cr			
37	**Plant** Khurja U1–2	**Promoter** NTPC	**MW** 1,320
Expenditure incurred ₹928 cr		**Total expenditure projected** ₹11,089 cr	
Avoided expenditure if shelved ₹10,161 cr			
38	**Plant** Meja U2	**Promoter** NTPC/UPRVUNL	**MW** 660
Expenditure incurred ₹10,537 cr		**Total expenditure projected** ₹12,176 cr	
Avoided expenditure if shelved ₹1,639 cr			
39	**Plant** Ghatampur U1–3	**Promoter** NLC/UPRVUNL	**MW** 1,980
Expenditure incurred ₹9,382 cr		**Total expenditure projected** ₹17,237 cr	
Avoided expenditure if shelved ₹7,855 cr			
40	**Plant** Tanda U6	**Promoter** NTPC	**MW** 660
Expenditure incurred ₹7,423 cr		**Total expenditure projected** ₹9,188 cr	
Avoided expenditure if shelved ₹1,765 cr			
41	**Plant** Harduaganj Exp II, U10	**Promoter** UPRVUNL	**MW** 660
Expenditure incurred ₹3,496 cr		**Total expenditure projected** ₹5,500 cr	
Avoided expenditure if shelved ₹2,004 cr			
42	**Plant** Obra C U1–2	**Promoter** UPRVUNL	**MW** 1,320
Expenditure incurred ₹3,571 cr		**Total expenditure projected** ₹10,416 cr	
Avoided expenditure if shelved ₹6,845 cr			
43	**Plant** Panki U1	**Promoter** UPRVUNL	**MW** 660
Expenditure incurred ₹16 cr		**Total expenditure projected** ₹5,500 cr	
Avoided expenditure if shelved ₹5,484 cr			
SUB TOTAL	**MW 8,580**	**Expenditure incurred ₹39,416 cr**	
Total expenditure projected ₹81,672 cr		**Avoided expenditure if shelved ₹42,256 cr**	
TOTAL	**MW 47,120**	**Expenditure incurred ₹2,14,580 cr**	
Total expenditure projected ₹4,01,284 cr		**Avoided expenditure if shelved ₹1,89,994 cr**	
Savings from halting further expenditure only on projects stressed/stalled/ in early stages of construction		**₹1,55,551 cr**	
Savings from halting expenditure on early stage projects under active construction only (excluding stalled projects)		**₹92,477 cr**	

Expenditure figures taken from CEA's Broad Status Report, May 2020.

climate risk horizons

FINDING 3

Rs. 12,000 crore = savings from rationalising fixed cost payments

Due to surplus generating capacity and lower than projected demand, several states that have signed Power Purchase Agreements in the last ten years have found themselves paying high fixed costs despite no actual requirement for power from certain generating plants. Maharashtra, Tamil Nadu, Uttar Pradesh, Karnataka and Gujarat in particular have been hard hit, contributing to the worsening of discom finances. We have attempted to calculate this burden for all 11 states to give an indication of an extent of the drain on discoms and potential savings available through a rationalisation exercise.

These savings can be realised by renegotiating contracts to lower annual fixed cost payments in exchange for a peaking power premium tariff, reduced return on equity, an extension in the life of the contract or some similar mechanism that reduces the burden on the discom but also upholds the sanctity of the contract. In the case of state-owned power generation assets there is even greater scope for renegotiation or drastic changes to the fixed cost charges. The fixed cost burden discoms face can be categorised in two ways. First, fixed costs from plants with significant electricity dispatch and high fixed cost, usually younger plants less than ten years old. The second category consists of the fixed cost payable to plants that have low or even zero dispatch. The fixed cost amount in these cases could be high or low, but discoms are liable to pay it irrespective of the volume of electricity purchased. It is important to note that the dispatch data in the tariff order is a forecast and can differ from actual supply, though this variation has no effect on total fixed cost or per unit variable cost.

In the case of state sector plants, it is easy to identify under-utilised plants with high fixed cost dues just by looking at the scheduled dispatch and fixed costs payable. With plants in the central and private sectors however it is not easy to identify how much of the capacity is contracted to a discom, so the scheduled dispatch figures are not of much help. In the absence of information about contracted capacity, we can identify plants/units that are underutilised and therefore impose a significant fixed cost burden on the discom by another method. This involves assigning a minimum electricity dispatch required to justify a given fixed cost.

When considered on a per unit basis, the variable cost is constant while the fixed cost fluctuates as a factor of energy dispatched: higher the dispatch lower is the per unit fixed cost and vice versa. To determine how much states are paying in terms of excessive fixed costs, we maintain ₹4/kWh as being the upper limit of a competitive electricity tariff, as explained in the Data and Methods section.

The CEA gives existing variable costs for coal plants ranging between 1.5 and 4.66.[19] The typical percentage of fixed cost contribution to a coal power plant's final tariff varies between 25–40%. Here we conservatively assume a 50:50 split—that is ₹2 for variable costs and ₹2 for fixed costs in a ₹4/kWh tariff. By keeping ₹2/kWh as the ceiling for acceptable fixed costs, we arrive at potential savings that can accrue to states through a rationalisation and renegotiation exercise. So for example, this means that for every 100 crore spent as fixed cost the total dispatch should not be less than 500 million units. A dispatch lower than this implies an excessive fixed cost burden.

Using this method, Table 9 below identifies plants for which states appear to be paying an excessive burden in terms of high fixed costs, and quantifies potential savings. As can be seen, this problem is especially severe for Uttar Pradesh, Maharashtra, Karnataka, Tamil Nadu and Gujarat.

FIGURE 4

Excess fixed cost incurred by states (in crores)

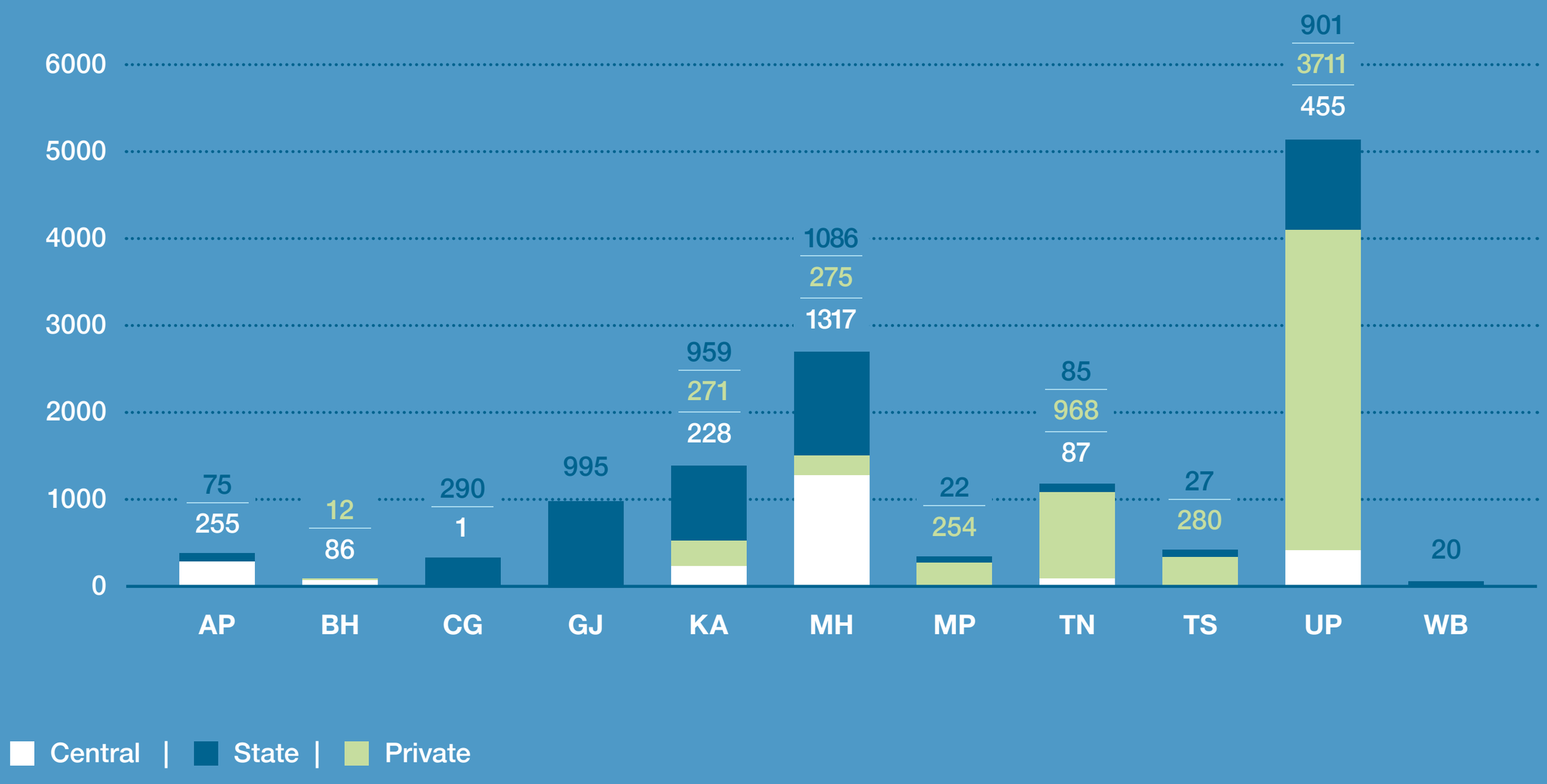


TABLE 9

Plants for which states are paying high fixed cost burdens (>2/kWh)

	Plant/unit	Dispatch (MU)	Total fixed cost	Excessive FC >2/kWh p.a.
Andhra Pradesh				
1	Rayalaseema Stage III	552.37	₹186.96 cr	₹76.48 cr
2	Neyveli New TPS	361.6	₹77.68 cr	₹5.36 cr
3	Vallur TPP	430.87	₹125.46 cr	₹39.28 cr
4	Kudgi	609.01	₹332.24 cr	₹210.43 cr
	Total			**₹331.55 cr**
Bihar				
5	KBUNL 2 (Muzaffarpur)	1,665.41	₹409.69 cr	₹76.60 cr

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	Plant/unit	Dispatch (MU)	Total fixed cost	Excessive FC >2/kWh p.a.
6	Barauni Stage II	420.37	₹90.8 cr	₹6.72 cr
7	JITPL (Derang)	1,463.98	₹304.5 cr	₹11.70 cr
8	Nabinagar Railway	522.63	₹107.66 cr	₹3.13 cr
	Total			**₹98.17 cr**
Chhattisgarh				
9	Korba TPS	1,306.12	₹340 cr	₹78.77 cr
10	Marwa TPS	7,055.09	₹1,622 cr	₹211 cr
11	Solapur	520.59	₹104.74 cr	₹0.62 cr
	Total			**₹290.39 cr**
Gujarat				
12	GSECL Gandhinagar 5	84	₹23 cr	₹6.2 cr
13	GSECL Gandhinagar 3-4	166	₹204 cr	₹170.8 cr
14	GSECL Sikka Expn	199	₹629 cr	₹589.2 cr
15	GSECL Kutch Lignite 1-3	867	₹207 cr	₹33.6 cr
16	GSECL Kutch Lignite 4	247	₹62 cr	₹12.6 cr
17	BECL Bhavnagar TPS	3,481	₹879 cr	₹182.8 cr
	Total			**₹995.2**
Karnataka				
18	Bellary TPS 1	1,430	₹290.18 cr	₹4.18 cr
19	Bellary TPS 2	1,300	₹459.09 cr	₹199.09 cr
20	Bellary TPS 3	1,400	₹613.22 cr	₹333.22 cr
21	Yermarus	1,571.63	₹736.36 cr	₹422.03 cr
22	Vallur St I	738	₹160.86 cr	₹13.26 cr
23	NLC TPS 2 Exp	582	₹140.79 cr	₹24.39 cr
24	Koderma U7&8	1,446.42	₹311.9 cr	₹22.62 cr
25	Kudgi	3014	₹771 cr	₹168.2 cr
26	Udupi	4,352.26	₹1,141 cr	₹270.54 cr

	Plant/unit	Dispatch (MU)	Total fixed cost	Excessive FC >2/kWh p.a.
	Total			**₹1,457.53 cr**
Madhya Pradesh				
27	Satpura TPS Ph IV	3,253	₹672.84 cr	₹22.24 cr
28	Jaiprakash Power STPS Nigri	3,362	₹709.17 cr	₹36.77 cr
29	NTPC Unchahar Stage IV	2	₹0.46 cr	₹.06 cr
30	Jaypee Bina	1,436	₹504.75 cr	₹217.55 cr
	Total			**₹276.62 cr**
Maharashtra				
31	Bhusawal TPS U3	0	₹144.29 cr	₹144.29 cr
32	Bhusawal TPS U5	2,535.73	₹565.71 cr	₹58.56 cr
33	Khargone	171.26	₹36.23 cr	₹1.98 cr
34	Nashik TPS U3	777.01	₹159.77 cr	₹4.368 cr
35	Nashik TPS U4	680.07	₹159.77 cr	₹23.756 cr
36	Nashik TPS U5	550.58	₹159.77 cr	₹49.654 cr
37	Parli TPS U6	0	₹255.76 cr	₹255.76 cr
38	Parli TPS U7	0	₹255.76 cr	₹255.76 cr
39	Parli TPS U8	246.85	₹341.49 cr	₹292.12 cr
40	Gadarwara I	28.62	₹31.68 cr	₹25.95 cr
41	Gadarwara II	28.62	₹31.68 cr	₹25.95 cr
42	Mauda U1&2	933.85	₹529.19 cr	₹342.42 cr
43	Solapur U1	251	₹486.54 cr	₹436.34 cr
44	Solapur U2	0	₹486.54 cr	₹486.54 cr
45	RattanIndia Amravati	2,085.63	₹692.48 cr	₹275.35 cr
	Total			**₹2,678.81 cr**
Tamil Nadu				
46	North Chennai TPS St II	3,847.39	₹854.07 cr	₹84.59 cr
47	NLC Zero Lignite	0	₹218.93 cr	₹218.93 cr

	Plant/unit	Dispatch (MU)	Total fixed cost	Excessive FC >2/kWh p.a.
48	DBPL Baradarha TPS	1,489.6	₹422.03 cr	₹124.11 cr
49	Jindal Power	2,864.62	₹847.5 cr	₹274.56 cr
50	PTC India	716.16	₹230.2 cr	₹86.97 cr
51	GMR Energy	1,074.23	₹305.07 cr	₹90.22 cr
52	IL&FS (Cuddalore)	3,867.24	₹1,033.40 cr	₹259.95 cr
	Total			**₹1,139.35 cr**
Telangana				
53	Kothagudem VI U11&12	2,483.41	₹514.04 cr	₹17.36 cr
54	Kakatiya St I	2,605.08	₹530.7 cr	₹9.68 cr
55	SGPL TPP Unit 2	4,244.22	₹1,128.73 cr	₹279.88 cr
	Total			**₹306.92 cr**
Uttar Pradesh				
56	Parichha	0	₹64.53 cr	₹64.53 cr
57	Parichha Extn	853.58	₹360.35 cr	₹189.63 cr
58	Harduaganj	319.39	₹85.3 cr	₹21.42 cr
59	Harduaganj Ext	1,368.59	₹574.97 cr	₹301.25 cr
60	Parichha Extn II	1,073.4	₹538.7 cr	₹324 cr
61	Unchahar I	927.54	₹202.78 cr	₹17.27 cr
62	Unchahar II	474.45	₹101.89 cr	₹7 cr
63	Unchahar III	224.9	₹67.11 cr	₹22.13 cr
64	NCTPS 1 (Dadri)	184.36	₹61 cr	₹24.12 cr
65	NCTPS 2 (Dadri)	145.08	₹128.46 cr	₹99.44 cr
66	Mauda I	24.83	₹6.91 cr	₹1.94 cr
67	Solapur TPS	7.32	₹4.11 cr	₹2.64 cr
68	IGSTPP Jhajjar	86.12	₹44.88 cr	₹27.65 cr

	Plant/unit	Dispatch (MU)	Total fixed cost	Excessive FC >2/kWh p.a.
69	BEPL Barkhera	90.91	₹119.56 cr	₹101.38 cr
70	BEPL Khambhakhera	92.06	₹120.82 cr	₹102.41 cr
71	BEPL Kundrakhi	83.37	₹120.28 cr	₹103.61 cr
72	BEPL Maqsoodapur	86.75	₹119.99 cr	₹102.64 cr
73	BEPL Utraula	85.43	₹123.71 cr	₹106.62 cr
74	KSK Mahanadi	3,969.32	₹865.84 cr	₹71.98 cr
75	Lalitpur	5,486.34	₹3,366.55 cr	₹2,269.28 cr
76	MB Power (Anuppur)	2,509.32	₹743.06 cr	₹241.20 cr
77	RKM Power	1,475.55	₹454.56 cr	₹159.45 cr
78	Rosa I	4,733.42	₹1,370.98 cr	₹424.30 cr
79	New Nabinagar U1*	297.8	₹65.22 cr	₹5.66 cr
80	Meja Phase I*	2675.71	₹556.19 cr	₹21.05 cr
81	Tanda II U1*	1,836.3	₹457.16 cr	₹89.9 cr
82	Meja Phase II*	1,940.89	₹404.5 cr	₹16.32 cr
83	Tanda II U2*	778.72	₹303.66 cr	₹147.92 cr
	Total			**₹5,066.8 cr**
West Bengal				
84	Kanti Bijli Utpadan	192	₹58.34 cr	₹19.94 cr
	Total			**₹19.94 cr**
Potential savings from capping fixed cost at ₹2/kWh **₹12,661.28 cr**				

**Under construction but included in tariff order.*

FINDING 4

Rs. 55,000 crore (annual) = savings from replacing all power at tariffs >4/kWh with renewable energy

Affordable power is essential for both industrial and domestic consumers. Predictable, low electricity costs are essential to expanding the small and medium scale industries that provide the bulk of employment and livelihoods across urban and semi-urban India, or to sustain government programmes such as the 'Make in India' and 'Atmanirbhar' initiatives. In this context, it's instructive to assess what the savings potential of a longer term programme to replace the most costly coal power with renewable energy could be in terms of lower power purchase costs to discoms and consumers.

Recent tariffs discovered for solar and wind in India have been in the ₹2.5–3/kWh range. Bloomberg New Energy Finance estimates a continued cost reduction for new solar PV by 2025 and 2030 of 14% and 22% respectively, and a decline in costs for solar/wind and battery storage of about 40% by 2030.[20]

The CEA also assumes a similar cost trajectory decline for battery energy storage systems by 2030.[21] Despite these expected cost reductions, this analysis errs on the conservative side by assuming a new renewable energy tariff of ₹3/kWh.

Against a ₹3/kWh renewable energy tariff benchmark, any power plant with a tariff above ₹4/kwh is uncompetitive. We believe this to be a conservative comparison, as opposed to a more aggressive cut off of ₹3 or ₹3.5/kWh.

Figure 5 and Table 10 below summarise the savings potential if each of the 11 states under discussion phased out coal power purchases with tariffs above ₹4/kWh and replaced that volume of electricity with renewable power at ₹3/kWh. Obviously, such a massive change cannot be carried out immediately but should be part of the long-term planning for discoms and state and central governments in order to lower the cost of electricity and boost economic and social indicators.

FIGURE 5

Replacing costliest TPPs vs. total overdues (in crores)

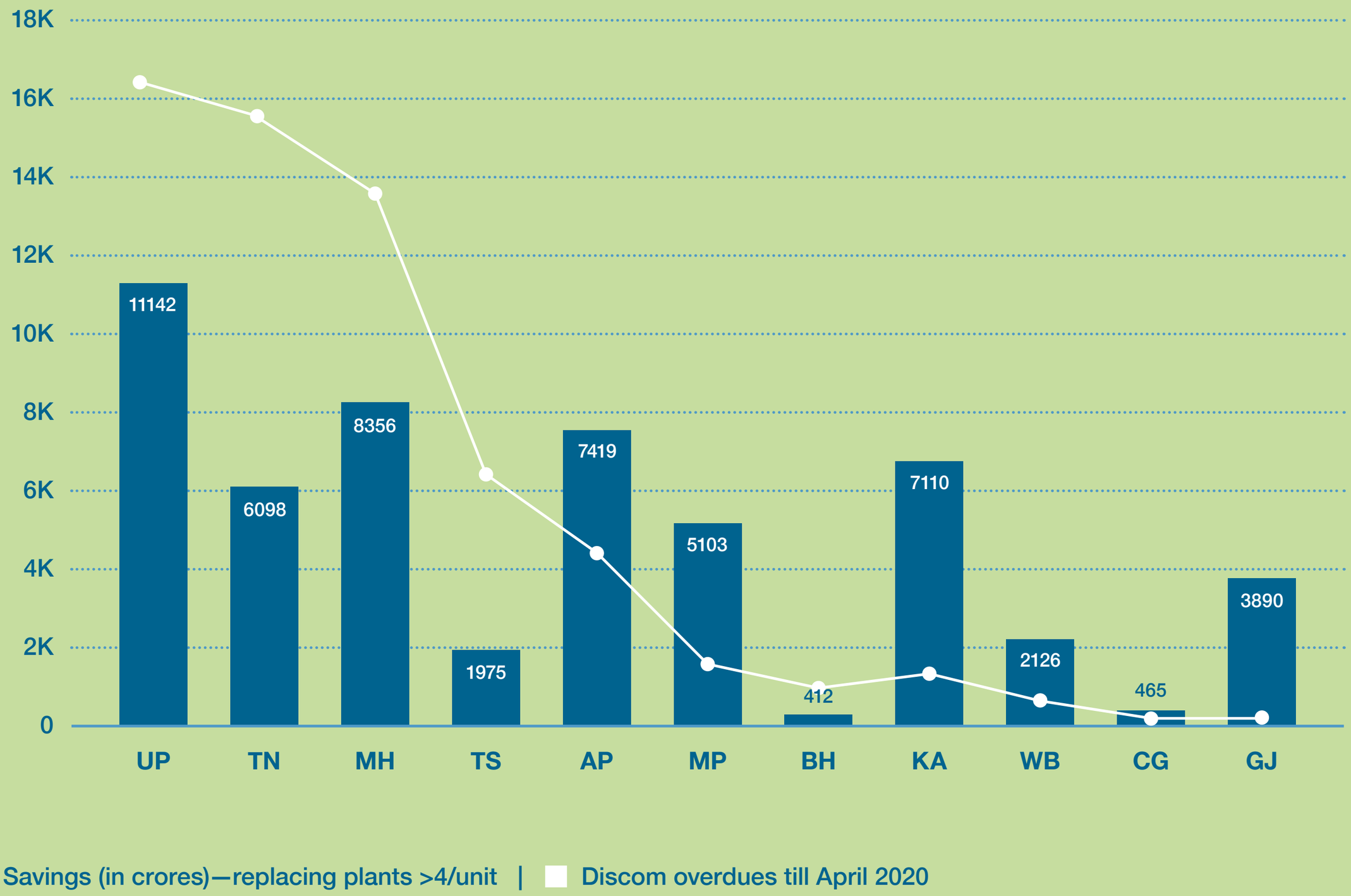

TABLE 10

Replacement of all thermal power >Rs.4/kWh with RE at or below Rs.3/kWh; potential savings for states (in crores)

State	MU purchased > 4/kWh	Cost of power purchased >4/kWh	Estimated savings by replacing with RE = ₹3/kWh p.a.
Andhra Pradesh	26,955	₹16,361 cr	₹7,092 cr
Bihar	11,245	₹5,024 cr	₹1,651 cr
Chhattisgarh	2,811	₹1,307 cr	₹464 cr
Gujarat	20,316	₹9,985 cr	₹3,890 cr
Karnataka	28,563	₹15,679 cr	₹7,110 cr

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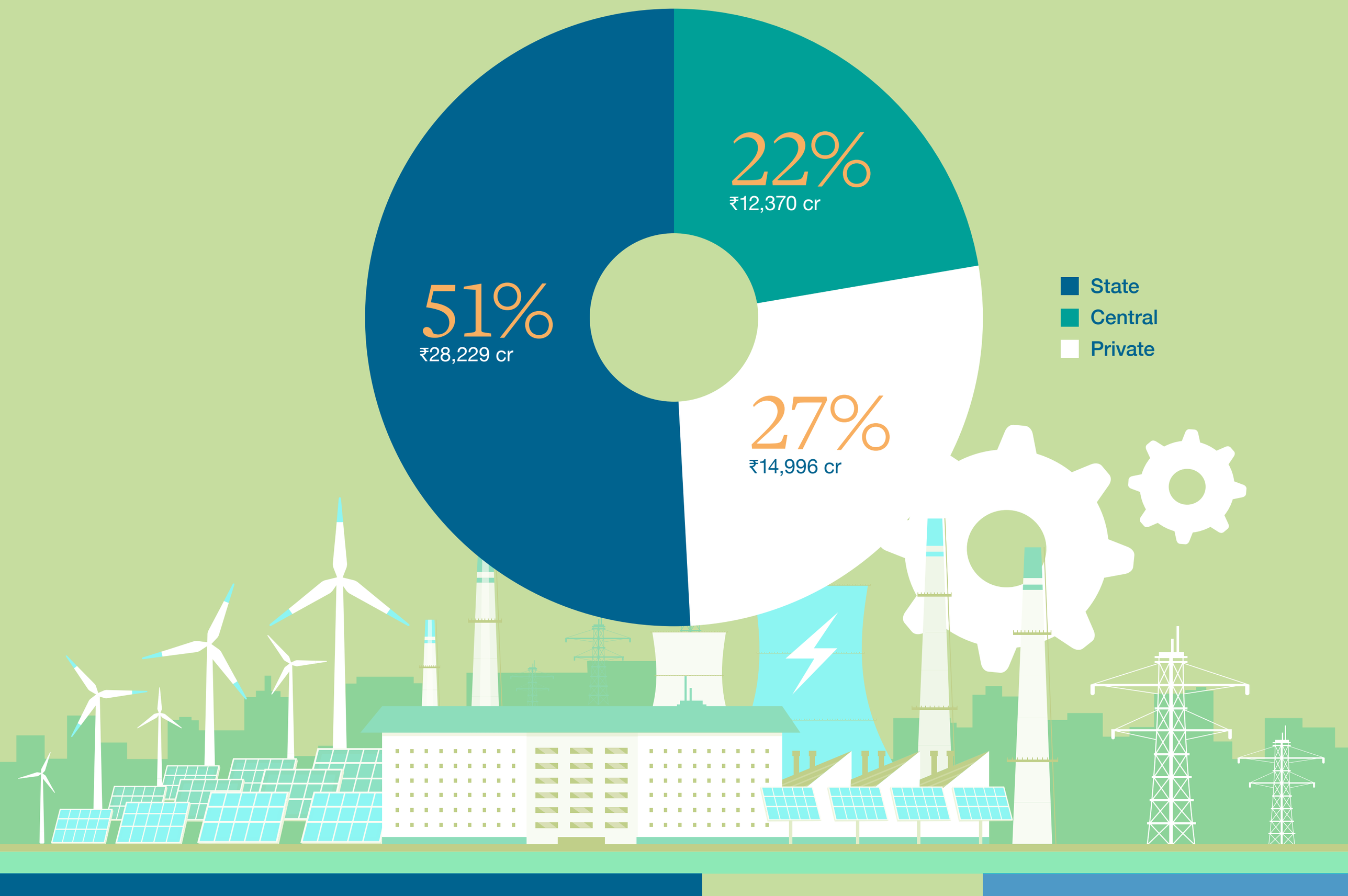
State	MU purchased > 4/kWh	Cost of power purchased >4/kWh	Estimated savings by replacing with RE = ₹3/kWh p.a.
Madhya Pradesh	35,262	₹15,681 cr	₹5,103 cr
Maharashtra	42,264	₹21,179 cr	₹8,356 cr
Tamil Nadu	39,176	₹17,850 cr	₹6,097 cr
Telangana	13,565	₹6,044 cr	₹1,974 cr
Uttar Pradesh	34,086	₹21,367 cr	₹11,141 cr
West Bengal	12,958	₹6,013 cr	₹2,125 cr
Total			**₹55,003 cr**

FIGURE 6

Ownership of plants with tariffs > Rs.4/kWh; savings from replacement with renewable energy (in crores)



05 Conclusions

01

Phasing out coal plants that are 20 years or older will provide immediate and significant savings to financially stressed discoms and electricity consumers. These savings are in the form of avoided retrofit costs and lower power purchase costs through replacement with renewable energy.

02

Since all the plants in this age cohort are government-owned, phasing them out is largely a matter of political will.

03

Halting further expenditure on coal plants that are in the early stages of construction is essential if states are not to create a fresh round of non-performing assets, or lock discoms into expensive Power Purchase Agreements and fixed cost obligations.

04

Rationalising fixed cost payments to bring them to acceptable levels is another potential source of discom savings, particularly in the case of public sector, government owned generating stations. Options that can deliver this outcome while maintaining sanctity of contract need to be explored.

05

Short term pain incurred from these measures, (such as some lenders having to incur hair cuts on outstanding loans due to the renegotiation of fixed costs, or government owned generators having to shutter a plant earlier than expected) should be viewed against the significant savings that will accrue to discoms and consumers.

06

Apart from the direct financial savings, there are significant ancillary benefits in terms of reduced pollution, greater water availability for other uses and the possible diversion of land for community or industrial use.

06 Endnotes

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07 Annexures: state tariff graphs

FIGURE 7

Andhra Pradesh coal TPP tariffs (in Rs.)

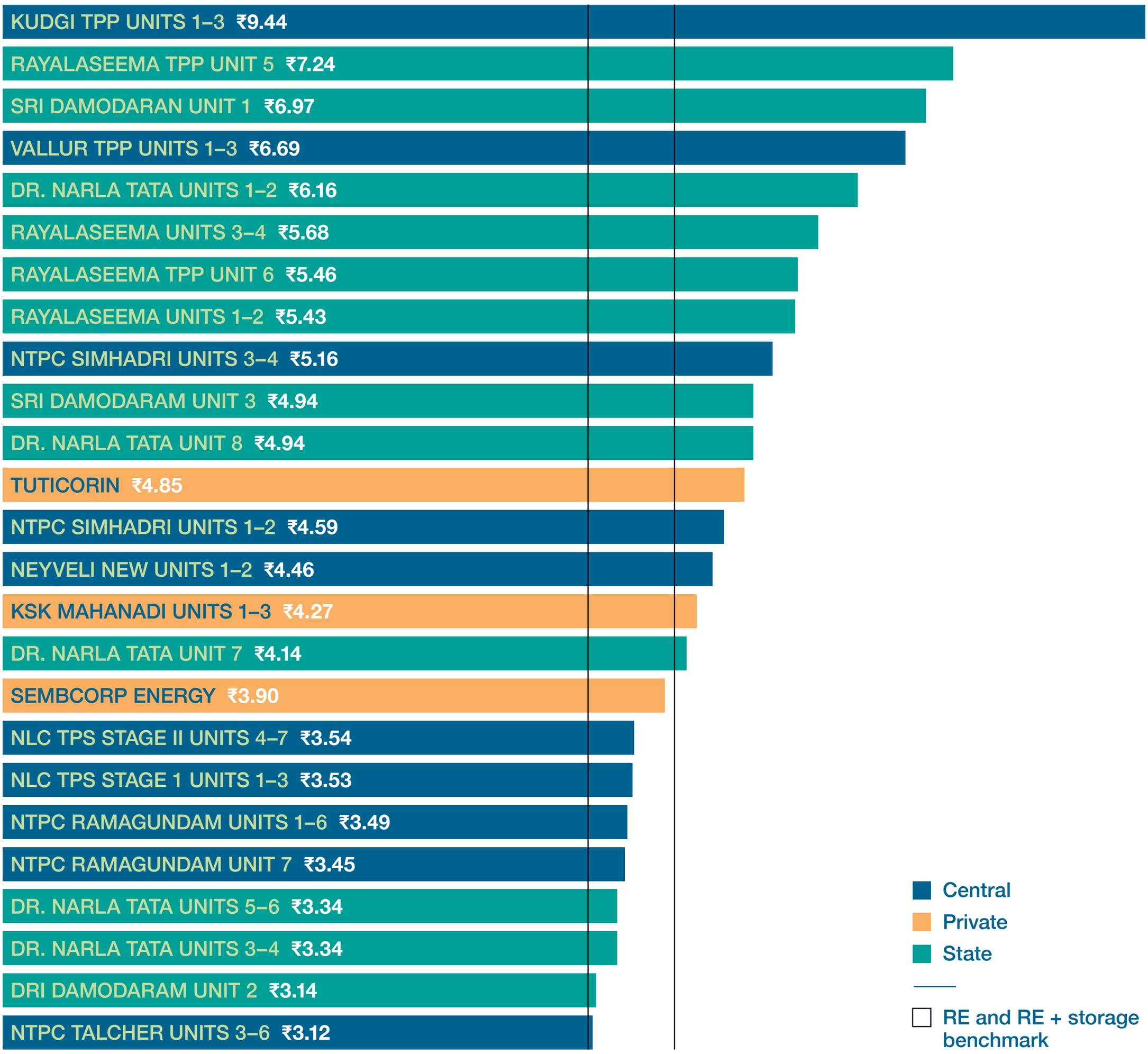

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FIGURE 8

Bihar coal TPP tariffs (in Rs.)

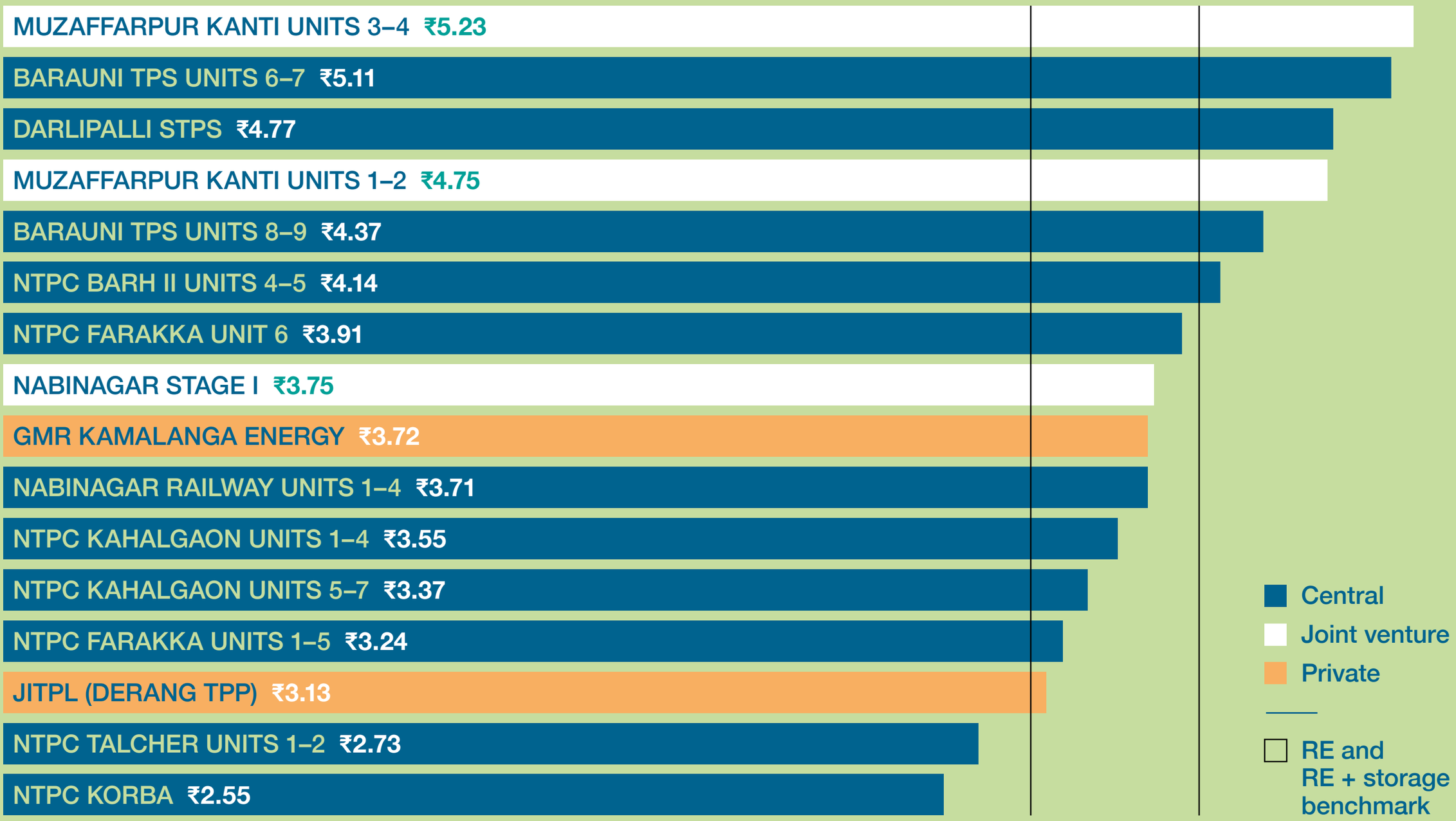

FIGURE 9

Chhattisgarh coal TPP tariffs (in Rs.)

FIGURE 10

Gujarat coal TPP tariffs (in Rs.)

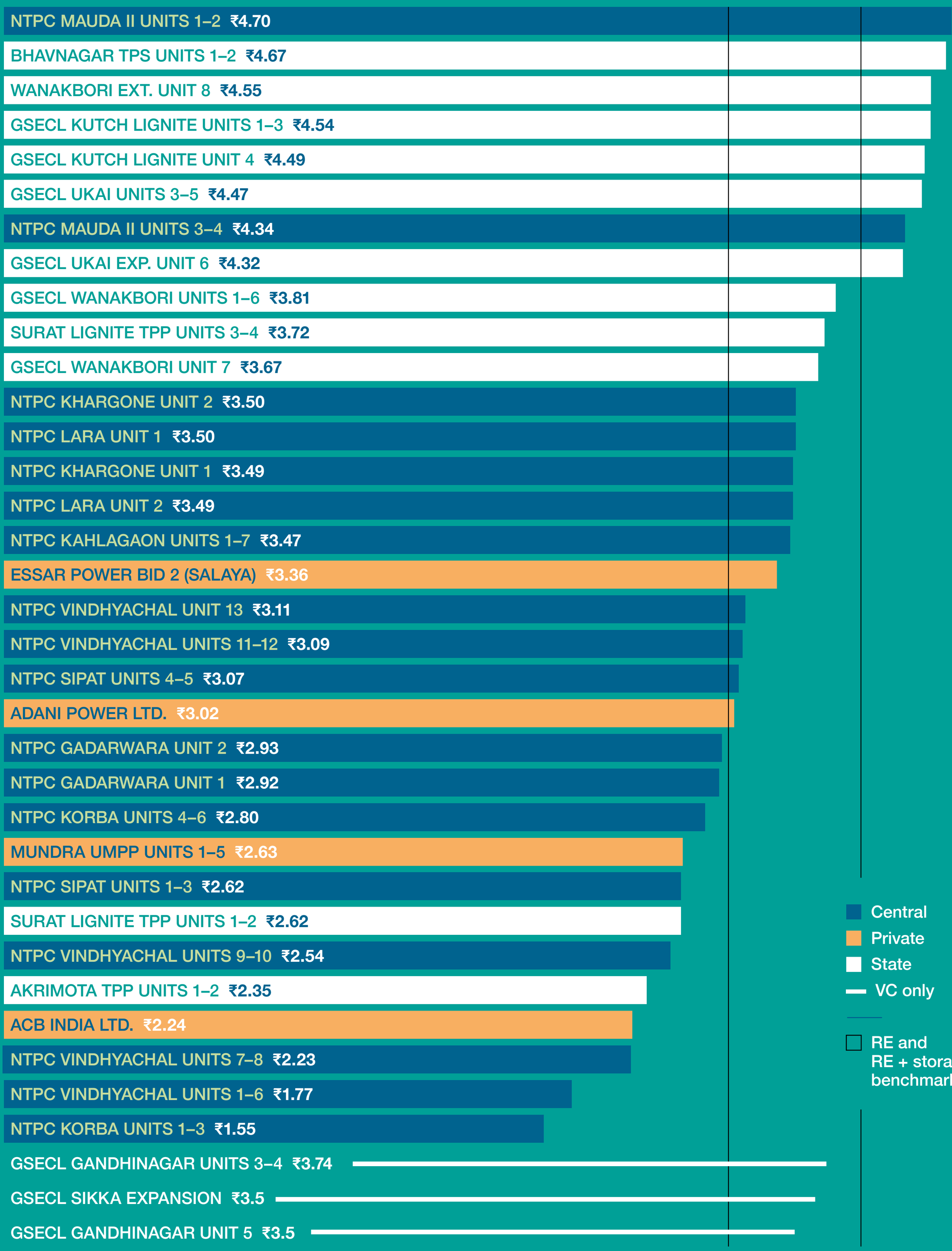

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FIGURE 11

Karnataka coal TPP tariffs (in Rs.)

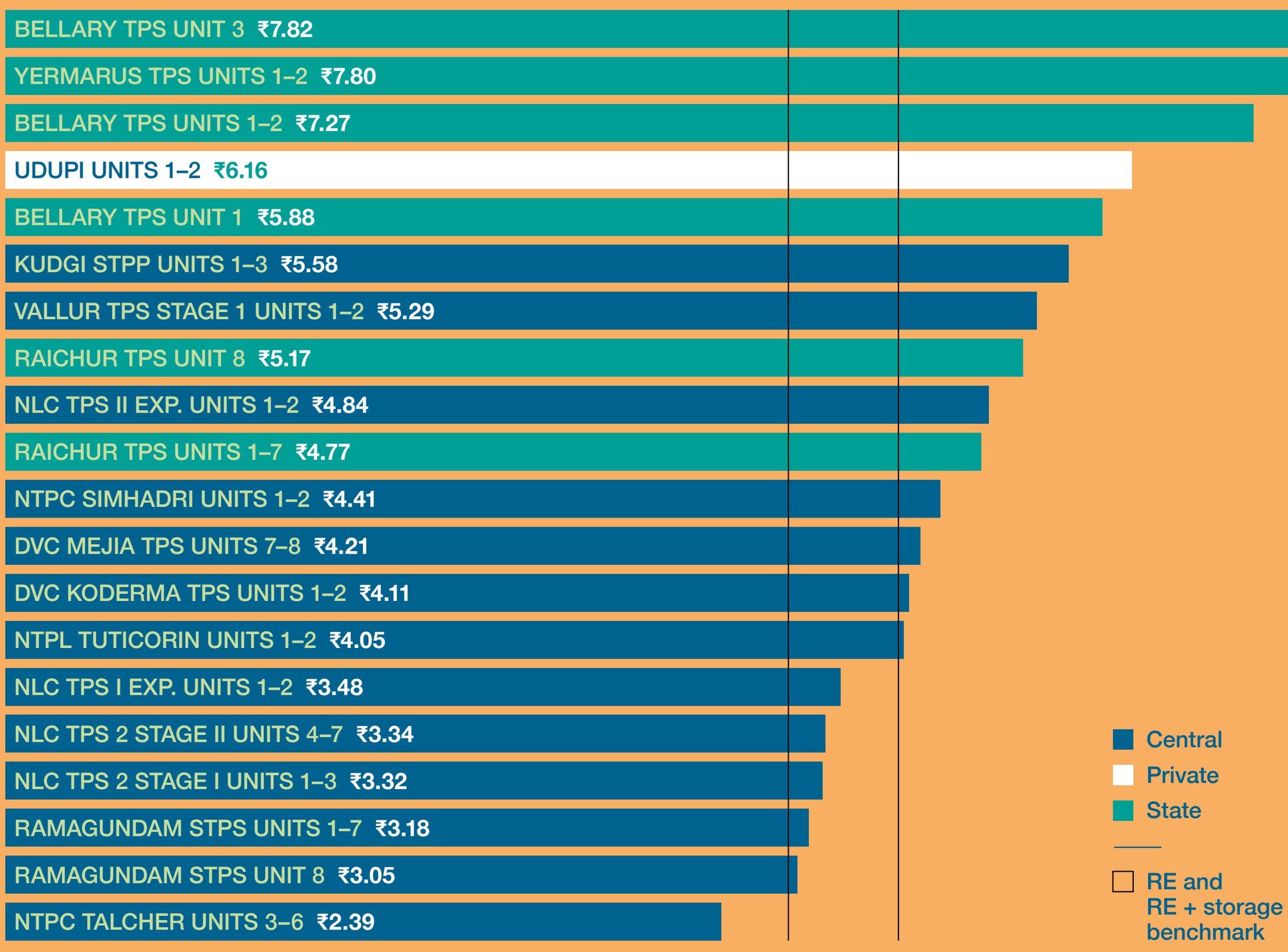
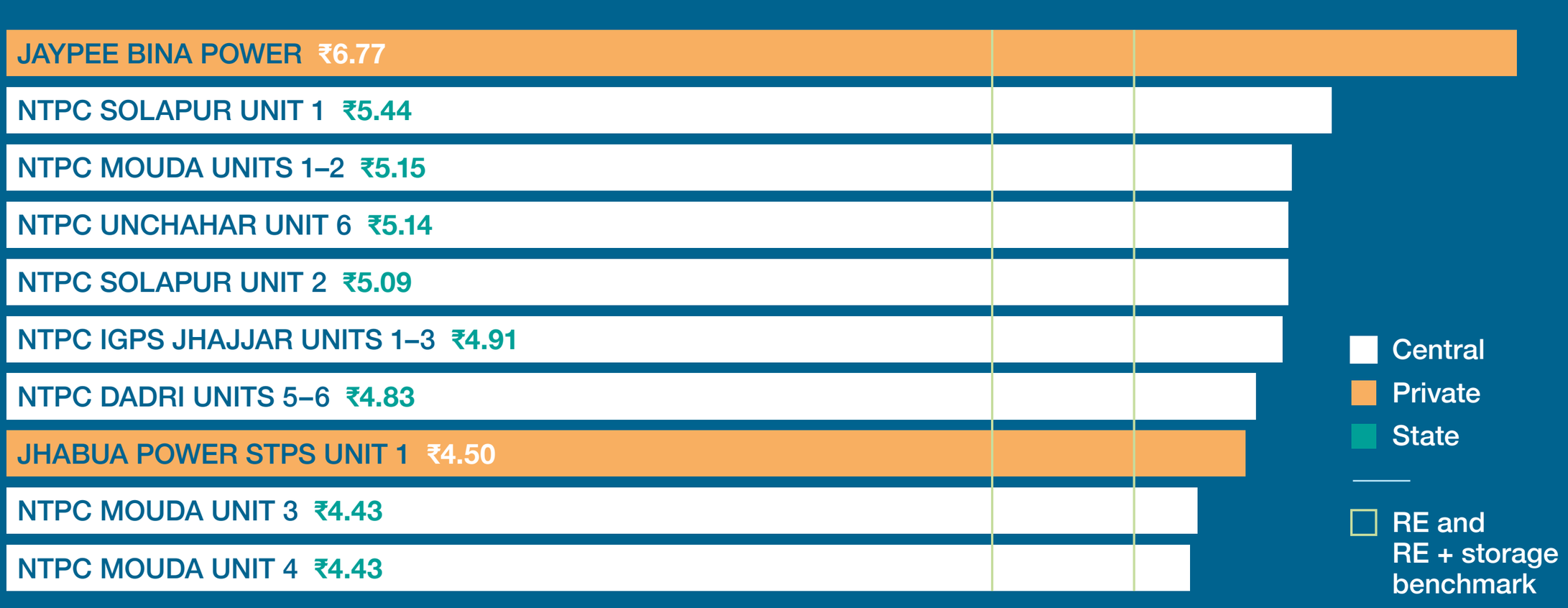


FIGURE 12

Madhya Pradesh coal TPP tariffs (in Rs.)



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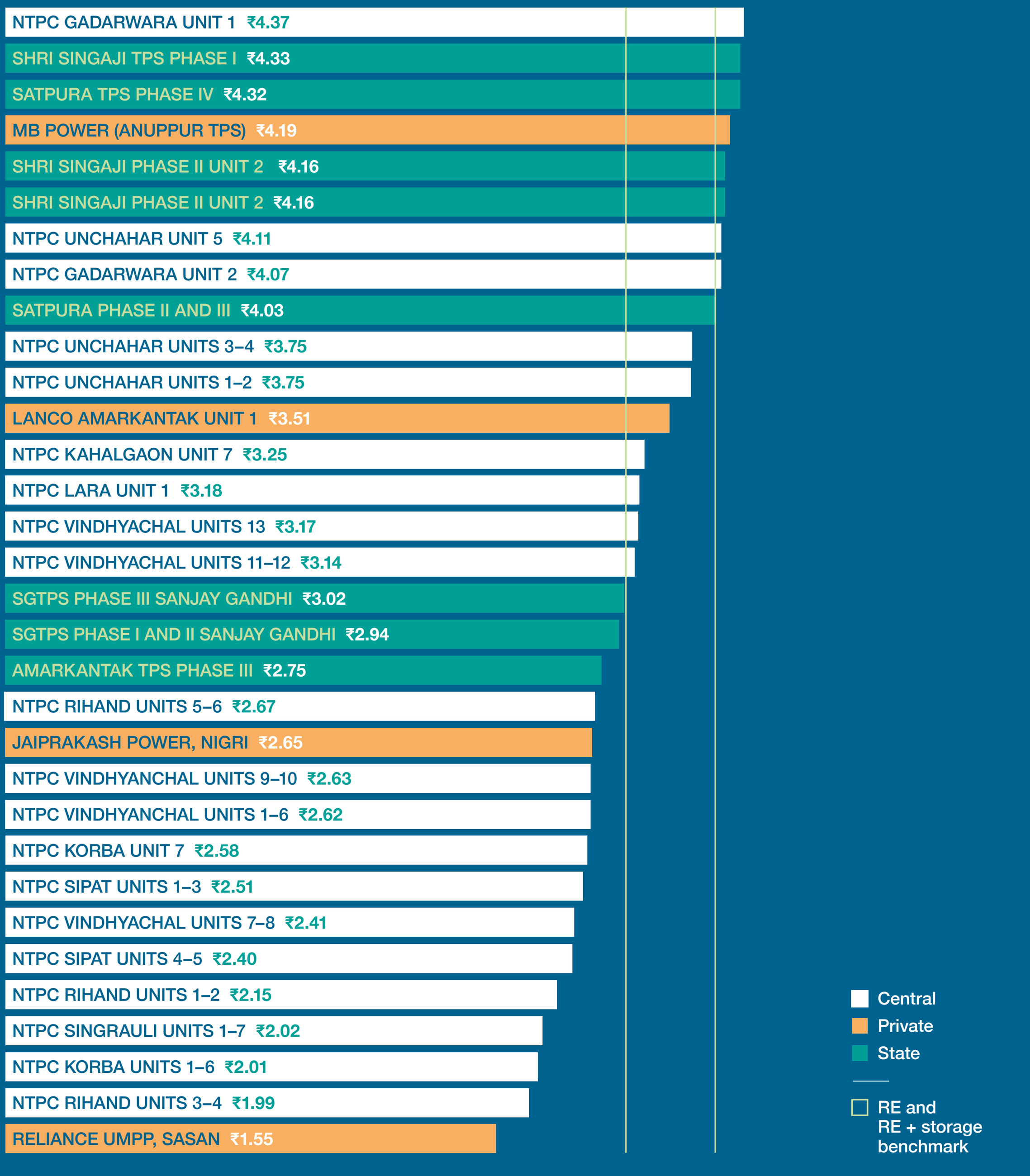

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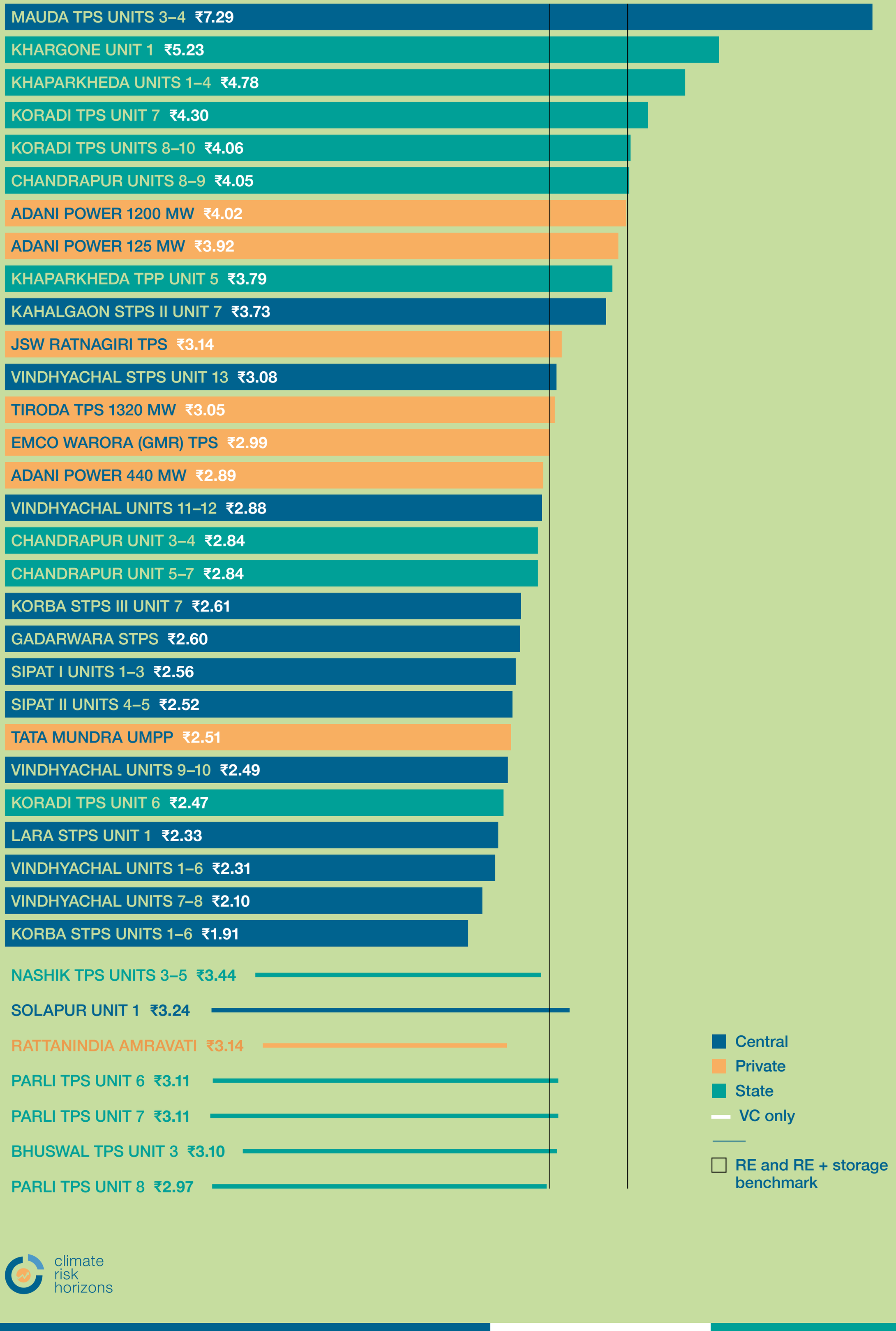
FIGURE 13

Maharashtra coal TPP tariffs (in Rs.)



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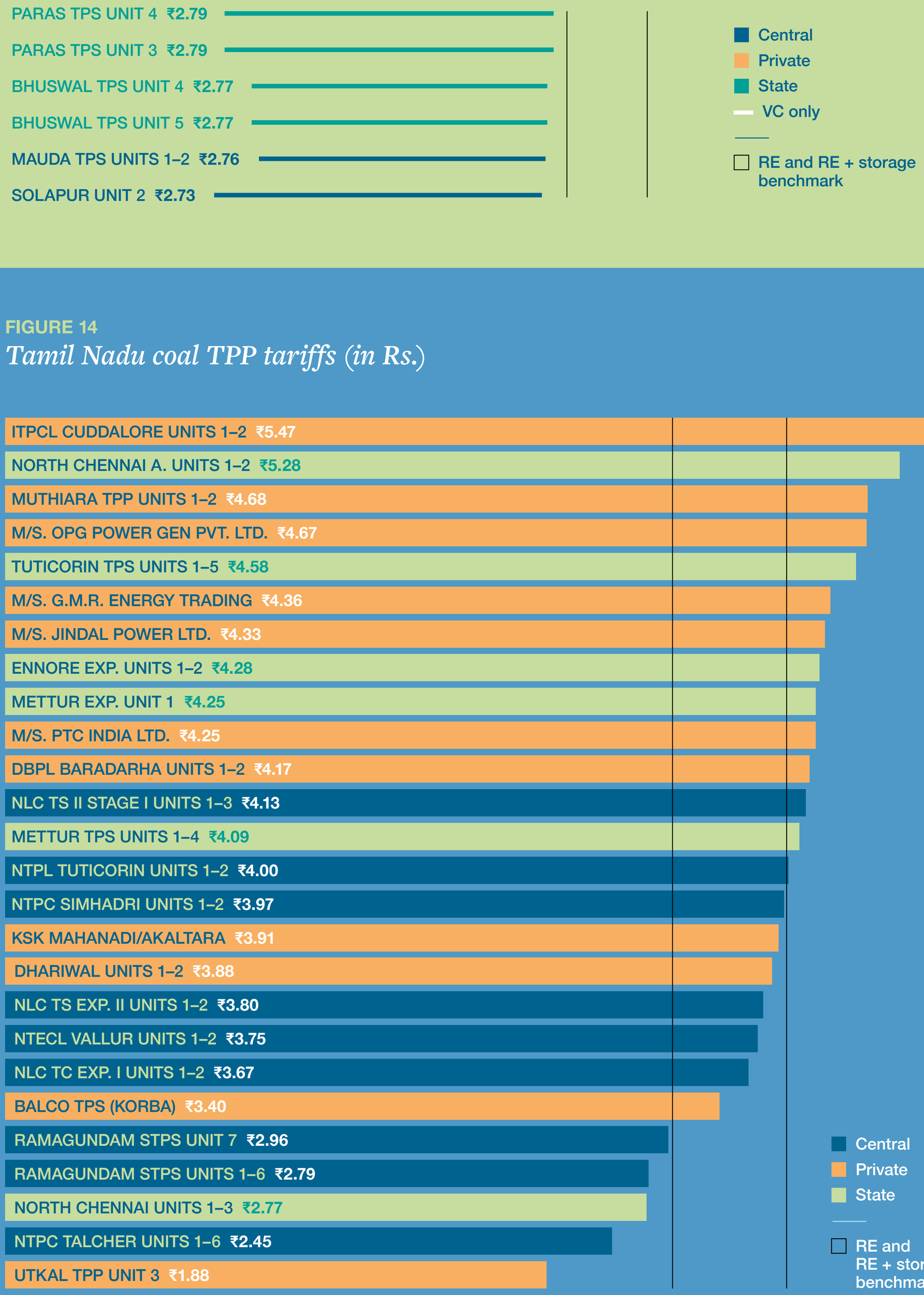

FIGURE 14

Tamil Nadu coal TPP tariffs (in Rs.)

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FIGURE 15

Telangana coal TPP tariffs (in Rs.)

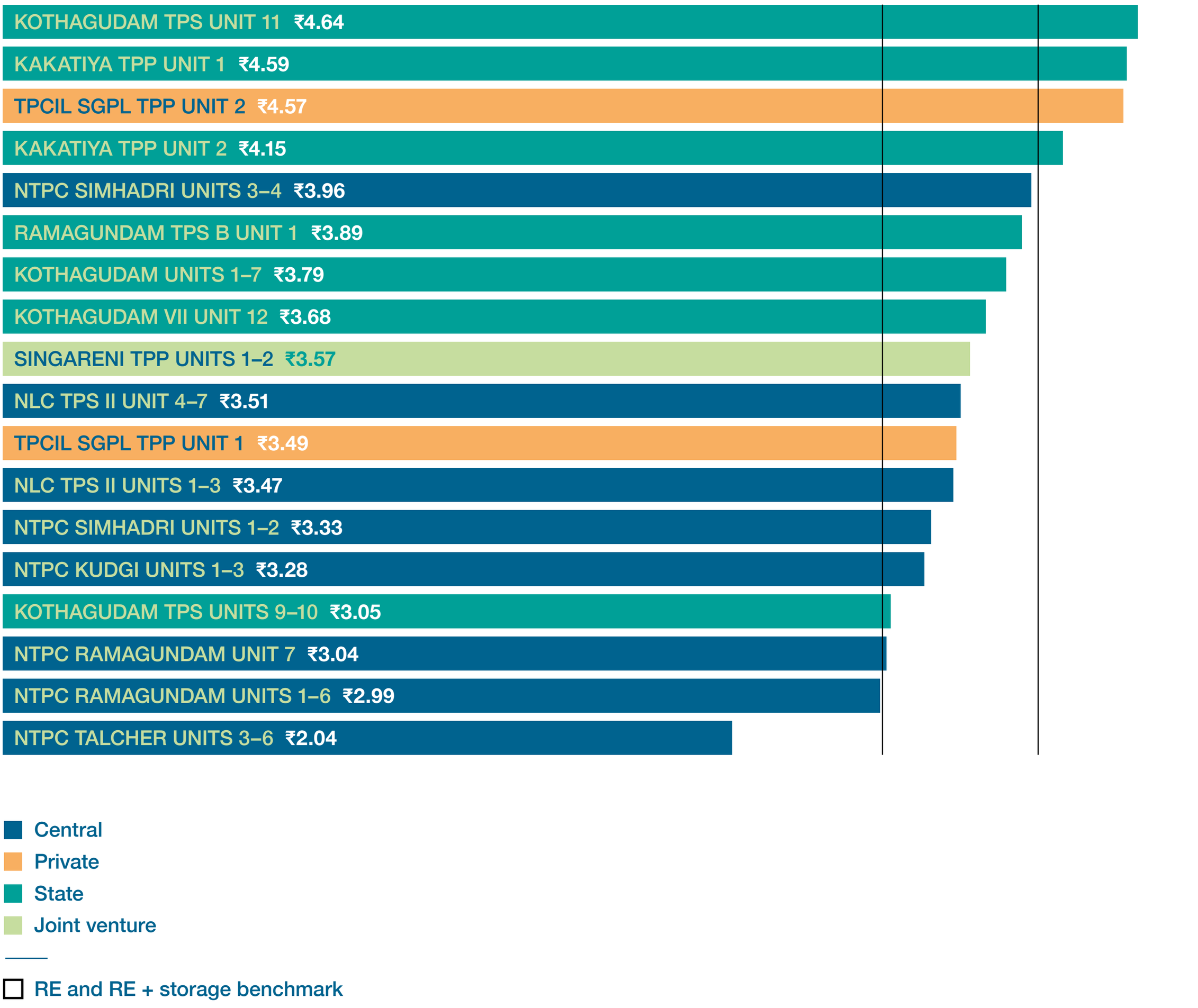
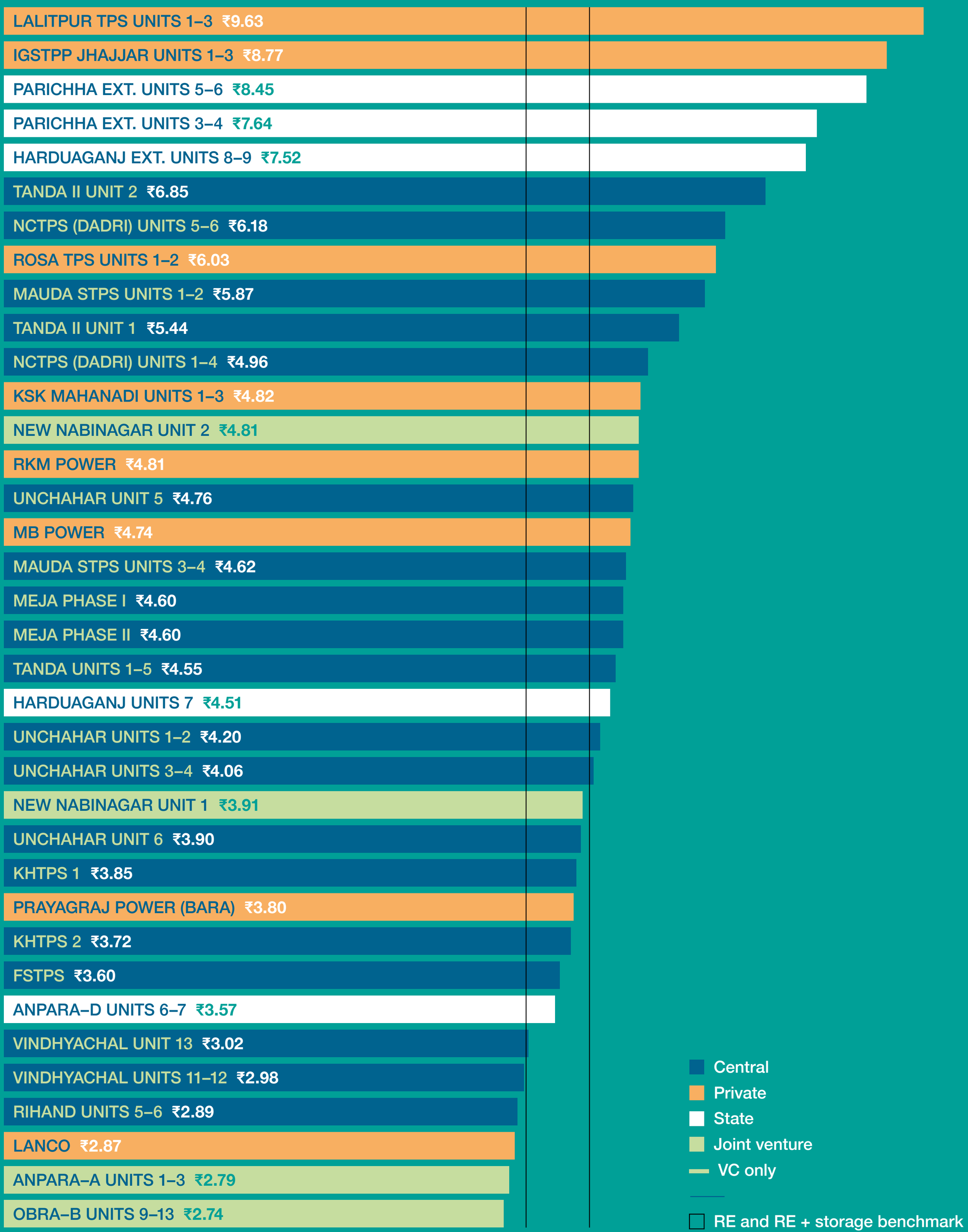


FIGURE 16

Uttar Pradesh coal TPP tariffs (in Rs.)



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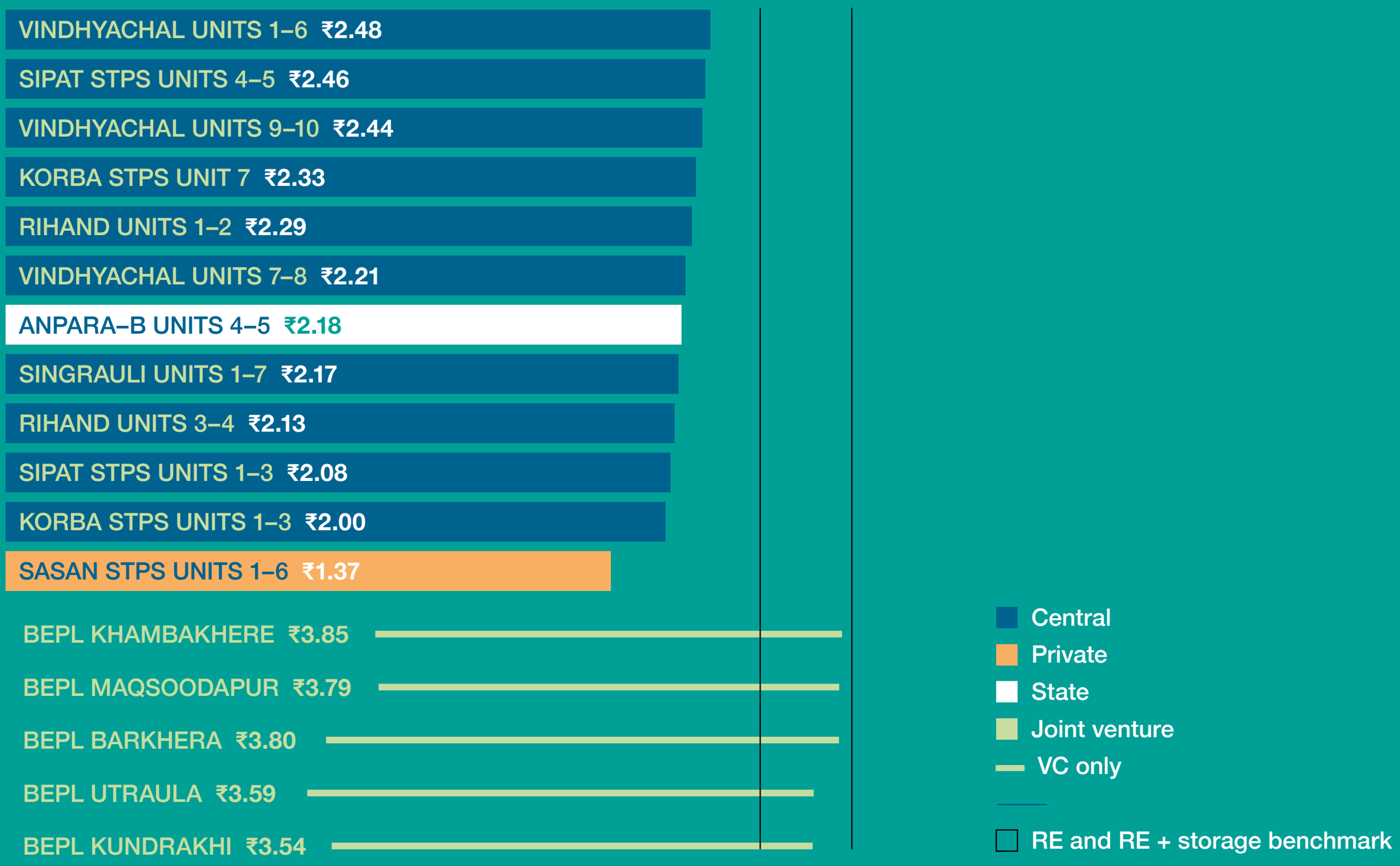
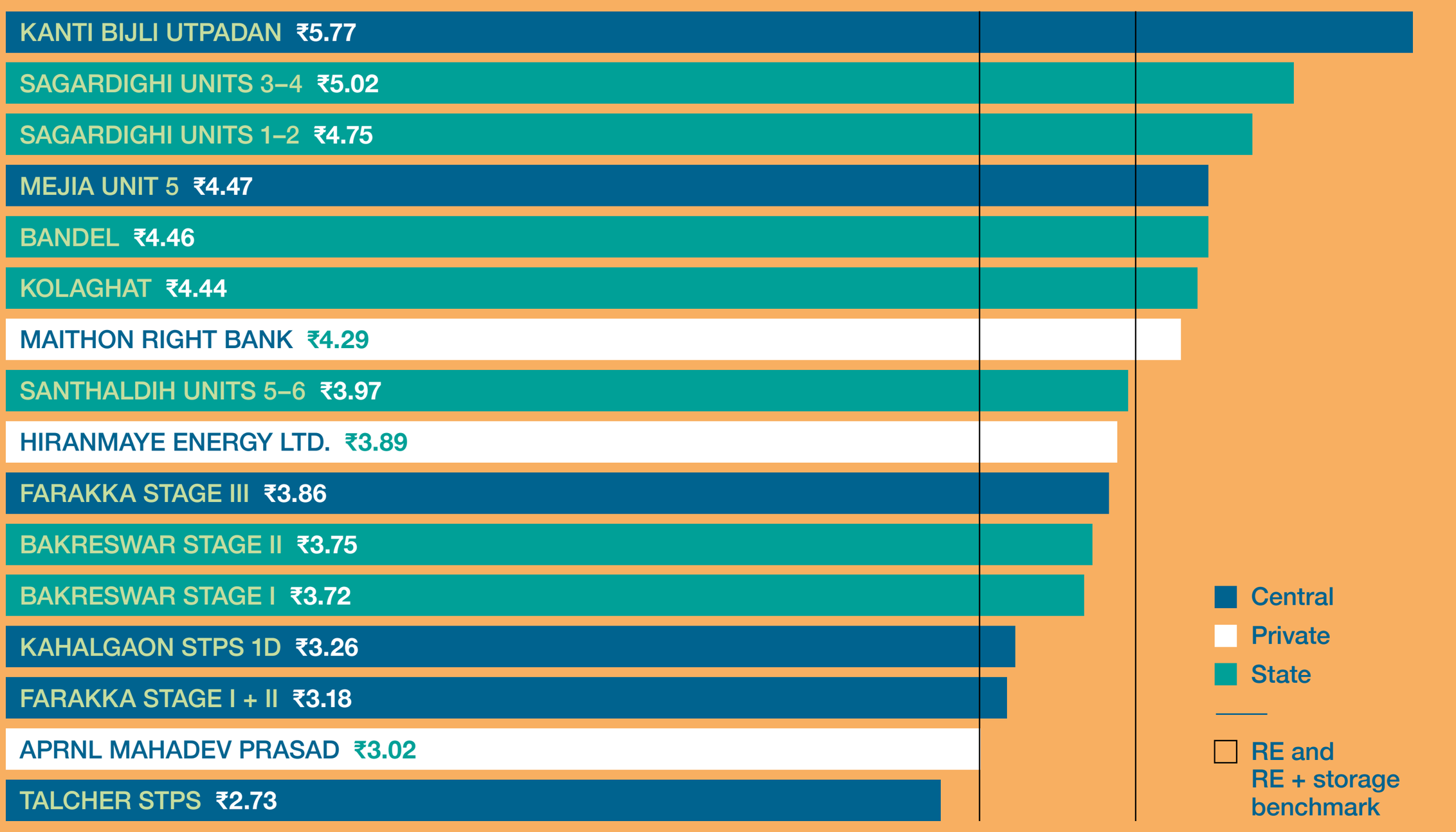


FIGURE 17

West Bengal coal TPP tariffs (in Rs.)



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