climate risk horizons

TANGEDCO's Recipe for Recovery

Retiring old coal, stopping new build and boosting renewables

Tamil Nadu can save ₹35,000 cr. over five years by shutting down 3.1 GW of old coal plants, boosting renewable energy and halting construction of new coal plants

Authors

Ashish Fernandes
CEO & Lead Analyst, Climate Risk Horizons
ashish.fernandes@climateriskhorizons.com

Harshit Sharma
Lead Researcher, Climate Risk Horizons
harshit.sharma@climateriskhorizons.com

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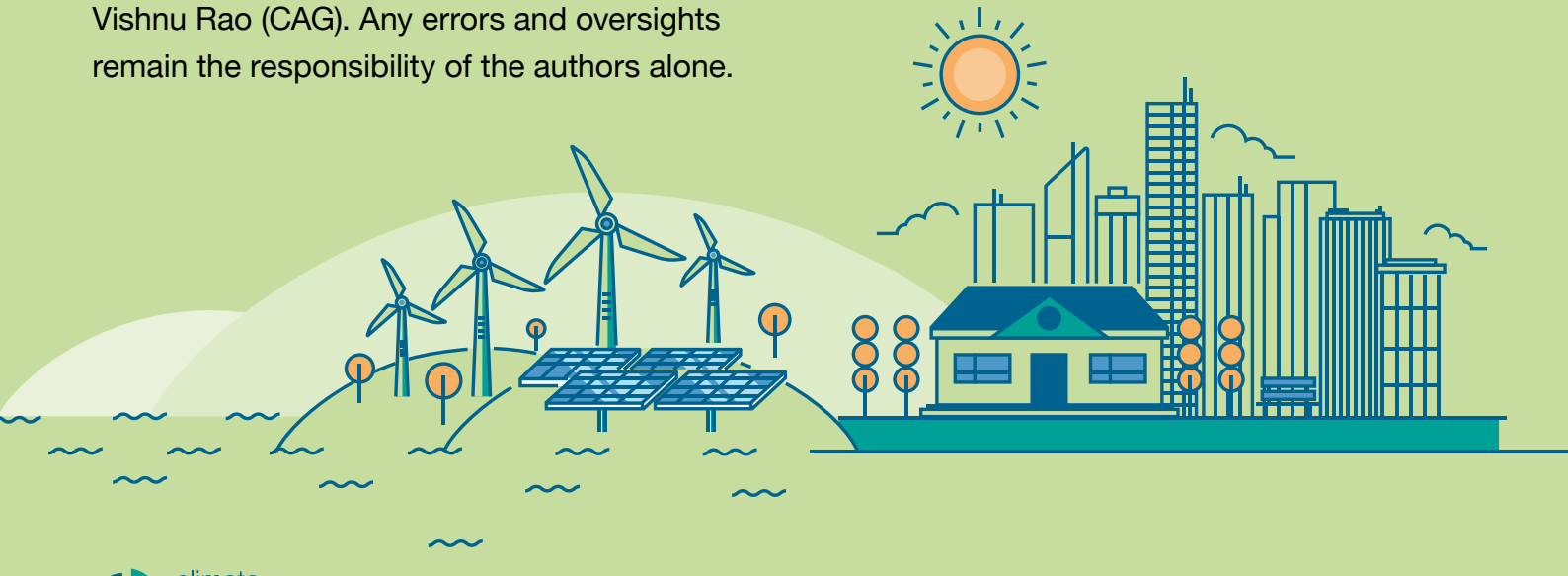

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01 Executive summary

The Covid-19 pandemic has caused an economic shock that has strained the finances of governments at the state and central level alike. Pre-Covid-19, the financial status of most state distribution companies was shaky—the pandemic has exacerbated this. As with several other states, Tamil Nadu's generation and distribution company TANGEDCO is now facing a severe financial crisis.

Without measures to lower the cost of power supply, TANGEDCO will need repeated bailouts.

Delayed subsidy payments, "electricity theft" and dues not being paid by government-owned entities are well-known factors undermining discom finances; excessive projections of electricity demand (by virtually all entities in the electricity space, governmental and non-governmental) have also played a role. These projections have led states to sign Power Purchase Agreements (PPA) in excess of actual requirements, resulting in overcapacity in the electricity system, and disproportionate fixed cost obligations for many discoms, including TANGEDCO. Climate Risk Horizons has previously estimated that contracted PPAs in excess of requirements are imposing an excessive burden of over ₹1,100 cr. per annum on TANGEDCO.[1] In combination, these factors have created the situation TANGEDCO is in today.

TANGEDCO had overdues of ₹20,646 cr. as of October 2020.[2] Reports indicate that the Centre has approved a ₹30,230 cr. bailout package for Tamil Nadu.[3] However, in the absence of structural reforms, this amounts to kicking the can down the road again. In the two years since January 2017 when the Tamil Nadu government joined the UDAY discom revival scheme, TANGEDCO's losses grew from ₹7,760 cr. in FY 2018 to ₹12,623 cr. in FY 2019, and in 2019 its total debt was estimated at ₹1,13,438 cr.[4] Media reports suggest that TANGEDCO loss per unit of power sold has grown to ₹2.2,[5] up from ₹1.36 in FY 2019. Without measures to bridge that gap, the utility will need repeated bailouts every few years, harming the energy security and overall economic outlook of the state.

Getting TANGEDCO on sound financial ground is critical to Tamil Nadu's energy transition and economic recovery plans. The state is a leader in terms of renewable energy development. If adequate electricity is to be provided to all, and if renewable energy projects in the pipeline are

not to suffer the same financial struggles as many coal power generators today, TANGEDCO must be able to pay generators reliably.

Even as the financial crisis facing discoms roils the power sector and financial institutions, Tamil Nadu is also bearing the brunt of severe air pollution and an unfolding climate crisis. Coal-fired power plants are the common thread running through all three crises.

The financial costs from air pollution in India are now well documented—an estimated 5.4% of GDP.[6] 'Natural' disasters like the devastating Chennai floods in 2015,[7] the multi-year drought that saw the city's water supplies exhausted in 2019,[8] or the locust swarms[9] over large parts of India in May 2020 bear a clear climate imprint. The climate-change induced warming of the Bay of Bengal is also supercharging cyclones: India's east coast has been hit by several powerful storms (Amphan, Nivar and Nada) in 2020 alone.[10] Each of these extreme weather events cause suffering and loss of human life, apart from very significant economic losses through damaged assets and a loss of productivity.

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. This will help tackle air pollution, but shutting down older power plants will 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. 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. In this analysis, we will show that this fear is unfounded both because of the current energy surplus scenario, and because more cost-efficient alternatives are available to deal with probable growth in electricity demand.

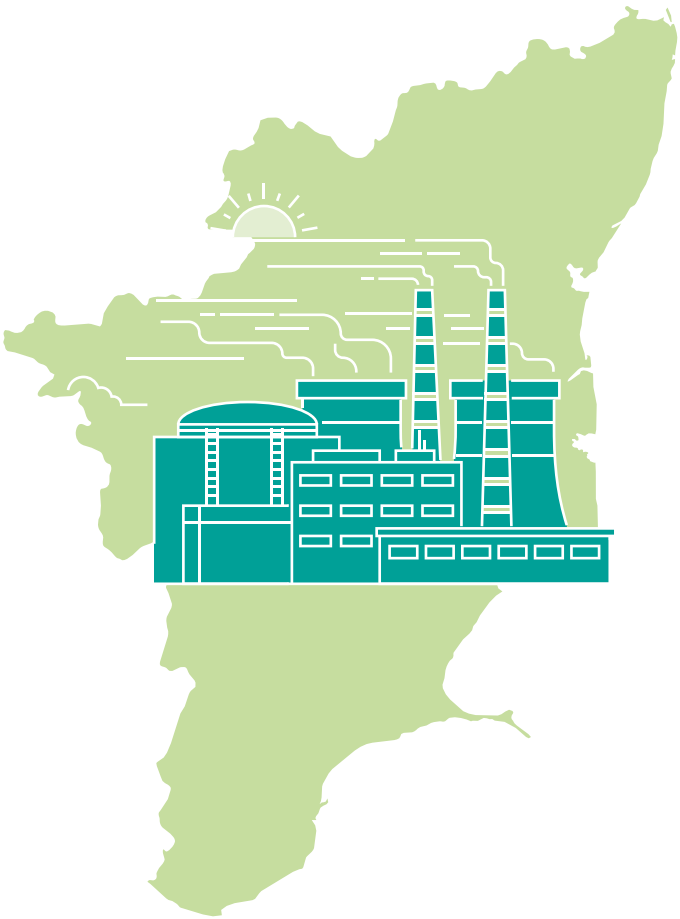
This analysis of Tamil Nadu's coal fleet attempts a guiding framework to identify which power plants can be phased out in the near term at a net benefit to the state and its consumers. These phaseouts have significant co-benefits: improving the financial condition of state governments and distribution companies, lowering the electricity purchase costs for consumers and ensuring better utilisation of newer, more efficient and lower cost electricity generation assets, in addition to social benefits (cleaner air, less fly ash disposal, etc).

This analysis of Tamil Nadu's coal fleet attempts a guiding framework to identify which power plants can be phased out in the near term at a net benefit to the state and its consumers.

The financial benefits that an accelerated phase out of old power plants can bring to Tamil Nadu

consumers are on account of replacing the higher cost power from older plants with cheaper options, as well as avoiding costs from retrofits that are needed to ensure compliance with air pollution laws, if the plants are to continue operating beyond 2022.

Secondly, we also assess potential savings from freezing expenditure on new coal plants that are still at early stages of construction and destined to be economically uncompetitive with cheaper sources of electricity.



Lastly, we have also enumerated potential savings if a longer term project to phase out the most expensive coal power plants, irrespective of age, were to be pursued. Lowering the cost of electricity is important for all players—TANGEDCO, the state government, consumers and small/medium scale industries as well. The gap between average cost of supply and average realisation for TANGEDCO in 2020 has been reported at ₹2.2 per unit. This subsidy is borne by the state government—a reduction in the cost of power implies a lower subsidy burden, and lower cross subsidies to be charged on larger industrial/manufacturing consumers. Lower cost power will have a multiplier effect on Tamil Nadu's small- and medium-scale enterprises and the economy at large. Utilising some or all of these cost reduction opportunities will benefit TANGEDCO, the Tamil Nadu state government and consumers, and reduce the need for repeated bailouts of TANGEDCO by the state or central government, while potentially also improving the balance sheets of banks exposed to the power sector.

Key findings

#1

An accelerated shut down of plants 20 years and older in Tamil Nadu can yield savings of approximately ₹9,000 crores over 5 years (Table 1). Savings will accrue in two ways:

➔ *Shutting down 3,150 MW of older, inefficient coal plants will save an estimated INR 1,670 cr. in terms of avoided retrofit costs for Flue Gas Desulphurisers and Low NOx Burners. A quick phaseout of these plants (or phaseout of the power purchase agreement in the case of Central sector plant NLC), is the most economical option as retrofits to make them legally compliant with emission standards would require additional capex and raise the cost of power and eventually power tariffs. All of these plants are between 28 and 40 years old.*

➔ *If scheduled dispatch from these 3,150 MW of older plants were to be replaced with electricity either from new renewables or from the power exchange at an average of INR 3/kWh, there would be a further net savings of at least INR 1,459 cr. per annum based on current tariffs. Since coal power tariffs tend to escalate annually, the actual savings over a 5-year tariff period would be over INR 7,295 cr.*

TABLE 1

Coal plants in Tamil Nadu 20 years or older that can be phased out with potential savings

	Power station/unit	MW	Age	Tariff (₹/kWh)	Savings from replacement with RE (₹cr. p.a.)	Savings from avoided retrofit (₹cr., one-time
1	Tuticorin TPS	1050	28–40	4.58	918.47	556.5
2	Mettur TPS	840	29–32	4.09	586.38	445.2
3	North Chennai TPS	630	32–25	2.77	-180.62	333.9
4	NLC TS—II Stage 1*	630	31–32	4.13	134.95	333.9
	Total	**3150**			**1459.18**	**1669.5**

* Central sector project supplying power to TANGEDCO

#2

Freezing expenditure on 3,580 MW of early stage TANGEDCO projects under active construction can save approximately ₹26,000 cr. of public funds (Table 2).

Tamil Nadu has surplus generation capacity in operation as of 2020. An additional 7,385 MW of coal power is officially under construction across the state. Of this, 3,145 MW is at an advanced stage and likely to be completed within the next 1 year or less. Once commissioned, these plants will pose an additional fixed cost burden for TANGEDCO while further depressing capacity factors across the coal fleet. The remaining 3,580 MW, however, is still at an early stage. Freezing further expenditure on their construction will free up significant resources.

TABLE 2

Savings from freezing expenditure on early stage projects under active construction in Tamil Nadu

	Power station/unit	Promoter	MW	Expenditure incurred	Total expenditure projected	Avoided expenditure if shelved
1	Ennore Exp.	TANGEDCO	660	791	5,421	4,630
2	Uppur Units 1–2	TANGEDCO	1,600	2,977	12,778	9,801
3	Udangudi Units 1–2	TANGEDCO	1,320	993	13,076	12,083
	Total		**3,580**	**4,628**	**31,275**	**26,514**

(Figures in crores, data as of September 2020)

#3

If scheduled dispatch/generation from all plants with tariffs at ₹4/kWh or higher (irrespective of age) were to be gradually replaced with power from renewables or from the power exchanges at an average of ₹3/kWh, there would be a potential savings of approximately ₹30,000 cr. over 5 years (based on current power tariffs) in terms of reduced power purchase costs for the state of Tamil Nadu.

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, or (where all parties are government entities) early termination of the contract by mutual agreement, given the savings that will be generated across the system. Contracts could also be reconfigured to reward flexible generation through a premium for peaking power supply. The savings in Table 3 below are gross, excluding any costs associated with contract termination/restructuring.

TABLE 3

Potential savings (gross) by replacement of all thermal power >Rs. 4/kWh with RE at or below Rs. 3/kWh

Plant	Scheduled dispatch (MU) > 4/kWh	Total cost (₹CR)	Estimated savings by replacing with RE=3/kWh (annual, ₹CR)
ITPCL Cuddalore	3,867.24	2,116.22	956.05
N. Chennai A U1–2	3,847.39	2,032.69	878.47
Muthiara U1–2	3,996.15	1,870.13	671.29
OPG Pvt. Ltd.	529.96	247.27	88.28
Tuticorin TPS U1–5	5,811.71	2,661.98	918.47
GMR Energy Trading	1,074.23	468.35	146.08
Jindal Power Ltd.	2,864.62	1,239.96	380.57
Ennore Exp. U1–2	1,735.17	742.89	222.34
Mettur Exp. U1	4,039.76	1,716.42	504.49
PTC India Ltd.	716.16	304.68	89.93
DBPL Baradhara U1–2	1,489.60	621.64	174.76
NLC II St. 1 U1–2	1,189.45	491.78	134.95
Mettur U1–4	5,386.35	2,202.28	586.38
Total	**39,176**	**17,850**	**6,097**

TABLE 4

Summary of savings

Potential savings for Tamil Nadu discoms and state government	
Avoided retrofits by phasing out plants 20 years and older	₹1,670 cr.
Replace lost generation from plants 20 years and older with renewable energy	₹1,459 cr. p.a. / ₹7,295 cr. (5 years)
Rationalise under construction projects in the state/central sector, freezing expenditure on early stage plants	₹26,514 cr.
Phase out all plants with tariffs > ₹4kWh & replace with = ₹3/kWh	₹6,097 cr. p.a. / ₹30,485 cr. (5 years)
Total	**₹34,100 cr. (first year) ₹57,766 cr. (5 years)**

Recommendations

A detailed plan that incorporates the four elements laid out below is required for any TANGEDCO recovery to be successful and sustainable.

01

Accelerate the phase out of older, inefficient, polluting coal plants.

All of these plants at or near the end of their life are owned by the state and central government, 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, the government could instead shut them down by 2022, (the deadline for compliance) or earlier, and generate immediate savings and power purchase cost reductions.

There is surplus generation capacity in the system (T.N.'s entire coal fleet ran at 56% PLF in FY 2020) to compensate for the loss of generation. TANGEDCO can plan to replace lost generation with renewable energy/renewable + storage projects, particularly distributed small projects that reduce wheeling losses and avoid issues of displacement/land conflict.

Given recent price declines, new RE projects will provide electricity at cheaper rates than existing or new thermal power.

TANGEDCO needs to bring down the average cost of power purchased. This can be done over the long term through a planned phase out of PPAs 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 flexible generation through a premium for peaking power supply at times when cheaper renewables are unavailable. These and other options that lower the average purchase price need to be explored.

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 economic choice might be to proceed, but in the case of any project that still requires an expenditure of thousands of crores, the state government is better off halting the project and diverting the land for more constructive purposes (or returning it to the original owners/users). If not,

we envisage the creation of further stranded assets and financial stress for TANGEDCO.

03

Incentivise community level grid-connected decentralised solar/solarisation of pump sets to meet rural/agricultural demand.

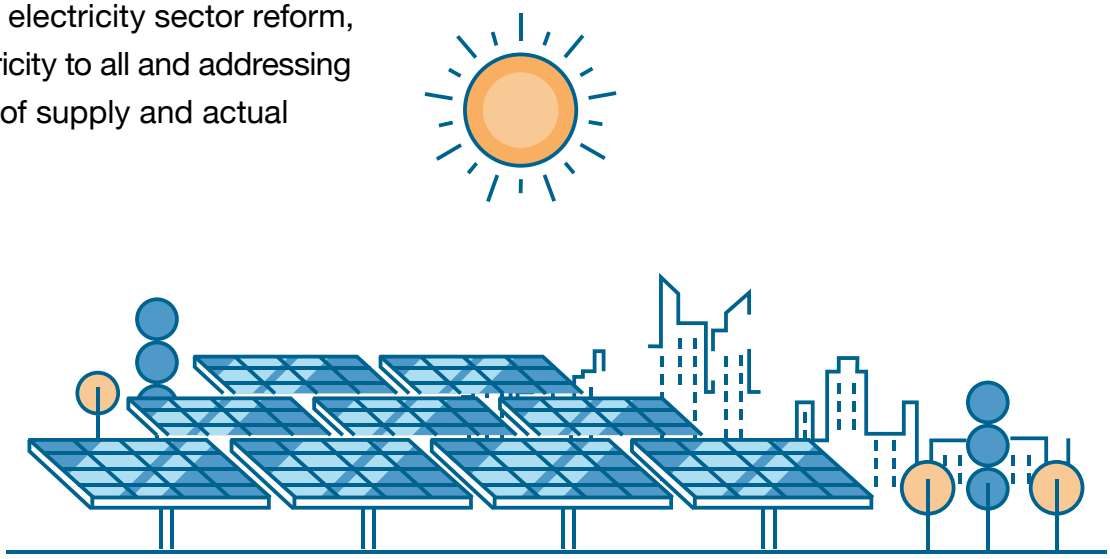
Removal of cross subsidies used to provide cheap or free power for agricultural use can be socially regressive and politically difficult. Meeting a growing proportion of this demand closer to source through distributed solar installations and the solarisation of pump sets are useful ways to reduce losses. Savings generated from pursuing the options listed in this report could be invested in meeting rural/agricultural demand via solar, yielding a double benefit for discoms. More fundamentally, policy incentives to encourage regionally appropriate cropping are essential. There has been other research on this,[11,12] 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, delivering reliable electricity to all and addressing the gap between cost of supply and actual revenue recovery.

04

Tap green finance to transition away from coal.

The Tamil Nadu state government should assess the feasibility of tapping into international green finance flows, raising funds for energy transition investments (solar/wind capacity, battery storage, modernisation of grid infrastructure) that are tied to a parallel commitment to retire old coal assets. "Transition bonds" could also be used to defray costs associated with coal plant retirement.

Diverting some or all of the savings spelled out above towards cheaper renewable energy, grid modernisation, energy efficiency, rural grid connected solar/wind, energy storage investments or to tackle the health and social impacts of the Covid-19 pandemic would be a productive use of public money.



02 Background

A look at Tamil Nadu's energy scenario shows that a convergence of factors provides the state an opportunity to make a shift in its electricity system in a way that restores TANGEDCO to financial health by reducing power purchase costs, while also addressing concerns around the price of electricity, air pollution and water scarcity. These factors are present across the country and in most states, including Tamil Nadu.

FACTOR 01»

Surplus generation capacity

In FY 2020, the average plant load factor of the coal fleet in Tamil Nadu was just 56%, down from 60% and 57% in FY 2019 and FY 2018 respectively.

TABLE 5

Plant Load Factors for Tamil Nadu (coal and lignite)

	FY 2018	FY 2019	FY 2020
PLF	57.69	60.67	56.05
Installed Coal/Lignite Capacity	13,747.19 MW	13,647.19 MW	13,756.74 MW

When broken down to individual plants, we can see that several younger plants recorded sub-optimal utilisation.

TABLE 6

Coal power plants located in Tamil Nadu showing age, tariff and utilisation for FY 2020

Plant *Tuticorin TPS* | *Units 1–5* Age *29, 30, 39, 41, 42* | 1050 MW Tariff *Rs. 4.58* Utilisation *55.90%*	Plant *Mettur TPS* | *Units 1–4* Age *31, 32, 34, 34* | 840 MW Tariff *Rs. 4.09* Utilisation *60.72%*	Plant *Mettur Expansion* | *Unit 1* Age *9* | 600 MW Tariff *Rs. 4.25* Utilisation *48.11%*
Plant *North Chennai TPS* | *Units 1–3* Age *25, 26, 27* | 630 MW Tariff *Rs. 2.77* Utilisation *59.53%*	Plant *North Chennai TPS Stage II Unit 1* | Age *8* | 600 MW Tariff *Rs. 5.28* Utilisation *46.01%*	Plant *North Chennai TPS Stage II Unit 2* | Age *8* | 600 MW Tariff *Rs. 5.28* Utilisation *61.47%*
Plant *NLC TS II Stage I* | *Units 1–3* Age *33, 34, 34* | 630 MW Tariff *Rs. 4.13* Utilisation *79.86%*	Plant *NLC TS II Stage II* | *Units 4–7* Age *30, 30, 29, 28* | 840 MW Tariff *** Utilisation *76.13%*	Plant *NLC TS Expansion I* | *Unit 1* Age *19* | 210 MW Tariff *Rs. 3.67* Utilisation *88.24%*
Plant *NLC TS Expansion I* | *Unit 2* Age *18* | 210 MW Tariff *Rs. 3.67* Utilisation *85.68%*	Plant *NLC TS Expansion II* | *Unit 1* | Age *9* | 250 MW Tariff *Rs. 3.8* Utilisation *37.37%*	Plant *NLC TS Expansion II* | *Unit 2* Age *6* | 250 MW Tariff *Rs. 3.8* Utilisation *34.21%*
Plant *NTPL (Tuticorin JV)* | *Unit 1* Age *6* | 500 MW Tariff *Rs. 4.0* Utilisation *62.77%*	Plant *NTPL (Tuticorin JV)* | *Unit 2* Age *6* | 500 MW Tariff *Rs. 4.0* Utilisation *43.59%*	Plant *NTPC Vallur* | *Unit 1* Age *8* | 500 MW Tariff *Rs. 3.75* Utilisation *45.28%*
Plant *NTPC Vallur* | *Unit 2* Age *7* | 500 MW Tariff *Rs. 3.75* Utilisation *41.93%*	Plant *NTPC Vallur* | *Unit 3* Age *7* | 500 MW Tariff *#* Utilisation *19.52%*	Plant *Neyveli New TPS* | *Unit 1* Age *1* | 500 MW Tariff *#* Utilisation *13.09%*

Plant *Neyveli Zero Lignite (STCMS)*
Unit 1 | Age *19* | 250 MW
—
Tariff *Rs. 3.44**
Utilisation *61.55%*

Plant *Tuticorin TPP (IBTPL)*
Unit 1 | Age *8* | 150 MW
—
Tariff #
Utilisation *0%*

Plant *Tuticorin TPP (IBTPL)*
Unit 2 | Age *8* | 150 MW
—
Tariff #
Utilisation *0%*

Plant *Cuddalore IL & FS* | *Unit 1*
Age *6* | 600 MW
—
Tariff *Rs. 5.47*
Utilisation *68.05%*

Plant *Cuddalore IL & FS* | *Unit 2*
Age *5* | 600 MW
—
Tariff *Rs. 5.47*
Utilisation *63.82%*

Plant *Muthiara TPP* | *Unit 1*
Age *7* | 600 MW
Tariff *Rs. 4.68*
Utilisation *42.61%*

Plant *Muthiara TPP* | *Unit 2*
Age *5* | 600 MW
—
Tariff *Rs. 4.68*
Utilisation *21.10%*

* Variable charge only– zero schedule in 2017 TNERC tariff order
# Not part of 2017 TNERC tariff order

The usual argument against the replacement of old coal power with variable renewable energy (viz, the need for grid balancing power sources) thus does not apply, given that Tamil Nadu's coal fleet has significant unutilised capacities that can be called upon if the need arises. There are similar unutilised capacities in neighbouring states as well. This provides the state of Tamil Nadu with the chance to retire older, less efficient and more polluting power plants. Given the significant surplus generation capacity in the system, keeping inefficient plants in service is not an optimal way to ensure grid stability.

An additional 7,385 MW of coal power is officially under construction across the state. Of this, 3,145 MW is likely to be completed within the next 12 months. Once commissioned, these plants will impose additional fixed costs for TANGEDCO (translating into higher average cost of power) while further depressing capacity factors across the rest of the state's coal fleet, barring a sudden increase in electricity demand.

Capacity sufficient to meet peak load and electricity demand growth

If the 3,150 MW of older coal plants identified in this report are retired by 2022, the total installed capacity of coal will remain largely unchanged, as there is another 3,145 MW of new coal expected to be commissioned within the next few months.

On an annual basis there is clearly surplus generation capacity available to Tamil Nadu. But the concern is around the availability of sufficient generation capacity at moments of peak load, and the likelihood of demand growth outstripping

the current situation of surplus in the near future. As Table 7 shows, even during peak load months for the last three years, there has been significant unused thermal generation capacity, with the PLFs of private generators in Tamil Nadu ranging between 41.4% and 53.4%, while that of central and state thermal plants has been between 73% and 81%. Clearly, while capacity factors at the central and state plants are higher than the annual average, there is still enough headroom for increased generation across all three categories, but most particularly with the private sector plants.

TABLE 7

Demand and Plant Load Factors in peak months

	Peak Month	Average Peak Demand (MW)*	PLF (Thermal, Peak Month)			
			State	Central	Private	Combined
FY 2018	April 2017	14,388	73.67%	81.37%	53.4%	72.3
FY 2019	March 2019	15,314	79.9%	72.03%	41.4%	67.61
FY 2020	Apr 2019	14,991	73.8%	55.36%	46.8%	72.3

* Average based on State Load Dispatch Centre data of daily peaks in the relevant peak demand month.

However, even the above data is averaged over a peak month. TN's highest ever peak demand, based on TNTRANSCO reports, was of 16,151 MW at 19:05 hours on April 3, 2019.[13] The state was able to meet this peak with zero load shedding and still had an unused coal and nuclear capacity (allocated to TNEB) of over 2,600 MW. Of this, unused TNEB thermal capacity itself was 860 MW.

Since FY 2018, the state's peak electricity demand has been growing at a CAGR of 2.87%, for an anticipated peak demand of 16,800 MW in FY 2021, according to the CEA.[14] This is significantly lower than past projections. For example, in 2016, TANGEDCO had projected to the TNERC that its demand would be 18,841 MW in FY 2020.[15]

While it is too early to tell how long lasting the impacts of the coronavirus slowdown on electricity demand will be, even if we assume energy demand growth returns to pre-Covid levels (~3%), the state will need 18,908 MW by FY 2025.

A supportive policy environment for new renewable energy will ensure future electricity demand is met at lower costs.

This additional demand can be met in several ways—ensuring higher utilisation levels of the operational fleet across all three sectors—state, central and private—is the easiest short-term solution to meet peak requirements. Looking further out, ensuring a supportive policy and investment environment for new renewable energy to grow, (including RE + storage) is essential, as renewable energy will be at significantly lower rates than existing coal power so long as there is a clear offtake agreement with TANGEDCO. Increased power purchase from the open market is a third option already in use by TANGEDCO, particularly given the progress that has been made on grid integration. In combination, these solutions can address apprehensions about having enough 'firm' power to meet peaking demand.

FACTOR 02»

Legal liability from failure to comply with air emission and other environmental norms

Coal power generation makes a significant contribution to India's air and water pollution problems. The Ministry of Environment, Forests & Climate Change requires air 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 cleaner air. The public and political pressure to tackle air

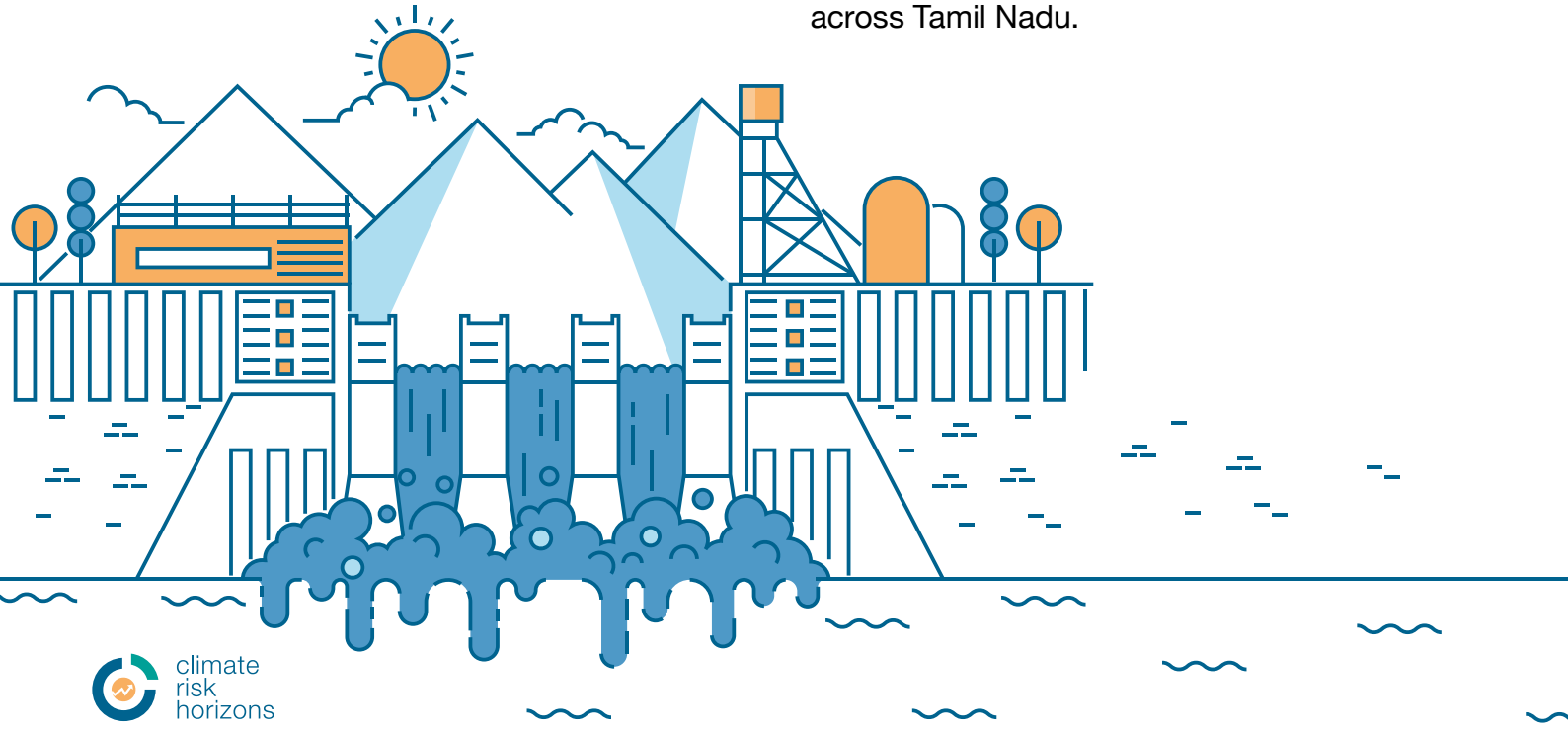
pollution is growing as pollution levels have once again risen to unhealthy levels with the lifting of Covid-19 restrictions. With public pressure growing, all coal power plants will have to install pollution control technologies, or face growing litigation, loss of social license and political pressure.

In the case of Tamil Nadu's old coal fleet, incurring an additional financial burden to install Pollution Control Technology is simply not economically wise. Given the financial condition of TANGEDCO, an accelerated phase out is the more economical choice. In addition to the air pollution regulations, Tamil Nadu's coal plants also face legal liability from ash pond leaks and other discharges, which are the subject of numerous legal proceedings.[16] Ash ponds and related pipeline infrastructure at the state's older plants have repeatedly failed.[17] Shutting down the older plants will prevent recurrences and allow the state to address the legal liabilities already created.

FACTOR 03»

Falling cost of renewable energy

New renewable energy (solar PV or wind) is now reliably available at less than ₹3/kWh, with a record low tariff of ₹1.99/kWh set in December 2020.[18] Even at a conservative ₹3/kWh, renewable energy is cheaper than a large segment of existing coal power generation and at 40–50% of the cost of new coal power. Recent bids for round the clock renewable energy (with storage) saw a combined tariff of ₹3.6[19]—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.[20] Even if further cost declines do not materialise, existing costs already question the competitiveness and financial viability of any new coal project. This brings into doubt the financial viability and economic desirability of the 6.7 GW of new coal plants under active construction across Tamil Nadu.



03 Data and methods

This report relies on the last publicly available generation tariff order (dated November 2017 FY 2017–2019) by the Tamil Nadu Electricity Regulatory Commission for data on total tariff, fixed costs and variable costs as well as scheduled electricity dispatch.[21]

The CEA's National Electricity Plan 2018[22] has three lists of plants that should be retired. These lists are 1) those considered for retirement by 2022, 2) those >25 years 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) shows stronger system-wide financial benefits.

The CEA has provided indicative estimates of FGD capex costs,[23] ranging from 30–45 lakh per MW, depending on unit size. 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.[24] 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 scheduled dispatch in the last available generation tariff order, we estimate likely net savings or loss per annum after replacing the lost generation from the plants being retired. Since the last generation tariff order is from November 2017 covering the period till FY 2019, there will be variance with actual tariff and dispatch figures, therefore total power purchase cost will vary. Such variations are typically minor.

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 at least 33% more expensive than alternatives available today. and overall economic outlook of the state.

This assumption is based on renewable energy and renewable energy+storage bids recorded over the last year. New solar/wind tariffs are uniformly in the ₹2.3–3/kWh, and solar + storage tariffs discovered in recent auctions range between ₹3.6–4.3.kWh. The solar/wind + storage tariffs can vary significantly depending on the size of storage and the specifics of the storage systems used. 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 + battery storage of about 40% by 2030.[25] The CEA also assumes a similar cost trajectory decline for battery energy storage systems by 2030.[26] Lawrence Berkeley National Laboratory estimates solar PV + Li-ion battery storage costs at ₹3.94 in 2020, falling to ₹3.32 by 2025.[27] 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 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 (September 2020).[28] The estimation of savings from avoided expenditure has been included in this analysis to give a system-wide perspective of possible savings. Since these are TANGEDCO plants, the ultimate burden of paying for under construction plants will fall on the state government and consumers.

We have also flagged probable additional benefits that might accrue from shutting down these plants, namely:

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

2. What is the water stress level of the district where the plant is located (based on the World Resource Institute's Aqueduct database)?

04 Findings

FINDING 1

Rs. 9,000 crores = Savings from retiring coal plants 20 years and older

Tamil Nadu can save approximately ₹9,000 crores over 5 years by shutting down coal plants that are over 20 years or older (Table 8). These savings will accrue in two ways:

1. Shutting down 3,150 MW of older, inefficient coal plants will save an estimated 1,670 crores in terms of avoided retrofit costs for Flue Gas Desulphurisers and Low NOx Burners, otherwise required by December 2022. 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.
2. If scheduled dispatch from these 3,150 MW of older plants were to be replaced with electricity from new renewables or from the power exchange there would be a further net savings of at least ₹1,459 cr. 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 ₹7,295 cr.

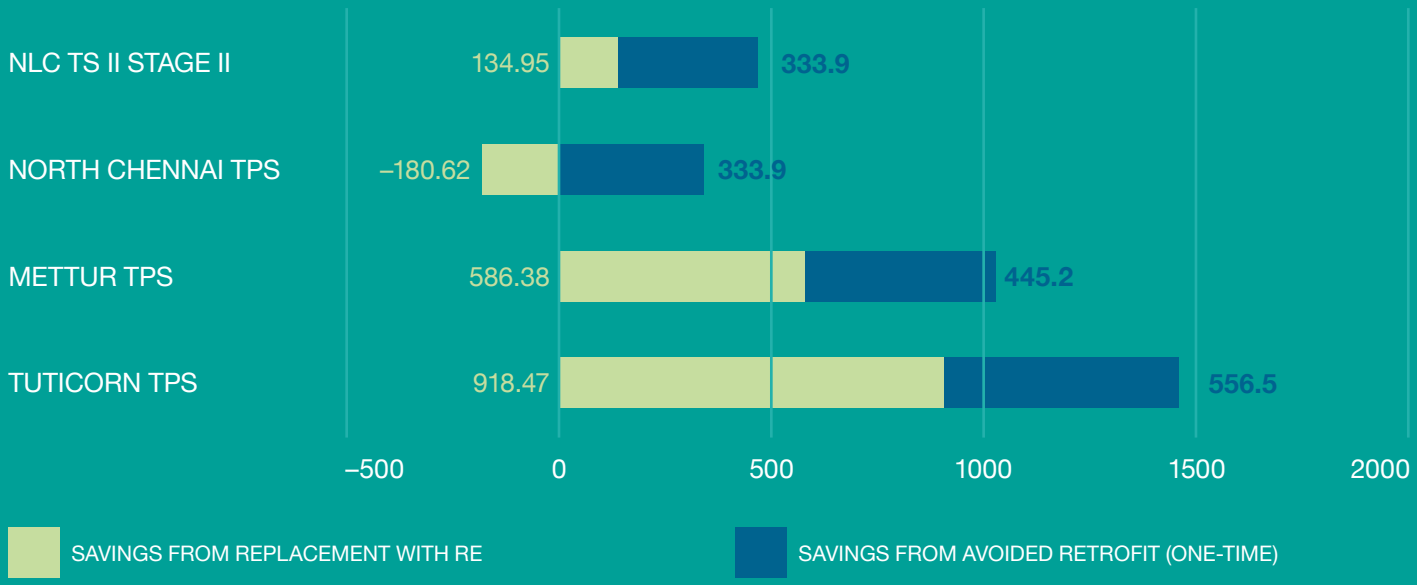
TABLE 8

Coal plants in Tamil Nadu 20 years or older that can be phased out with potential savings

Tamil Nadu				
1	**Power station** Tuticorin TPS	**Sector** State	**Age** 28–40	**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 avoided retrofit (one-time) ₹556.5 cr.		**Savings from replacement with RE** ₹918.47 cr. p.a.		
2	**Power station** Mettur TPS	**Sector** State	**Age** 29–32	**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 avoided retrofit (one-time) ₹445.2 cr.		**Savings from replacement with RE** ₹586.38 cr. p.a.		
3	**Power station** North Chennai TPS	**Sector** State	**Age** 32–35	**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 avoided retrofit (one-time) ₹333.9 cr.		**Savings from replacement with RE** ₹–180.62 cr. p.a.		
4	**Power station** NLC TS II Stage 1	**Sector** Centre	**Age** 31–32	**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 avoided retrofit (one-time) ₹333.9 cr.		**Savings from replacement with RE** ₹134.95 cr. p.a.		
TOTAL	**3,150 MW**	**Savings from avoided retrofit (one-time)** ₹1,669.5 cr. **Savings from replacement with RE** ₹1,459.18 cr. p.a./7,295 cr. (5 years)		

FIGURE 1

Savings from retiring old TPPs in Tamil Nadu; avoided retrofit cost and replacement of power with renewable energy (savings in Rs. cr)



Of these plants, the Tuticorin TPS has variable costs above ₹3/kWh—higher than any new renewable energy tariff. Retiring this plant and replacing its scheduled dispatch with renewable electricity at or below ₹3/kWh will yield a savings of at least ₹64 cr p.a., even if TANGEDCO continues to pay fixed costs for the plant. The variable costs for the other plants range between ₹2.18 and ₹2.97.

FINDING 2

Rs. 26,000 crores = Savings from pausing early stage projects under active construction

The surplus generation capacity in the state of Tamil Nadu has led to record low PLFs of 60% or less across the state's 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, the state government and project proponents continue to sink money into new projects under construction.

The CEA's September 2020 Broad Status Report lists 7.3 GW of projects officially under construction. Of this, the 660 MW Tuticorin Ind Barath project has been stalled for several years, and is unlikely to be revived as the project does not have a PPA.

There are 3,145 MW nearing completion and likely to be commissioned in the near future. These are the Neyveli New Unit 2 (500 MW), Tuticorin Stage IV Unit 1 (525 MW), the Ennore SCTP U1–2 (1320 MW) and the North Chennai Stage III (800 MW). Once commissioned, these plants will pose an additional fixed cost burden for state discoms while further depressing capacity factors across the coal fleet, barring a significant increase in electricity demand.

TABLE 9

Coal power plants nearing completion in Tamil Nadu

Plant	Promoter	MW	Expenditure incurred	Total Expenditure Projected
Neyveli New U2	Neyveli Lignite Corp.	500	7,615	7,080
Tuticorin St IV U1	SEPC Pvt Ltd	525	3,418	3,514
Ennore SCTP U1-2	TANGEDCO	1,320	4,142	9,800
North Chennai St III	TANGEDCO	800	5,689	6,376
Total		**3,145**		

Apart from this, there are an additional 3,580 MW of projects at an early stage of construction. These are all TANGEDCO projects and are unlikely to be commissioned for at least 3–4 years, by which time they will be neither required (due to the surplus generation capacity in the system) nor competitive with cleaner energy sources. These plants are destined to operate at very low capacity factors, perpetuating additional fixed cost burdens on TANGEDCO.

Freezing further expenditure on these 3,580 MW that are at early stages of construction would save ₹26,000 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 September 2020 is in Table 10.

TABLE 10

Savings from freezing expenditure on early stage projects under active construction in Tamil Nadu (in Rs. cr.)

Plant	Promoter	MW	Expenditure incurred	Total expenditure projected	Avoided expenditure if shelved
Ennore Exp.	TANGEDCO	660	791	5,421	4,630
Uppur Unit 1–2	TANGEDCO	1,600	2,977	12,778	9,801
Udangudi Unit 1–2	TANGEDCO	1,320	993	13,076	12,083
Total		**3,580**	**4,628**	**31,275**	**26,514**

FINDING 3

Rs. 30,000 crore = Savings over five years 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'/'Atmanirbhar' initiatives. In this context, it is instructive to assess what the savings potential of a longer-term programme to gradually replace the most expensive coal power with renewable energy could be in terms of lower power purchase costs to discoms and consumers. As mentioned earlier, recent tariffs discovered for solar and wind in India have been in the ₹2–3/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 + battery storage of about 40% by 2030.[30] The CEA also assumes a similar cost trajectory decline for battery energy storage systems by 2030.[31] 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 ₹3.0 or 3.5/kWh.

The long-term savings potential if Tamil Nadu gradually phased out power purchases from coal plants charging tariffs above ₹4/kWh and replaced that volume of electricity with renewable power at ₹3/kWh is obviously significant.

Such a massive change cannot be carried out rapidly but should be part of the long-term planning for the discom and state government in order to lower the cost of electricity and boost economic and social indicators.

Figure 2 below shows the current tariffs of Tamil Nadu's coal fleet, plotted against a benchmark RE + storage tariff of ₹3.0–4.0. Replacing all power purchased at ₹4.0 and above with new renewable energy at ₹3.0 (or less) will yield savings of ₹30,000 cr. over a 5-year period.

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, or (where all parties are government entities) early termination of the contract by mutual agreement, in order to tap into the savings that will be generated across the system. Contracts can also be reconfigured to reward flexible generation through a premium for peaking power supply, if the need arises.

FIGURE 2

Tariff comparison of all existing coal plants vs. new renewable energy

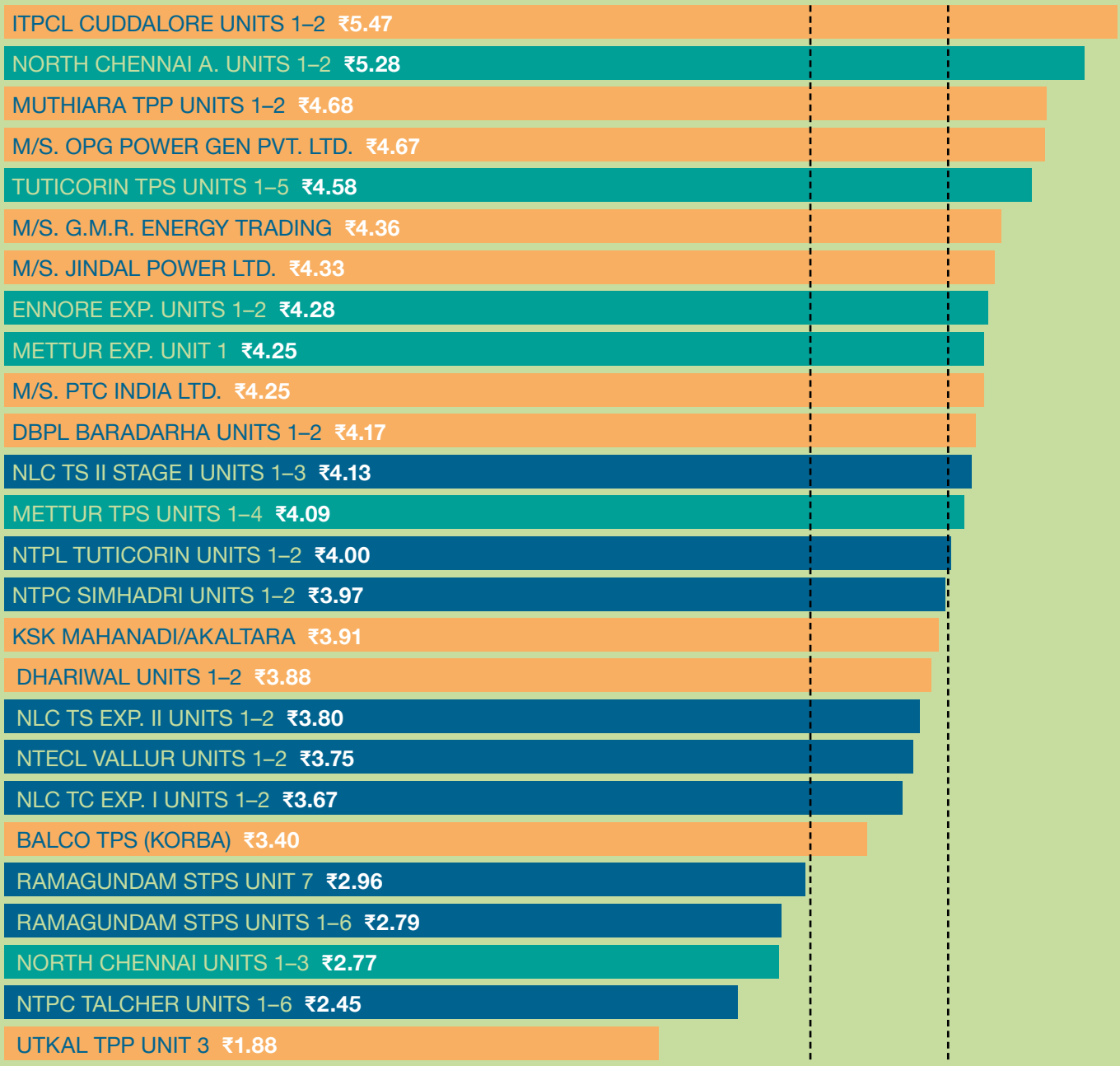


TABLE 11

Potential savings from replacement of all thermal power >Rs.4/kWh with RE at or below Rs. 3/kWh

Plant	Scheduled dispatch (MU) > 4/kWh	Total cost (cr.)	Estimated savings by replacing with RE = ₹3/kWh (annual, cr.)
ITPCL Cuddalore	3,867.24	2116.22	956.05
N. Chennai A U1–2	3,847.39	2,032.69	878.47
Muthiara U1–2	3,996.15	1,870.13	671.29
OPG Pvt. Ltd.	529.96	247.27	88.28
Tuticorin TPS U1–5	5,811.71	2,661.98	918.47
GMR Energy Trading	1,074.23	468.35	146.08
Jindal Power Ltd.	2,864.62	1239.96	380.57
Ennore Exp. U1–2	1,735.17	742.89	222.34
Mettur Exp. U1	4,039.76	1716.42	504.49
PTC India Ltd.	716.16	304.68	89.93
DBPL Baradhara U1–2	1,489.60	621.64	174.76
NLC II St. 1 U1–2	1,189.45	491.78	134.95
Mettur U1–4	5,386.35	2,202.28	586.38
Total	**39,176**	**17,850**	**6,097**

05 Conclusions

01»

Phasing out coal plants that are 20 years or older will provide immediate and significant savings to TANGEDCO 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 on the part of the state and centre.

03»

Halting further expenditure on coal plants that are in the early stages of construction is essential if the state is not to create a fresh round of Non Performing Assets, or lock TANGEDCO into expensive Power Purchase Agreements and fixed cost obligations.

04»

Short term pain incurred from these measures, (such as some lenders having to incur hair cuts on debt repayment or government owned generators having to shutter a plant earlier than expected) should be viewed against the significant savings that will accrue to to consumers across the system.

05»

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 other productive use, including repurposing for renewable electricity generation, energy storage or grid balancing.

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Climate Risk Horizons

16th Cross, № 40, off 8th Main Road,
Malleshwaram, Bengaluru Karnataka 560.055
Website www.climateriskhorizons.com
Email ashish.fernandes@climateriskhorizons.com
harshit.sharma@climateriskhorizons.com

Design Pallavi Baasri/pallavibaasri@gmail.com
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