climate risk horizons

West Bengal's energy transition: A ₹62,000 crore opportunity

Vishnu Teja, Ashish Fernandes

West Bengal's Energy Transition: *A ₹62,000 CR. Opportunity*

Authors

Vishnu Teja, *Energy Researcher*
Email: *vishnu.teja@climateriskhorizons.com*

Ashish Fernandes, *CEO & Lead Analyst*
Email: *ashish.fernandes@climateriskhorizons.com*

Suggested citation

Vishnu Teja and Ashish Fernandes. *West Bengal's Energy Transition:* A ₹62,000 CR. Opportunity. Climate Risk Horizons. March 2024.

—

Images: All images are from AdobeStock.com, unless otherwise mentioned

Design: Pallavi Baasri, *pallavibaasri@gmail.com*

About

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.

Learn more about us at *climateriskhorizons.com*

Registered address

Climate Risk Horizons
4th Floor, Umiya Emporium, Opp. Forum Mall,
Hosur Main Road, Koramangala, Bengaluru 560 029,
Karnataka, INDIA

Table of contents

1.0 List of abbreviations

₹/INR	Indian National Rupee
AP	Andhra Pradesh
BESS	Battery Energy Storage System
CAGR	Compound Annual Growth Rate
CEA	Central Electricity Authority
CGS	Central Generating Stations
CR.	Crore
CRH	Climate Risk Horizons
CUF	Capacity Utilisation Factor
DISCOMS	(Electricity) Distribution Companies
DSTPS	Damodaram Sanjeevaiah Thermal Power Station
DVC	Damodar Valley Corporation
EB	Electricity Board
FGD	Flue Gas Desulphuriser
FY	Financial Year
GW	Gigawatt
IRENA	International Renewable Energy Agency
KUSUM	Kisan Urja Suraksha Evam Utthaan Mahabhiyan
kW	Kilowatt
kWh	Kilowatt Hour
LCoE	Levelised Cost of Electricity
MoEF	Ministry of Environment, Forest, and Climate Change

MU	Million Units
MT	Million Tonne
MW	Megawatt
MWh	Megawatt Hour
MWp	Megawatt Potential
NIT	Notice Inviting Tenders
NTPC	National Thermal Power Corporation
PAT	Profit After Tax
PIB	Press Information Bureau
PLF	Plant Load Factor
PPA	Power Purchase Agreement
PSH	Pumped Storage Hydropower
PSP	Pumped Storage Project
PV	Photovoltaic (Solar)
RE	Renewable Energy
RTPS	Raghunathpur Thermal Power Station
TPP	Thermal Power Plant
TPS	Thermal Power Station
TPTCL	Tata Power Trading Company Limited
WB	West Bengal
WBSEDCL	West Bengal State Electricity Distribution Company Limited
WBSETCL	West Bengal State Electricity Transmission Company Limited

2.0 Figures and tables

List of figures

List of tables

3.0 Executive summary

Historically, West Bengal was closely linked to the Indian coal sector as it was home to the country's first commercial colliery at Raniganj, set up in 1774.[1] The state has some of the oldest coal mines in the country, and is significantly dependent on coal mining and coal-fired power for employment, revenue and electricity supply. Given the energy changes underway across India and globally, what are the opportunities and challenges facing the state? What do the unprecedented cost declines in renewable energy and similar expected declines in electricity storage costs mean for a state that is so dependent on coal for its power? Is there a way to leverage these cost declines for the state's benefit, without undermining other welfare goals such as employment? These are some of the issues this analysis attempts to address.

West Bengal today has a significant fleet of coal power plants, 4,945 MW across 33 units that are over 20 years old. Of these, 22 units (2,178 MW) are over 30 years old. Of the 20+ age cohort, 2,505 MW is state-owned. These old plants are less efficient and several require costly maintenance and upgrades.

West Bengal, like most other Indian states, also faces a significant air pollution burden, in which coal emissions play a major role. Reining in these emissions requires the installation of Flue Gas Desulphurisers, per the notification of the Ministry of Environment, Forests and Climate Change, at a significant capex. The option to pay fines for non-compliance has repeatedly delayed and weakened FGD installation nationwide.

Thus far, West Bengal has largely played spectator to the rapid rise of renewable energy across the rest of India. West Bengal currently has less than 200 MW of solar and wind, even as the average tariff for renewable energy has now fallen to less than ₹3/kWh, and in some cases closer to ₹2/kWh. With the costs of coal-fired electricity rising, this analysis suggests that West Bengal's neglect of renewable energy could be a major missed opportunity, one that if corrected can deliver financial benefits for the state's coffers and electricity consumers.

Careful planning and judicious investments will allow for the retirement of older, more expensive coal plants and deliver a net reduction in power purchase costs, resulting in long term financial benefits both for DISCOMs and the state government.

A convergence of factors today allows for win-win solutions that can deliver beneficial outcomes on several fronts: reducing the cost of power purchase (resulting in a reduced subsidy burden on the state government), reducing air pollution and allowing the state to attract the renewable energy industry.

West Bengal is in a position to phase out its older coal plants over the next two to five years, and replace scheduled dispatch from these plants with power from new renewable energy. This will result in a net saving to the state.

These savings accrue on account of replacing higher cost power from older coal plants with cheaper options, as well as avoiding capex for lifetime extension and retrofits that are otherwise needed to ensure compliance with air pollution laws if the plants are to continue operating beyond 2025. In the absence of retrofits, these plants are liable for financial penalties.

Over the coming decade, the state can also examine the potential financial benefits of continuing to phase down its use of coal power and gradually replace it with cheaper, cleaner options. This analysis also enumerates the potential savings from such a longer term project to phase out the most expensive coal power plants, irrespective of age.

Key findings

01»

All state and centre-owned TPPs in West Bengal require FGD retrofits. Per CEA estimates, this would amount to a total cost of at least **₹4,000 CR.** Of this, **₹2,252 CR.** would be the cost for FGD retrofits on plants that are already over 20 years of age.

02»

Substituting the purchase of higher cost power from centrally-owned TPPs with lower cost renewable energy can save up to **₹318 CR.** annually.

03»

Replacing generation from state-owned TPPs that are either older than 20 years or operating at a cost higher than **₹3/kWh** can save about **₹945 CR.** annually.

04»

If the TPPs (state and centre-owned) are not retrofitted to meet air pollution norms, they will need to pay penalties for every unit of electricity generated. Over a decade (2023–32), these penalties could amount to as much as **₹2,047 CR.** based on current utilisation levels.

05»

Halting development of four new thermal units could free up a total budget of **₹24,919 CR.** that could be invested in renewable energy, storage and grid strengthening.

06»

Electrifying irrigation pumps (for rice cultivation alone) with PV solar can save **₹2,072 CR.** annually by way of reduced thermal power demand.

07»

Cumulatively, CRH estimates that diversifying West Bengal's energy mix through a combination of judicious phase outs of old and expensive coal, an end to new coal plant construction and a boosting of renewable energy, could save West Bengal **₹62,193 CR.** over a ten-year period.

Table 1 West Bengal's energy transition–financial benefits		
Avoided FGD retrofit costs by retiring state-owned coal units over 20 years old	One-time	₹760 CR.
Savings from replacing thermal generation from centre-owned TPPs with unit costs higher than ₹4/kWh, with RE @₹2.7/kWh	10 years	₹3,182 CR.
Savings from replacing thermal generation from all state-owned TPPs, with RE at ₹2.7/kWh	10 years	₹9,450 CR.
Avoided penalties for emission non-compliance	10 years	₹2,047 CR.
Halting life extension for Kolaghat units 3 and 5	One-time	₹1,115 CR.
Halting new TPP development	One-time	₹24,919 CR.
Electrifying irrigation pumps with Solar PV for rice cultivation	10 years	₹20,720 CR.
Total savings (over 10 years)		**₹62,193 CR.**

This analysis suggests a suite of options and the potential savings that could accrue from each. It does not suggest a complete phase out of all coal fired power in the near term, as this is not feasible. However, through a mix of retiring old coal plants and boosting new renewables, there is significant opportunity to reduce West Bengal's dependence on coal and increase the diversity of its energy mix, at a net financial benefit to the state. The potential benefits could, in fact, be quite massive, unlocking resources that could be used

4.0 Background

Since FY 2016–17, electricity demand in West Bengal has been increasing at a CAGR of 4.51%.[2]
FY 2020–21 saw a fall in demand by 2.4% compared to the previous year, due to the COVID-19 pandemic. However, as per the latest report available on WBSETCL's website,[3] the demand has increased in 2021–22 by 7.4% compared to the previous year. As per PIB's latest report,[4] the electricity demand during the period April 2022 and February 2023 is around 55,133 MU.

Figure 1 Energy demand—state and central reports (in MU)

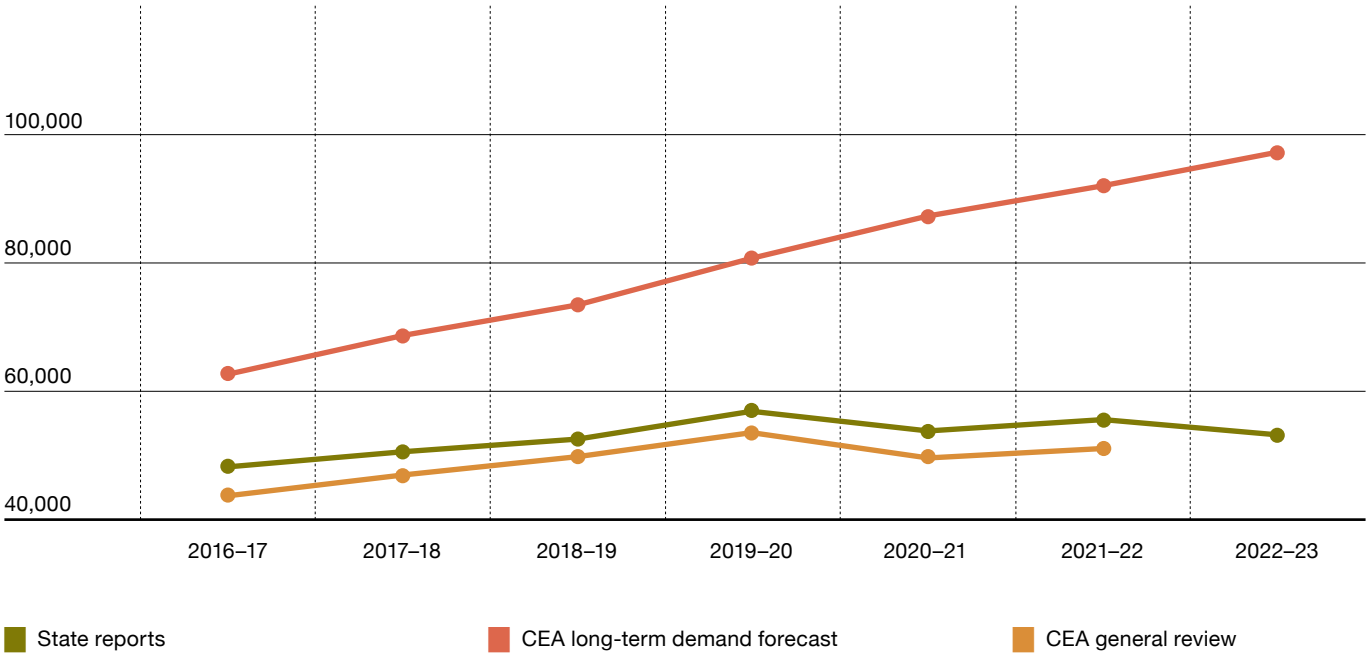
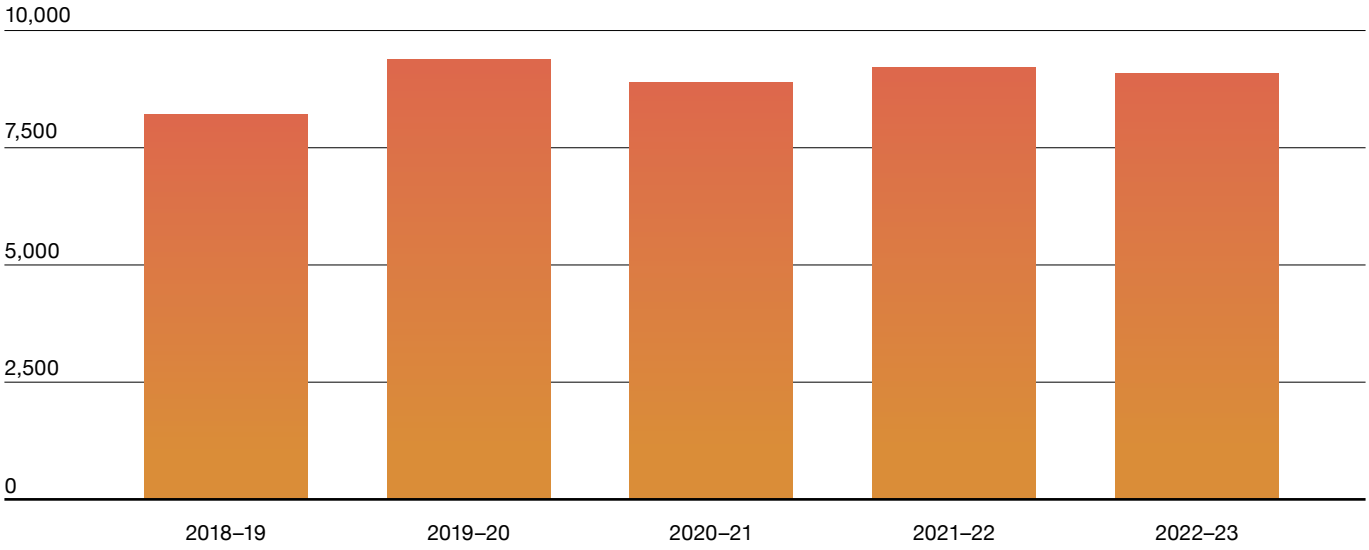


Figure 2 Peak demand in West Bengal (in MW)



About 38% of the thermal capacity in West Bengal, amounting to a total of 5,425 MW, is over 20 years old, and about 15% of the total thermal capacity is over 30 years old. Of the 4,945 MW of capacity that is older than 20 years old, 2,505 MW capacity is state-owned. Overall, the TPPs in WB are running at relatively high PLFs–TPPs under all three sectors had a higher PLF in 2022–23, in comparison to the previous year.

An assessment conducted in 2021 by the Centre for Science and Environment (CSE) shows that West Bengal tops the list of states buying coal-based power. 84% of the power plants that provide electricity to the state are far from meeting SO2 emission norms. More than 98% of West Bengal's electricity comes from coal power plants, highlighting the need to diversify the state's electricity mix.

Table 2 Plant Load Factors of TPPs in West Bengal[5]

Ownership	2022–23	2021–22
State	82.02%	70.04%
Private	68.01%	62.65%
Central	68.75%	67.75%

There is a disparity between the CEA's long-term electricity demand forecast[6] (released in 2016–17) and the actual electricity demand in West Bengal. This disparity can be attributed to CEA's optimistic assumptions, and is usually observed across all states. However, in the case of WB, the disparity is glaring. The long term demand report (released in 2017) forecast a total demand of around 96,962 MU in 2022–23, whereas the actual demand is lower than the forecast by 38%.

Figure 3 Age of West Bengal's thermal capacity

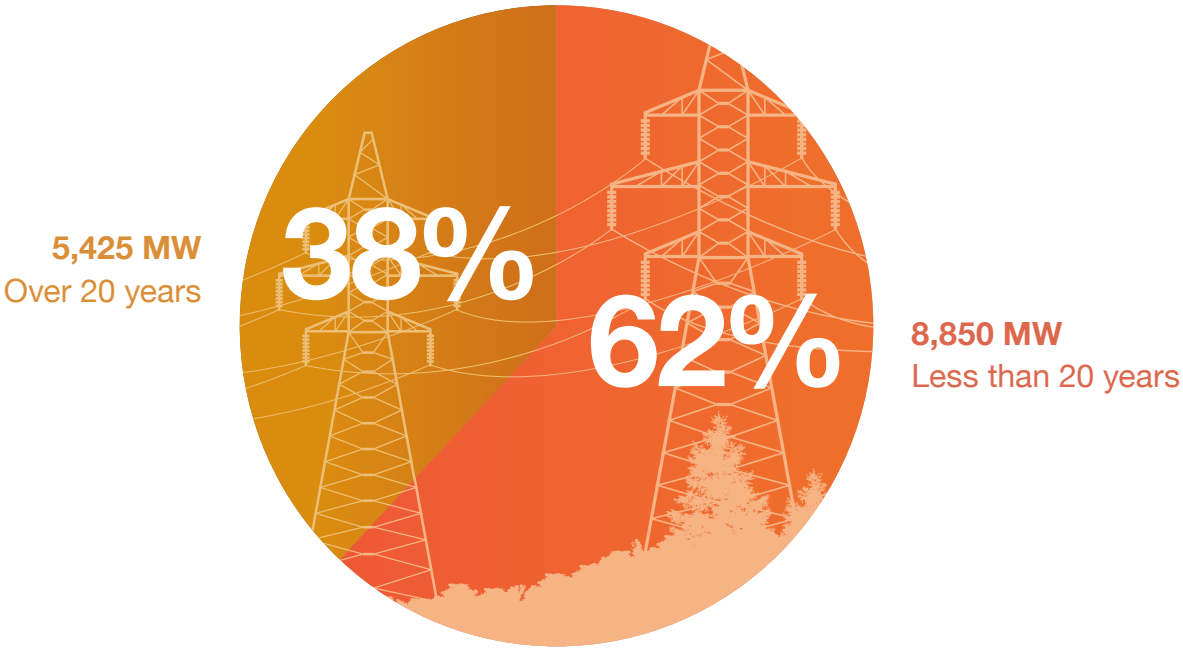
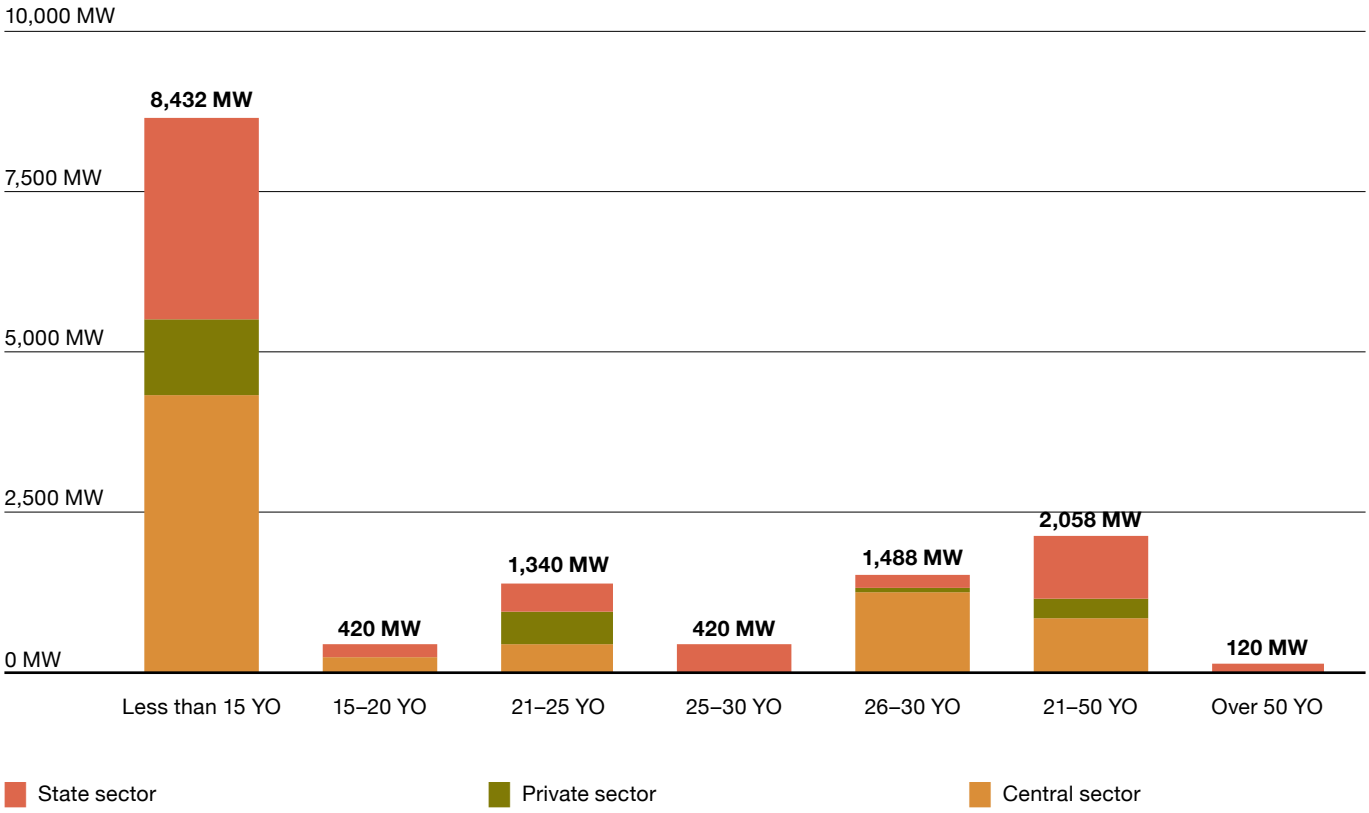


Figure 4 Age of West Bengal's TPP capacity



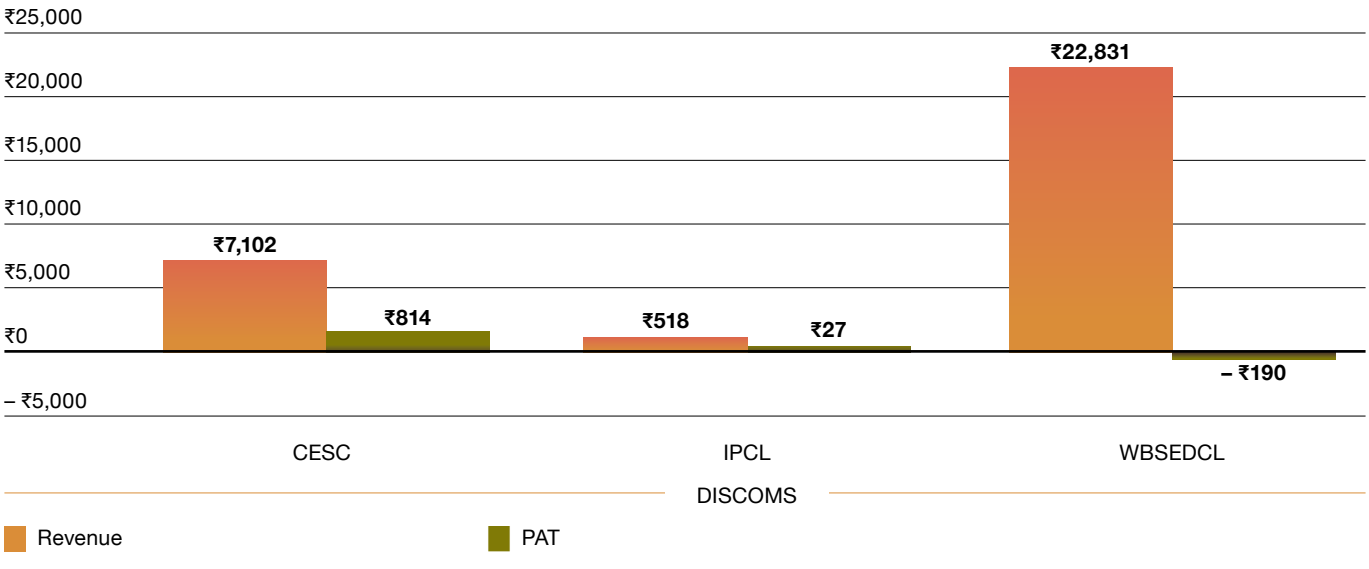
Performance of West Bengal's DISCOMs

By Pinakpani–Own work, CC BY-SA 4.0, Wikimedia

West Bengal has three distribution companies—West Bengal State Electricity Distribution Company Limited (WBSEDCL), Calcutta Electric Supply Corporation Limited (CESC), and Indian Power Corporation Limited (IPCL).

While WBSEDCL takes care of the majority of West Bengal's electricity distribution, both CESC and IPCL manage relatively smaller chunks. As per the 10th Annual Integrated Ratings and Ranking report (2022),[7] all the three DISCOMs are performing reasonably well. While IPCL and CESC were ranked 10th and 15th respectively among 52 DISCOMs in India, WBSEDCL was ranked 28th. While WBSEDCL has a negative PAT of ₹190 CR. in FY 2022, the other two are positive.

Figure 5 Revenue and PAT of West Bengal DISCOMs in 2021–22 (₹ CR.)



Increase in generation capacity

West Bengal is planning on expanding its thermal power capacity by about 2,900 MW.[8,9]

- Sagardighi TPP is extending its Phase III by adding a super critical thermal power unit (unit 5) with a capacity of 660 MW.
- Santaldih TPP is planning to extend its phase III by adding two super critical thermal power units (units 7 and 8), each with a capacity of 800 MW.
- Bakreshwar TPP is planning on extending its Phase III by adding a super critical thermal power unit (unit 6) with a capacity of 660 MW.

According to the Broad Status Report[10] by CEA, Sagardighi TPP extension is the only ongoing project. As per the latest cost projections done in October 2023, the project has progressed over 37%.

Table 3 Sagardighi TPP Extension	
Capacity	660 MW
Original cost estimate	₹3,862.65 CR.
Current cost estimate	₹4,567.32 CR.
Expenditure up to end of August 2023	₹1,715 CR.
Anticipated trial run	2025 January
% Completion[11]	**37%**

Total cost of the rest of the projects can be estimated by comparing them with similar projects. Santaldih extension can be compared with the 800 MW supercritical thermal plants that are under construction in Andhra Pradesh. The 800 MW unit of DSTPS (Krishnapatnam, Andhra Pradesh), which was completed in April 2023, had a total expenditure of ₹8,750 CR.

Bakreshwar TPP extension can be compared to the Sagardighi TPP extension project as they are both of the same capacity. This puts the total expected cost of expanding the thermal capacity in West Bengal at around ₹26,634 CR.

Table 4 Cost estimations of ongoing TPP development			
Planned project	**Estimated cost**	**Total expenditure (so far)**	**Source**
Sagardighi Unit 5	₹4,567 CR.	₹1,715 CR.	Broad Status Report by CEA
Santaldih Units 7 and 8	₹17,500 CR.	N/A	Comparison with similar project in AP
Bakreshwar Unit 6	₹4,567 CR.	N/A	Comparison with Sagardighi Unit 5
Total estimated cost	**₹26,634 .CR**		

Hydro power expansion

Most of West Bengal's current hydro power capacity projects are small/mini hydel projects ranging from 4 MW to 100 MW. These projects, if realised, will add around 385 MW to the existing hydro power capacity of the state.

West Bengal is also in the early stages of planning two pumped storage projects (PSPs) to increase its energy storage capacity by 1,900 MW. The Turga PSP is planned to have a peak storage capacity of 1,000 MW. The Bandu PSP is planned for 900 MW peak storage capacity, and is in the initial stages of planning. WBSEDCL plans to use these PSPs for storing energy generated from renewable sources.[12]

Cost declines in 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.[13] IRENA estimates LCOE of solar PV at ₹2.44/kWh, and onshore wind at ₹2.37/kWh.[14] This analysis assumes a more conservative average tariff of ₹2.7/kWh. At this level, renewable energy is cheaper than a large segment of existing coal power generation and less than 50% of the cost of new coal power.

Recent bids for round-the-clock renewable energy (with storage) saw a combined tariff ranging ₹3.9 to ₹4.27[15]—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 ₹3.32 by 2025 and ₹2.83 by 2030.[16] The winning bid for SECI's 400 MW round-the-clock renewable tender was as low as ₹2.9/kWh.[17] This analysis assumes an average tariff of ₹3.6/kWh for RE+Storage. Even if predicted cost declines do not materialise, existing costs already question the competitiveness and financial viability of any new coal project.

As of August 2023, West Bengal had a total RE capacity of 636 MW (excluding large hydro), of which only 194 MW is Solar PV and no Wind capacity.[18] West Bengal's share of India's 175 GW/2022 target is 5.3 GW in Solar and 50 MW in PSH.[19] So far, West Bengal has achieved less than 4% of this target. In FY 2021–22, West Bengal floated tenders to develop around 250 MW of solar PV.

By Shankar S., CC BY 4.0, Wikimedia

The cumulative energy generation from solar PV projects (in FY 2019–20 and FY 2020–21) located at various places in West Bengal,[20] seem to indicate an annual average CUF of about 15.4%. If WB achieves its target of 5.3 GW solar PV capacity, that would translate into an average electricity production of 19.6 MU per day, or about 7,150 MU per year, covering around 13% of WB's yearly electricity demand (2022–23). It is possible that actual CUF might be higher, given the advances in solar PV efficiency.

In 2018, the West Bengal government said[21] that it would not prioritise achieving the 2022 solar target as it lacks the land area required to develop high capacity solar parks, and that rooftop solar via net metering would disrupt the tariff structure of the distribution companies. However, in 2021, the state took a decision to allow net-metering for grid-connected rooftop PV with a minimum capacity of 1 kW.[22] This is expected to make grid-connected rooftop PV more financially attractive for households.

5.0 Findings

Switching to RE

Replacing costly coal generation (greater than ₹3/kWh)

Kolaghat, Bandel Stage I and II, Bakreshwar (units 4 and 5), Sagardighi Stage II, and Santaldih TPPs operate at a cost higher than ₹3/kWh, 11% more costly than the current RE tariff of ₹2.7/kWh. These TPPs are planned to account for a combined share of 83% of the generation from state-owned TPPs. Replacing the generation from these TPPs with RE at ₹2.7/kWh can bring in a yearly savings of ₹1162 CR.

Replacing TPPs older than 20 years

All units of Bandel TPS are over 30 years old. Four out of six units of Kolaghat are over 30 years old; the remaining two units are over 28 years old. Bakreswar TPS has three units that are older than 20 years. These units are responsible for generating a combined 8,125 MU. Except for Bakreshwar, both Bandel and Kolaghat are operating at a cost higher than ₹2.7/kWh. Given the age and higher unit cost (in comparison to RE at ₹2.7/kWh), these TPPs have high potential for savings. Replacing all the state-owned units that are older than 20 years with RE would increase power costs marginally, by ₹22 CR. This would however be offset by savings on FGDs and life extension costs, which are discussed below.

Replacing all thermal generation with RE

Except for Bakreshwar (units 1, 2, 3), the rest of the state-owned TPPs in WB have tariffs higher than ₹2.7/kWh.[23] Given that the tariff of renewable energy has gone down to ₹2.7/kWh or lower, switching generation sources can lead to savings. Assuming energy dispatch levels of FY 2022–23, hypothetical savings for the period 2022–2032 would amount to about ₹9,450 CR However, this hypothetical amount would be reduced by the need to have some generation met by a mix of RE+storage, which is currently available at between ₹3.5/kWh to ₹4.27/kWh.[24]

Table 5 Yearly savings by shifting to RE @ ₹2.7/kWh[25]

TPP	Dispatch (MU)	Unit cost (₹/kWh)	RE unit cost (₹/kWh)	Savings (₹ CR.)
Bakreshwar (1, 2, 3)	4,018	2.15	2.7	–219.85
Bakreshwar (4, 5)	2,678	4.41	2.7	458.01
Kolaghat	2,515	3.13	2.7	108.33
Bandel I	221	3.55	2.7	18.78
Bandel II	1,371	3.22	2.7	70.70
Santaldih	3,189	3.26	2.7	180.1
Sagardighi I	3,826	2.71	2.7	2.97
Sagardighi II	6,604	3.19	2.7	326.95
Total savings				**944.99**

Along with the savings incurred from shifting to RE @ ₹2.7/kWh and some quantum of RE+storage @ ₹3.5/kWh, there will be further cost savings in the form of avoided retrofits and life extension costs.

Reconsidering PPAs with centre-owned TPPs

Around 21.7% of West Bengal's demand is met by centre-owned TPPs. While Farakka TPS, Darlipali and TPTCL provide about 79% of the demand met by centre-owned TPPs, the rest of the TPPs provide between 300 MU and 700 MU each. The generation costs of most of these centre-owned TPPs is less than ₹4/kWh, however there are few TPPs that have higher generation costs than ₹4/kWh.

The Farakka TPS Stage III, Kanti Bijlee, DVC RTPS, and DVC Mejia V have generation costs higher than ₹4/kWh. Except for Farakka TPS Stage III, these TPPs, individually, cater to less than 3% of the demand met by centre-owned TPPs. WB should reconsider the PPAs with these TPPs. For instance, Kanti Bijlee has a variable cost of ₹2.6/kWh. Kanti Bijlee also has very high fixed costs. Even though Kanti Bijlee's scheduled dispatch is just about 7% of Farakka TPP's scheduled dispatch, its fixed cost is around 23% of the fixed cost of Farakka TPS. On an average, each unit bought from these four TPPs costs about ₹4.32/kWh.

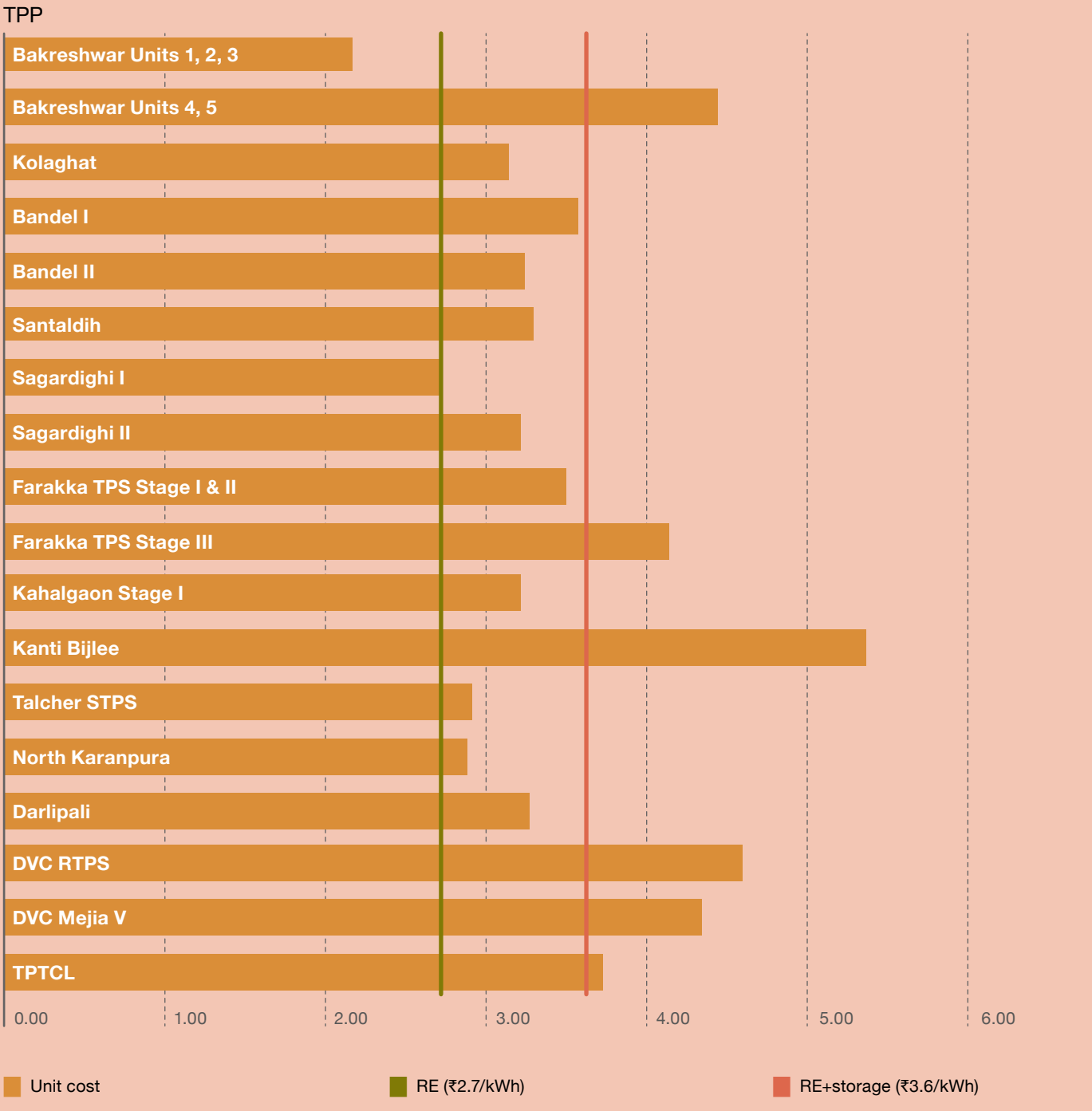
As the share of electricity generated by these TPPs is very low, shifting to cheaper TPPs or to much cheaper RE (@ ₹2.7/kWh) should be given due consideration.

Table 6 Centre-owned TPPs dispatch and cost

TPP name	Dispatch (MU)	Variable cost (₹/kWh)	Fixed cost (₹ Lakh)	Total cost (₹/kWh)
Farakka TPS Stage I and II	3,546	2.64	29,485.37	3.47
Farakka TPS Stage III	1,248	2.59	18,788.04	4.10
Kahalgaon Stage I	345	2.13	3,664.04	3.19
Kanti Bijlee	255	2.60	6,924.44	5.32
Talcher STPS	637	1.91	6,207.59	2.89
North Karanpura	691	1.17	1,1761.05	2.87
Darlipali	2,050	1.12	43,376.23	3.24
DVC RTPS	120	2.93	1,982.44	4.58
DVC Mejia V	339	2.91	4,737.78	4.31
TPTCL	2,105	2.22	31,019.29	3.70

Savings from replacing costly PPAs with centre-owned TPPs		
Scenario	**Savings (₹ CR.) (RE @ ₹2.7/kWh)**	**Savings (₹ CR.) (RE @ ₹3.6/kWh)**
Including Farakka TPS Stage III	318.18	141.59
Excluding Farakka TPS Stage III	143.77	79.51

Figure 6 Unit cost, RE and RE+Storage (₹/kWh)



Retrofits and extensions

With a large fleet of old thermal power plants, both state-owned and centre-owned, West Bengal has a huge task at hand. All these TPPs are to be retrofitted to stay compliant with the emissions norms. 16 units of state-owned TPPs with a total capacity of 4,400 MW, and 12 units of centre-owned TPPs with a total capacity of 4,500 MW require FGD retrofits. Most of these retrofit projects are in the NIT or bidding phase.[26] CEA estimates the cost of retrofitting to be around ₹0.45 CR./MW. The total expenditure would thus amount to about ₹4,005 CR. Of this, the FGD retrofits at units over 20 years of age (state- and centre-owned) would be about ₹2,252 CR. State-owned units alone would require about ₹760 CR. for retrofits. In addition to these costs, life extension costs of the Kolaghat TPP (Units 3 and 5) is estimated to be around ₹1,115 CR.[27] This makes the total cost of retrofits for units over 20 years of age and planned life extensions ₹3,367 CR.

Penalties: ₹2,000 CR. burden to the government

Of the five state-owned TPPs that are contracted to dispatch a total of 24,422 MU, four stations fall in Category C while one station falls in Category A.[28] None of these TPPs are in compliance with the emission norms and all require FGD retrofitting. If the retrofitting is delayed beyond 2024, the TPPs must pay penalties. Assuming energy dispatch levels of FY 2022–23, the total payable penalty can be as high as ₹2,047 CR. by 2032.

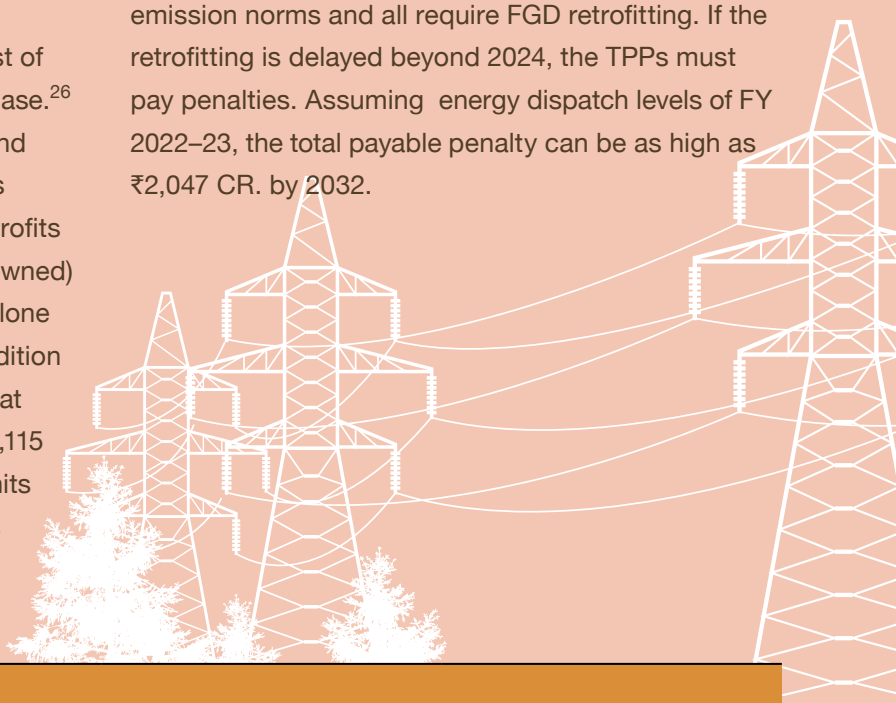


Table 7 Payable penalties (2023–32)

TPP name	Category	Dispatch (MU/year)	Penalty (₹ CR.)
Bakreshwar	C	6,696	510.6
Kolaghat	C	2,515	191.8
Bandel I	A	221	42.5
Bandel II	A	1371	263.9
Santaldih	C	3,189	243.2
Sagardighi I	C	3,826	291.7
Sagardighi II	C	6,604	503.6
Total payable penalty (₹ CR.)			**2,047.3**

Agri solar: annual savings potential of ₹2,000 CR.

West Bengal is the top producer of rice and jute[29] in India. WB produced 16.65 MT of rice in FY 2020–21, contributing over 13.6% of India's cumulative rice production.[30] The state also produced 7.61 million bales[31] of jute, equivalent to 1,370 MT, contributing close to 80% of India's total jute production.[32] Though rice and jute are water intensive crops, majority of the production is rainfed. However, due to climatic changes, many areas in which these crops are produced are facing a rainfall deficit. According to research conducted by Dr. D. K. Kundu, this deficit could go as high as 50%.[33] This deficit must be met with irrigation to maintain or increase production levels.

Electrifying irrigation pumps with decentralised PV can yield savings while maintaining steady production rates. While West Bengal has not been allotted any capacity or pumps under Component A of KUSUM, it has been sanctioned 10,000 standalone pumps under Component B, and 23,700 grid-connected agriculture pumps under Component C of KUSUM program. Less than 1% of the installations were completed as of September 2023.

Table 8 PM KUSUM

Component	Allocated no. of pumps	Installed no. of pumps
A	0	0
B	10,000	0
C	23,700	20

About 5.12 million hectares of land is being used for cultivating rice in West Bengal.[34] While only 27% of Aman rice requires irrigation, Boro rice is cultivated in the summer and is wholly irrigation dependent. While the estimated average annual energy use per hectare of groundwater irrigated area has been found to be as high as 6,997 units,[35] we can assume a much more moderate consumption of 3,000 units/hectare/annum. Based on these estimates, a minimum of 6,907 MU of electricity is consumed (annually) for the sole purpose of rice irrigation.

Table 9 Rice cultivation data	
Total area under rice cultivation	5.12 million hectares
Average energy consumption	3,000 units/hectare/annum

Table 10 Electricity requirement estimations

Crop	Area share	Cultivated area (million hectares)	Share of irrigated area	Area irrigated (million hectares)	Electricity required for irrigation (MU)
Aman crop	68.65%	3.51	27%	0.95	2,847
Boro crop	26.43%	1.35	100%	1.35	4,060
Minimum electricity required for irrigation (MU)					**6,907**

With the annual demand of 60,000 MU,[36] rice irrigation consumes over 11% of the state's demand. West Bengal's average cost of electricity generation is around ₹3/kWh.[37] If this entire demand is fulfilled by solar pumps, it can save around ₹2,072 CR. annually.

Repurposing old coal plant assets

West Bengal recently decided to shutdown some of its old TPPs. The state government ordered the closure/ decommissioning of unit 1 Bandel TPS (60 MW), and units 1 and 2 Kolaghat TPS (420 MW). Between January 2022 and March 2022, these TPPs have been decommissioned. Demolishing these TPPs can free up land that the state government can repurpose to develop solar PV with BESS (Battery Energy Storage System), which can further support the development of renewable energy. Any clean energy project developed at these sites would enjoy pre-existing benefits such as land availability and grid connections, lowering costs significantly. This warrants further detailed analysis to assess costs and benefits, investment required and potential returns on a site specific basis. Preliminary analysis of old coal power plants in Maharashtra and Tamil Nadu suggests that this could yield significant financial benefits.[38,39]

Retiring and repurposing Kolaghat TPS: Kolaghat units 1 and 2 are already decommissioned and scheduled for demolition; WB should consider retiring the rest of the three units too. Unit 3 is over 37 years old, unit 4 is over 28 years old, and unit 5 is over 30 years old. Though Kolaghat had a PLF of 55% in 2022–23, in the preceding two years its PLF was very low, (38.70% in 2021–22 and 16.03% in 2020–21). The state is planning to extend the life of units 3 and 5, at an expected cost of around ₹1,115 CR. It would be in the best interest of the state to halt the life extension process and consider decommissioning the entire TPP, repurposing the land area for PV Solar with BESS, and, if feasible, the turbogenerator as a synchronous condenser.

Table 11 Kolaghat thermal units

Unit	Capacity (MW)	Year Commissioned	Age (years)
Kolaghat TPS unit 1*	210	1990	31
Kolaghat TPS unit 2*	210	1985	36
Kolaghat TPS unit 3	210	1984	37
Kolaghat TPS unit 4	210	1993	28
Kolaghat TPS unit 5	210	1991	30
Kolaghat TPS unit 6	210	1993	28

* Decommissioned

By Biswarup Ganguly, CC BY 4.0, Wikimedia

Kolaghat's current share of generation can be transferred to TPPs which operate at a lower cost. Based on the particular units chosen to replace the generation from Kolaghat TPS, this can save West Bengal anywhere between ₹105 CR. to ₹246 CR. We have assumed an average of ₹175 CR. Assuming that the development of the solar PV plant with storage takes about three years, this would save around ₹525 CR. over the period of these three years.

To estimate the direct decommissioning costs of Kolaghat TPS, we can compare it with the Tuticorin TPS (Tamil Nadu), which has 5 units with a total capacity of 1,050 MW. Based on CRH's analysis of Tuticorin,[40] we estimate these costs to be about ₹380 CR.

Table 12 Savings from retiring Kolaghat TPP

	Savings one-time (₹ CR.)	Savings yearly (₹ CR.)
Savings from switching to cheaper TPP		175
Savings from halting life time extension	1,115	
Avoided retrofit costs	378	
Decommission costs	–380	

Estimating overall benefits of repurposing is difficult, as it is a function of the area that is available to develop solar PV capacity and BESS, post demolition. From satellite images (obtained from Google Maps), we estimate the area of the TPS (power plant along with the ashpond) to be about 212 acres, which can host about 40 MW Solar PV along with 100 MW/400 MWh BESS.

Including savings from avoided FGD retrofits for the four units, on a preliminary basis we estimate the total net savings[41] would be around ₹1,638 CR.

Table 13 Kolaghat TPS area estimates from Google Maps

Power plant	168 acres
Ash pond	44 acres

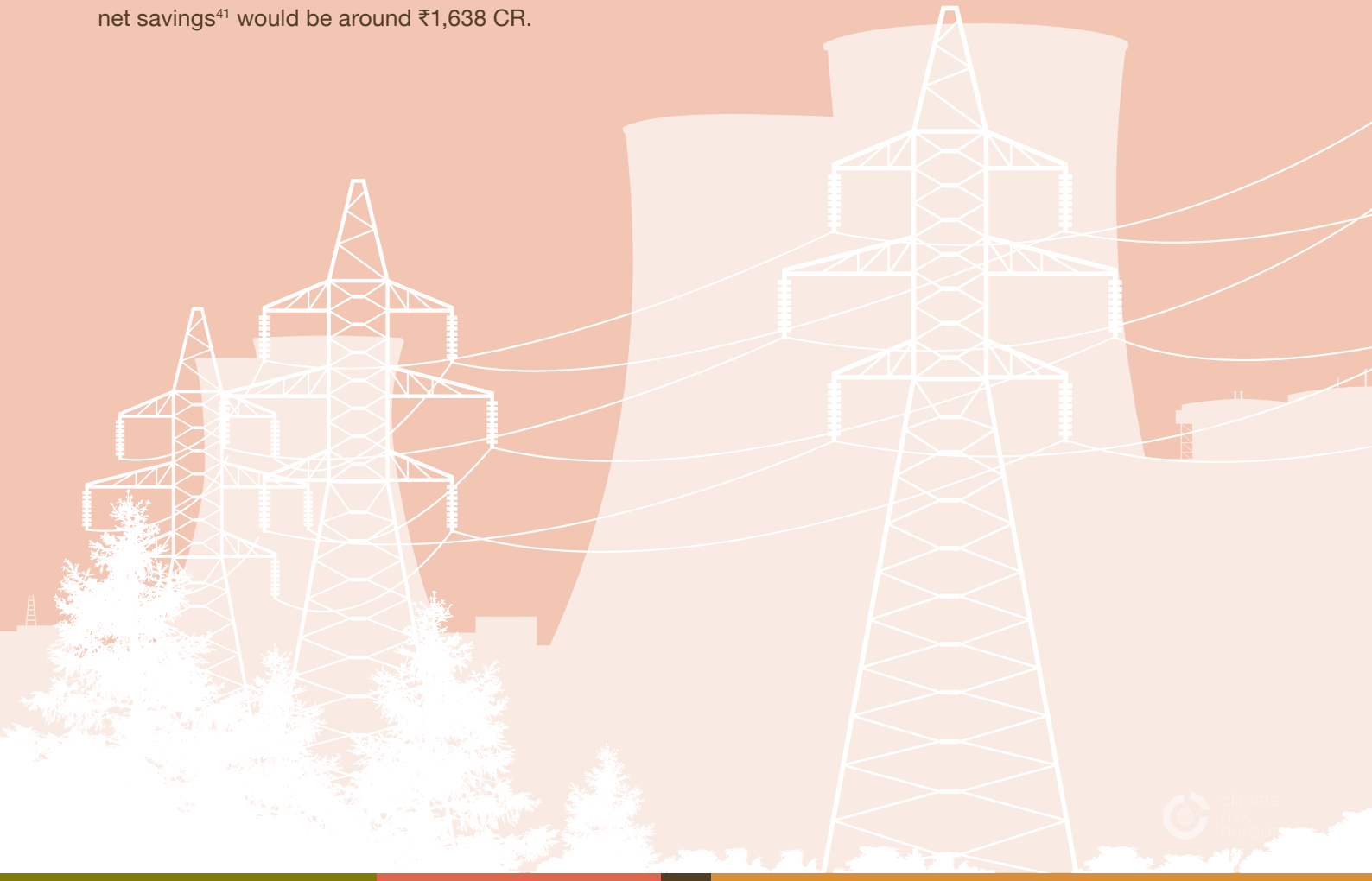


Image 1 Kolaghat TPS satellite view (Google Maps)

Image 2 Kolaghat TPS ash dyke satellite view (Google Maps)

Retiring and repurposing Bandel TPS

Bandel TPS has a total capacity of 330 MW. Units 1 and 2, each having a capacity of 60 MW, are more than 56 years old and are the most expensive units among the state-owned TPP units with a cost of about ₹3.59/kWh. Unit 5 is over 39 years old with an operating cost of ₹3.07/kWh. Bandel TPS has a planned dispatch of 1,983 MU for FY 2022–23, meeting about 4% of West Bengal's overall demand, making this TPP another option to be considered for decommissioning and repurposing to host PV solar with storage.

The savings from shifting the power generation from Bandel to a TPP with a lower unit cost can be between ₹88 CR. to ₹178 CR., depending on which units the generation is shifted to. We have assumed an average saving of ₹130 CR. Decommissioning the TPP would also avoid additional expenses in the form of FGD retrofit costs, or emission non-compliance penalties. As Bandel TPP falls under *Category A*[42] for emission non-compliance classification of TPPs, it would incur higher penalties even at lower generation levels. Over the next 10 years, assuming dispatch levels similar to FY 2022–23, the total penalty would amount to about ₹306 CR. Thus, cumulatively, shifting generation from Bandel can save anywhere between ₹540 CR. to ₹690 CR.

Table 14 Savings from retiring Bandel TPP

	Savings one-time (₹ CR.)	Savings yearly (₹ CR.)
Savings from switching to cheaper TPP		130
Avoided retrofit costs	149	
Avoided emission non-compliance penalties		30

Image 3 Bandel TPS satellite view (Google Maps)

From estimations made from satellite images (Google Maps), decommissioning and demolition of Bandel TPS can clear around 106 acres of land. This area can host around 20 MW solar PV along with 100 MW/400 MWh BESS.

Table 15 Bandel TPS area estimates from Google Maps

Power plant	32 acres
Ash pond	74 acres

Image 4 Bandel TPS ashpond satellite view (Google Maps)

6.0 Conclusion

The impetus in favour of renewable energy and the necessity of decarbonising the power system offers the state of West Bengal significant economic opportunities. Seizing these opportunities can deliver significant financial benefits for the state and its residents.

- Phasing out older coal plants will provide immediate and significant savings to West Bengal DISCOMs and electricity consumers. These savings are in the form of avoided retrofit costs and lower power purchase costs through replacement with new renewable energy.

- Since the plants in question are state government-owned, phasing them out is largely a matter of the state's political will.

- Short-term pain incurred from these measures, (such as government owned generators having to shutter a plant earlier than expected) should be viewed against the significant savings that will accrue for DISCOMs and consumers.

- 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.

- Financing models that can aid the retirement of older, expensive coal plants can play a role in speeding up West Bengal's energy transition.

7.0 Endnotes

1. https://coal.gov.in/en/about-us/history-background#:~:text=India%20has%20a%20long%20history,Western%20bank%20of%20river%20Damodar.
2. Based on data collected from state reports published on WBSEDCL, and PIB Report https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1909932
3. https://www.wbsetcl.in/annualreport/Annual%20Report%20for%20the%20FY%202021-22.pdf
4. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1909932
5. https://npp.gov.in/public-reports/cea/monthly/generation/18%20col%20act/2023/MAR/18%20col%20act-16_2023-MAR.pdf
6. https://cea.nic.in/old/reports/others/planning/pslf/Long_Term_Electricity_Demand_Forecasting_Report.pdf
7. https://pfcindia.com/DocumentRepository/ckfinder/files/GoI_Initiatives/Annual_Integrated_Ratings_of_State_DISCOMs/10th%20annual-integrated-ratings-and-ranking-2022%20(Aug%202022).pdf
8. Management Discussion & Analysis https://www.wbsedcl.in/irj/go/km/docs/internet/new_website/pdf/2.%20Management%20Discussion%20and%20Analysis_05_01.pdf
9. https://wbpdcl.co.in/project
10. https://cea.nic.in/wp-content/uploads/thermal_broad/2023/10/BS_cover_page_Oct_2023v_1.pdf
11. Based on total spend to estimated-cost ratio
12. https://www.wbsedcl.in/irj/go/km/docs/internet/new_website/TPSP.html
13. https://www.pv-tech.org/solar-tariffs-in-india-hit-record-low-after-gujarats-500mw-auction/
14. IRENA (2021), Renewable Power Generation Costs in 2020, International Renewable Energy Agency, Abu Dhabi.
15. https://renewablewatch.in/2023/04/10/winners-announced-for-remcls-solar-wind-hybrid-auction/
16. https://eta.lbl.gov/publications/estimating-cost-grid-scale-lithium
17. https://www.mercomindia.com/renew-power-seci-round-clock-renewable-tender
18. https://mnre.gov.in/img/documents/uploads/file_s-1696928037295.pdf
19. http://164.100.94.214/sites/default/files/uploads/Tentative-State-wise-break-up-of-Renewable-Power-by-2022.pdf
20. Data extracted from reports available at https://www.wbsedcl.in/irj/go/km/docs/internet/new_website/Annual_Reports.html
21. https://www.livemint.com/Politics/zYW7HJWCnC4UHN8NajGUON/Bengal-govt-wont-chase-the-centres-2022-target-on-solar-po.html
22. https://economictimes.indiatimes.com/industry/energy/power/bengal-paves-way-for-viable-rooftop-solar-energy-with-net-metering/articleshow/80299583.cms?from=mdr
23. https://wberc.gov.in/sites/default/files/TP89.pdf
24. https://powerline.net.in/2023/04/24/remcl-awards-960-mw-of-round-the-clock-renewable-power-projects/
25. Unit cost data collected from https://wberc.gov.in/sites/default/files/TP-89_20-21.pdf
26. https://cea.nic.in/wp-content/uploads/tprm/2021/12/Unit_wise_FGD_implementation_status_and_summary_sheet_for_December_2021.pdf
27. https://cea.nic.in/wp-content/uploads/tprm/2021/12/QRR_sept21-1.pdf
28. https://cea.nic.in/wp-content/uploads/tprm/2021/12/MoM_of_4th_Taskforce.pdf
29. Jute and Mesta
30. https://www.indiabudget.gov.in/economicsurvey doc/stat/tab118.pdf
31. 1 bale is equivalent to 180 Kgs
32. https://www.indiabudget.gov.in/economicsurvey doc/stat/tab118.pdf
33. https://www.researchgate.net/publication/304019632_Principles_and_practices_for_water_management_in_jute_crop#pf1
34. Agricultural Statistics at a Glance 2018: https://drive.google.com/file/d/1ubpNLjXvagcvY_enB3J7pIPFODoE3RZb/view
35. https://link.springer.com/article/10.1007/s13201-021-01543-w#
36. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1909932
37. Weighted average based on state-owned TPPs generation and cost figures
38. Tamil Nadu Report: https://climateriskhorizons.com/research/TN_Repurposing.pdf
39. Maharashtra Report: https://climateriskhorizons.com/research/MH_Repurposing_web_final.pdf
40. https://climateriskhorizons.com/research/TN Repurposing.pdf
41. Over a span of 3 years
42. https://cpcb.nic.in/uploads/Thermal_Power_Plant_overview.pdf

West Bengal's Energy Transition: A ₹62,000 CR. Opportunity

Vishnu Teja, Ashish Fernandes

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.

Learn more about us at *climateriskhorizons.com*

Registered address

Climate Risk Horizons

4th Floor, Umiya Emporium, Opp. Forum Mall,
Hosur Main Road, Koramangala, Bengaluru 560 029,
Karnataka, INDIA