Report # 5

Maheshkumar T
Project Associate, DST CPR, NISER, Bhubaneswar

Amarendra Das
Co-ordinator, DST CPR, NISER, Bhubaneswar

Laxmikanta Gual
Project Scientist, DST CPR, NISER, Bhubaneswar

Saudamini Das
Professor, Institute of Economic Growth, Delhi

Energy Transition in West Bengal:

Progress, Challenges, and Policy Insights

विज्ञान एवं प्रौद्योगिकी विभाग
भारत सरकार
DEPARTMENT OF SCIENCE & TECHNOLOGY
GOVERNMENT OF INDIA

DST
Centre for Policy Research (CPR)
National Institute of Science Education and Research (NISER) Bhubaneswar

DST - Centre for Policy Research

National Institute of Science and Educational Research Bhubaneswar, Jatani, Khordha, Pin-752050

https://dstcpr.niser.ac.in

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Laxmikanta Gual

Saudamini Das

DST- Centre for Policy Research

National Institute of Science Education and Research (NISER), Bhubaneswar

DST- Centre for Policy Research,
National Institute of Science Education and Research,
Bhubaneswar, Odisha

In December 2021, the Ministry of Science and Technology, Department of Science and Technology (Policy Research Programme) made an open call for the submission of Expressions of Interest in STI Policy Research towards the Establishment of the Centre for Policy Research (CPR) by the academic and research Institutes in India. After multiple rounds of consultations and review, the DST-CPR at NISER received the final sanction order from the Government of India, Ministry of Science & Technology, Department of Science & Technology, bearing the letter No DST/PRC/CPR/NISERBhubaneswar-2023 (G)(PCPM) dated 29/03/2023.

The primary focus of the DST-CPR at NISER is to study the Energy Transition and the secondary focus is to study the Tribal Education, and Innovations for Tribal Education in Eastern India covering Odisha, Bihar, Chhattisgarh, Jharkhand and West Bengal.

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Principal Investigator: Amarendra Das

Disclaimer:

Opinions and recommendations in the report are exclusively of the author(s) and not of any other individual or institution including DST-CPR, NISER, Bhubaneswar. This report has been prepared in good faith on the basis of information available at the date of publication.

DST-CPR, National Institute of science Education and Research, Bhubaneswar

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List of Abbreviations

BEE	Bureau of Energy Efficiency
CAGR	Compound Annual Growth Rate
CEA	Central Electricity Authority
CMERI	Central Mechanical Engineering Research Institute
COP26	26th Conference of the Parties (UN Climate Conference)
CPR	Centre for Policy Research
DDUGJY	Deen Dayal Upadhyaya Gram Jyoti Yojana
DRE	Decentralized Renewable Energy
DVC	Damodar Valley Corporation
EC	Energy Conservation
ECBC	Energy Conservation Building Code
EEFP	Energy Efficiency Financing Platform
EV	Electric Vehicle
FDG	Flue Gas Desulphurization
FEEED	Framework for Energy Efficient Economic Development
GHG	Greenhouse Gas
GSDP	Gross State Domestic Product
HT	High Tech
ICED	India Climate Energy Dashboard
MNRE	Ministry of New and Renewable Energy
MSME	Micro, Small and Medium Enterprises
MTEE	Market Transformation for Energy Efficiency
NABARD	National Bank for Agriculture and Rural Development
NAPCC	National Action Plan on Climate Change
NFI	National Foundation for India
NIWE	National Institute of Wind Energy
NMEEE	National Mission for Enhanced Energy Efficiency
NSM	National Solar Mission
NSDP	Net State Domestic Product
NREMPP	New and Renewable Energy Manufacturing Promotion Policy
NRES	Non-Conventional and Renewable Energy Sources
PAT	Perform, Achieve, and Trade
PCGERSE	Policy on Co-generation and Generation of Electricity from Renewable Sources of Energy
PEUM	Partial End Use Methodology
RPO	Renewable Purchase Obligation
SPI	Smart Power India

STPS	Super Thermal Power Station
T&D	Transmission and Distribution
TPS	Thermal Power Station
UNFCCC	United Nations Framework Convention on Climate Change
WBGEDCL	West Bengal Green Energy Development Corporation Limited
WBREDA	West Bengal Renewable Energy Development Agency
WBREP	West Bengal Rural Electrification Programme
WBSEDCL	West Bengal State Electricity Distribution Company Limited
WBSDA	West Bengal State Forest Development Agency

Executive Summary

This report examines the current energy landscape in West Bengal. As of 2024, the state remains heavily dependent on thermal energy, which accounts for approximately 81.1% of its electricity generation capacity. Renewable energy sources, including hydropower, comprise the remaining 18.9%. Among thermal sources, coal is the dominant contributor, making up 80.4% of the total, and placing West Bengal as the state with the second-highest number of operational coal-based units in eastern India. The state is currently facing an energy deficit, with demand exceeding supply—a challenge expected to intensify as energy consumption rises steadily toward 2032. This growth is particularly pronounced in the domestic and high-tech industrial sectors, followed by commercial users. Rising power demand, driven by population growth and urbanization, underscores the urgent need for sustainable energy solutions. Renewable energy offers a viable, cost-effective alternative to meet this demand. However, the state is struggling to achieve its renewable energy capacity targets. Despite setting a goal of 2,706 MW by 2022, this target remains unmet as of 2024. These two years, 2022 and 2024, were designated as critical benchmarks in the state's energy policy. During this period, the private sector played a leading role in the energy transition, surpassing both central and state initiatives in renewable energy capacity installation. Nevertheless, West Bengal holds significant potential in renewables, currently utilizing only about 6% of its total capacity (excluding hydropower). This untapped potential presents substantial opportunities for the expansion of solar and wind energy, which could also contribute to increased employment across the state.

Introduction

India's journey toward self-reliance in the energy sector necessitates robust state-level participation and strategic initiatives to unlock the full potential of its energy resources, particularly renewables. This transition is vital for steering the country toward its net-zero emissions target by 2070. Achieving this milestone is unlikely without a significant shift to renewable energy. Nonetheless, coal is expected to remain the cornerstone of India's energy system for at least the next two decades (Garg et al., 2024). As a result, national priorities must centre on implementing effective policies aimed at decarbonizing the economy while actively promoting alternative green energy sources. Strengthening coordination between central and state governments is crucial to accelerating the energy transition across all major economic sectors and enhancing India's response to climate change and global warming.

West Bengal was one of the early adopters of renewable energy in India. As early as 1994–95, the state government introduced solar energy initiatives to electrify remote settlements in the Sundarbans region, which remained beyond the reach of the conventional power grid. These pioneering efforts reflected a strong initial commitment to sustainable energy, particularly in inaccessible regions. However, despite more than three decades of such initiatives, West Bengal continues to lag behind in renewable energy adoption. As of 2022–23, thermal power still accounted for approximately 87% of the state's electricity generation.

According to the State Energy and Climate Index, West Bengal ranks 10th in total final energy consumption among Group 1 states and holds the 14th position out of 20 larger states in overall performance (Pandey et al., 2022). Rapid population growth and urbanisation—currently advancing at a rate of 3.92%—are fuelling rising domestic energy demand. The state's Gross State Domestic Product (GSDP) stood at ₹15,36,681 crore (based on 2011–12 prices) in 2021–22. Peak electricity demand in 2021 varied between 16 MW and 20 MW. Electricity generation rose from 36,922.44 GWh in 2019–20 to 40,125.51 GWh in 2020–21, indicating an annual growth of 8.68%.

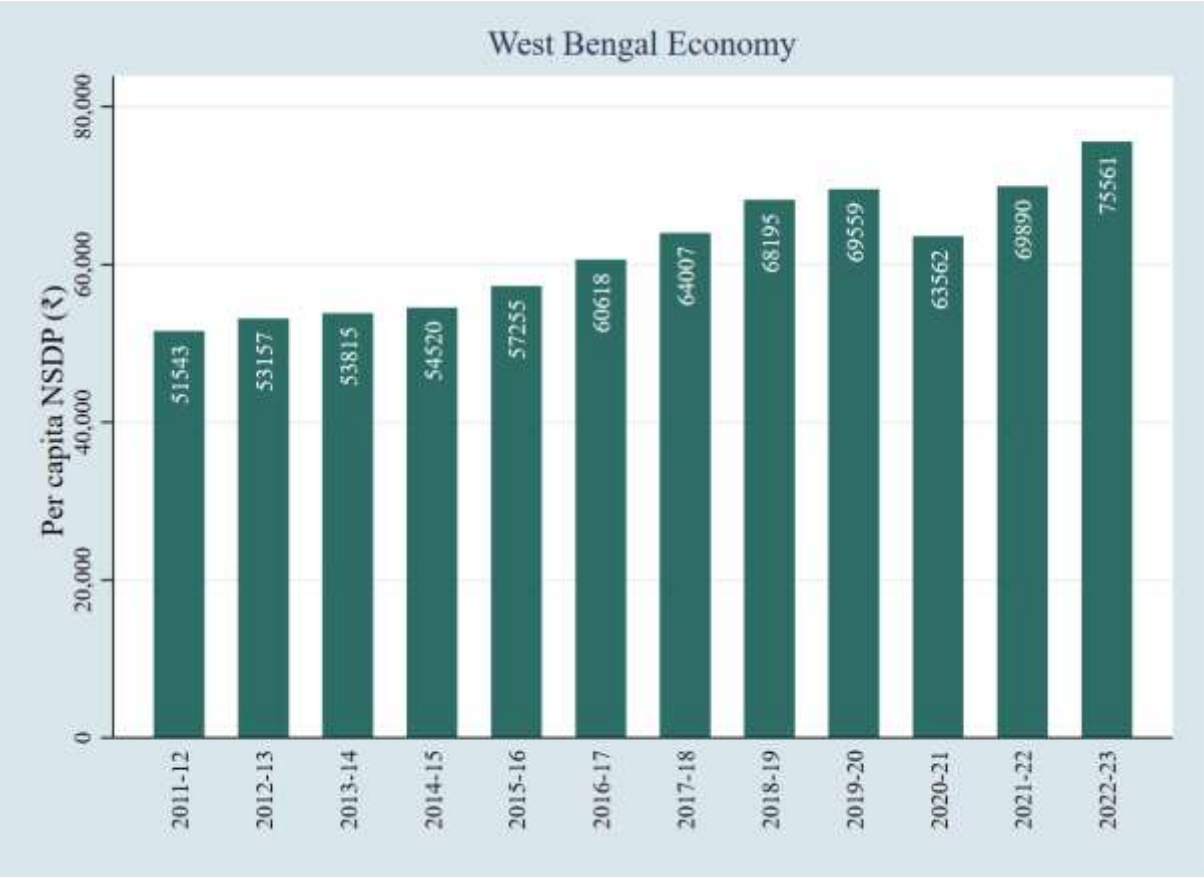
West Bengal has an estimated renewable energy generation potential of approximately 2,206 MW (excluding solar), yet only about 193 MW has been achieved to date. Ensuring reliable and uninterrupted electricity for all households remains a national objective, made more urgent by a 19% surge in domestic energy demand in recent years. Industrialisation is also accelerating, leading to increased electricity requirements in the industrial and commercial sectors. Notably, the Adani Group has announced plans to invest ₹10,000 crore (US$1.29 billion) in West Bengal over the next decade. Similarly, the JSW Group intends to establish a 900 MW pumped-storage hydropower facility in the state.

To support renewable energy development, the state government established the Department of Non-Conventional and Renewable Energy Sources (NRES), tasked with promoting the adoption and development of renewable energy technologies and identifying new areas for exploration. The department’s implementation is carried out primarily through two agencies: the West Bengal Renewable Energy Development Agency (WBREDA) and the West Bengal Green Energy Development Corporation Limited (WBGEDCL).

This chapter evaluates West Bengal's current energy transition using data from various government sources and official reports. It explores the state's evolving energy mix and assesses improvements made through strategic diversification. The analysis further considers future opportunities and challenges, along with policy recommendations for advancing renewable energy uptake. The study employs trend analysis with a focus on descriptive statistics, using the compound annual growth rate (CAGR) to measure and interpret development across key indicators.

Economic Scenario of West Bengal

Figure 1: Per Capita Net State Domestic Product in West Bengal



Source: Reserve Bank of India, 2024; Notes: Per Capita Net State Domestic Product (NSDP) (₹) at constant price with the base: 2011-12.

West Bengal's per capita income showed a steady increase up to the financial year (FY) 2019–20. However, this upward trend was interrupted in FY 2020–21 due to the economic disruptions caused by the COVID-19 pandemic, which affected the entire country, including West Bengal. Despite this setback, the state's Net State Domestic Product (NSDP) growth rate recovered quickly, and income levels resumed their upward trajectory. Recent trends, as illustrated in Figure 1, indicate a period of income stability. Nonetheless, over the long term, the state has experienced a relative economic decline. A recent report analyzing the relative economic performance of Indian states from 1960–61 to 2023–24 highlights this trend: West Bengal accounted for 10.5% of the national GDP in 1960–61, making it the third-largest contributor at the time. By 2023–24, its share had dropped to just 5.6%. Furthermore, the

state's relative per capita income has consistently declined and now falls below that of states such as Rajasthan and Odisha (Sanyal & Arora, 2024).

Energy Scenario in West Bengal

Table 1: Installed Capacity (in MW) of Power Utilities in West Bengal

Ownership /Sector	Thermal					Nuclear	Renewable			Grand Total
	Coal	Lignite	Gas	Diesel	Total		Hydro	RES* (MNRE)	Total	
State	4810.00 (80.2%)	0.00	80.00 (1.3%)	0.00	4890.00 (81.5%)	0.00	986 (16.4%)	121.95 (2%)	1107.95 (18.5%)	5997.95
Private	2437.00 (82.3%)	0.00	0.00	0.00	2437.00 (82.3%)	0.00	0.00	522.88 (17.7%)	522.88 (17.7%)	2959.88
Central	1436.34 (77.8%)	0.00	0.00	0.00	1436.34 (77.8%)	0.00	410.00 (22.2%)	0.00	410.00 (22.2%)	1846.34
Total	8683.34 (80.4%)	0.00	80.00 (0.7%)	0.00	8763.34 (81.1%)	0.00	1396.00 (12.9%)	644.83 (6%)	2040.83 (18.9%)	10804.17

Source: Central Electricity Authority Dashboard, Government of India, 2024, (As on 31.07.2024); * Renewable Energy Sources

Table 1 presents a summary of power generation utilities in West Bengal from both renewable and non-renewable sources. The state remains heavily reliant on non-renewable energy, with thermal power accounting for approximately 81.1% of the total installed capacity. In contrast, renewable sources, including hydroelectric power, contribute only 18.9%. Coal dominates the energy mix, representing 80.4% of the total capacity, with contributions from the state, central, and private sectors. Among these, the private sector leads in coal-based installations, comprising 82.3%, followed by the state sector at 80.2%, while the central sector contributes a slightly lower share at 77%.

Regarding renewable energy, 18.9% of the state's installed capacity comes from these sources. The central sector is the largest contributor, accounting for 22.2% of this capacity. Within the renewable category, hydropower plays a significant role, making up 12.9% of the total installed capacity, again led by the central sector with a 22.2% share. For other renewable energy sources (RES), the private sector dominates with a 17.7% share, while the state sector's involvement remains minimal at only 2%.

Table 2: Installed capacity by sector in West Bengal (2019-2024)

Year	Central	Private	State	Total
2019	7205.2	2407.9	6605.5	16218.6
2020	7205.2	2460.5	6498.0	16163.7
2021	7205.2	2490.8	6498.0	16193.9
2022	7187.7	2511.2	6084.6	15783.5
2023	6995.2	2544.8	5998.0	15538.0
2024	6995.2 (45%)	2553.5 (16.4%)	5998.0 (38.6%)	15546.7 100.0
CAGR 2019-24	-0.0059 -0.6%	0.011813 1.2%	-0.01911 -1.9%	-0.00843 -0.8%

Source: CEA dashboard, 2024. https://cea.nic.in/dashboard/?lang=en

Table 2 presents the sector-wise installed energy capacity in West Bengal over recent years. The data reveal a declining trend in the state's overall installed capacity, which decreased from 16,218.6 MW in 2019 to 15,546.7 MW in 2024, reflecting a negative compound annual growth rate (CAGR) of -0.8% over this period. This decline is particularly evident in the state sector, where installed capacity dropped from 6,605.5 MW in 2019 to 6,315.6 MW in 2024, corresponding to a negative CAGR of -1.9%. The central sector also experienced a slight decline, with capacity falling from 7,205.2 MW to 6,995.2 MW, resulting in a negative CAGR of -0.6%.

Despite this reduction, the central sector continues to hold the largest share of installed capacity, accounting for 7,149.4 MW (45%) in 2024. The state sector follows with 5,998.0 MW (38.6%), while the private sector contributes 2,553.5 MW (16.4%).

Interestingly, while the central and state sectors have seen negative growth rates at -0.6% and -1.9%, respectively, the private sector has recorded a positive CAGR of 1.2% during the same period. This trend highlights the increasing role of private investment in the state's energy sector. The private sector's growing capacity, particularly in the context of renewable energy, suggests a potential surge in future contributions and a stronger alignment with the broader green energy transition goals.

Table 3: Energy generation from different parameters

Year	Hydro-Generation (in MU)	Coal - Generation (in MU)	Bio Power - Generation (in MU)	Small-Hydro - Generation (in MU)	Solar Generation (in MU)	Total
2012-13	1228.00	62835.29	-	-	-	64063.29
2013-14	1494.00	64089.53	-	-	-	65583.53
2014-15	2286.63	64039.20	-	-	-	66325.83
2015-16	2134.00	61589.18	1444.31	192.32	6.28	65366.09
2016-17	2839.00	70593.84	1433.93	125.17	14.98	75006.92
2017-18	2277.00	66339.51	1387.01	192.53	20.55	70216.60
2018-19	2919.81	74072.66	1284.49	163.62	40.71	78481.29
2019-20	2916.38	69240.63	1295.07	115.36	64.29	73631.73
2020-21	3212.29	72701.33	1349.72	106.36	73.90	77443.60
2021-22	3189.81	83203.11	1593.95	21.05	98.24	88106.16
2022-23	3423.73	87646.57	1088.88	204.43	125.04	92488.65
2023-24	2816.49	89454.26	1547.62	204.47	168.32	94191.16
CAGR 2015-2024	0.0353	0.0478	0.0087	0.0077	0.5084	0.0467
	3.5%	4.8%	0.9%	0.8%	50.8%	4.7%

Source: CEA dashboard, 2024. https://cea.nic.in/dashboard/?lang=en

Coal

At present, West Bengal is the fourth largest coal reserve state among the eastern states, following Jharkhand, Chhattisgarh, and Odisha, and India as a whole (NSO, 2024). The major chunk of the energy requirements in West Bengal for electric power is met by fossil fuel, especially coal. The actual electricity generation using coal has increased from 62835.29

MW in 2012-13 to 89454.26 MW in 2023-24. The compound annual growth rate (CAGR) for coal-based electricity generation is about 4.8 percent during 2015–2024.

Hydro

Hydro-based electricity generation is the second highest contributing component in the state, which increased with the CAGR (2015-2024) of 3.5 percent.

Solar

Solar is an emerging segment from the renewable energy category in the state, which has more advantages in the near future. It has the highest CAGR rate of 50.8 percent during 2015-2024 as compared to all other components in the state. This increasing share from this component is evident in the states' green energy transition, using the natural resources. This not only helps the state to reduce carbon footprints but also provides more employment opportunities in this sector, fostering the renewable energy sector.

Bio power & Small hydro power

Electricity generation using Bio power and small hydro is marginally increasing each year, with the CAGR of 0.9 percent and 0.8 percent, respectively. These components have a lower energy generation as compared to the rest of the components.

Table 4: Energy intensity

Year	Energy Consumption (GWh)	GSDP 2011-12 prices (Crore INR)	Energy Intensity (2/3)
2012 -13	824301.17	5,42,191	1.52
2013-14	873428.18	5,58,497	1.563
2014-15	945736.65	***5,74,364***	1.64
2017-18	1123426.86	6,76,050	1.66
2018-19	1209971.63	7,17,043	1.687
2019-20	1248085.82	7,70,058	1.62

*Energy consumption has been taken from the CEA website
*GSDP has been taken from MOSPI.

Table 4 presents data on energy consumption, Gross State Domestic Product (GSDP), and energy intensity in West Bengal across various years. Energy intensity is defined as the ratio of energy consumption (measured in GWh) to GSDP (in crore INR at constant 2011–12 prices), indicating the amount of energy used to produce one unit of economic output. A higher energy intensity implies greater energy usage per unit of economic production, often reflecting lower energy efficiency.

In 2012–13, West Bengal's energy intensity stood at 1.52, meaning 1.52 GWh of energy was consumed for every crore INR of GSDP. This ratio gradually increased in subsequent years, reaching 1.64 in 2014–15 and peaking at 1.687 in 2018–19. The upward trend suggests that energy consumption was growing at a faster pace than economic output, indicating rising energy demand to support economic activities.

However, in 2019–20, the energy intensity declined slightly to 1.62, signaling a modest improvement in energy efficiency. This decline suggests that the state managed to generate more economic output with relatively lower growth in energy consumption. Overall, the data reflect a fluctuating pattern in energy intensity, shaped by changing dynamics between energy usage and economic growth. The slight decrease in 2019–20 may point to early efforts toward improving energy efficiency or a structural shift in the economy toward less energy-intensive industries.

Table 5: The trend of Energy requirements and availability

Year	Energy requirement	Energy availability	Gap
2020	4145.324	4136.766	-8.5583
2021	4553.924	4549.196	-4.7267
2022	4911.973	4906.056	-5.9183
2023	5566.408	5559.53	-6.8767
2024	4719.193	4714.803	-4.3900
Total	4789.983	4783.588	-6.3947

Source: CEA dashboard, 2024. https://cea.nic.in/dashboard/?lang=en

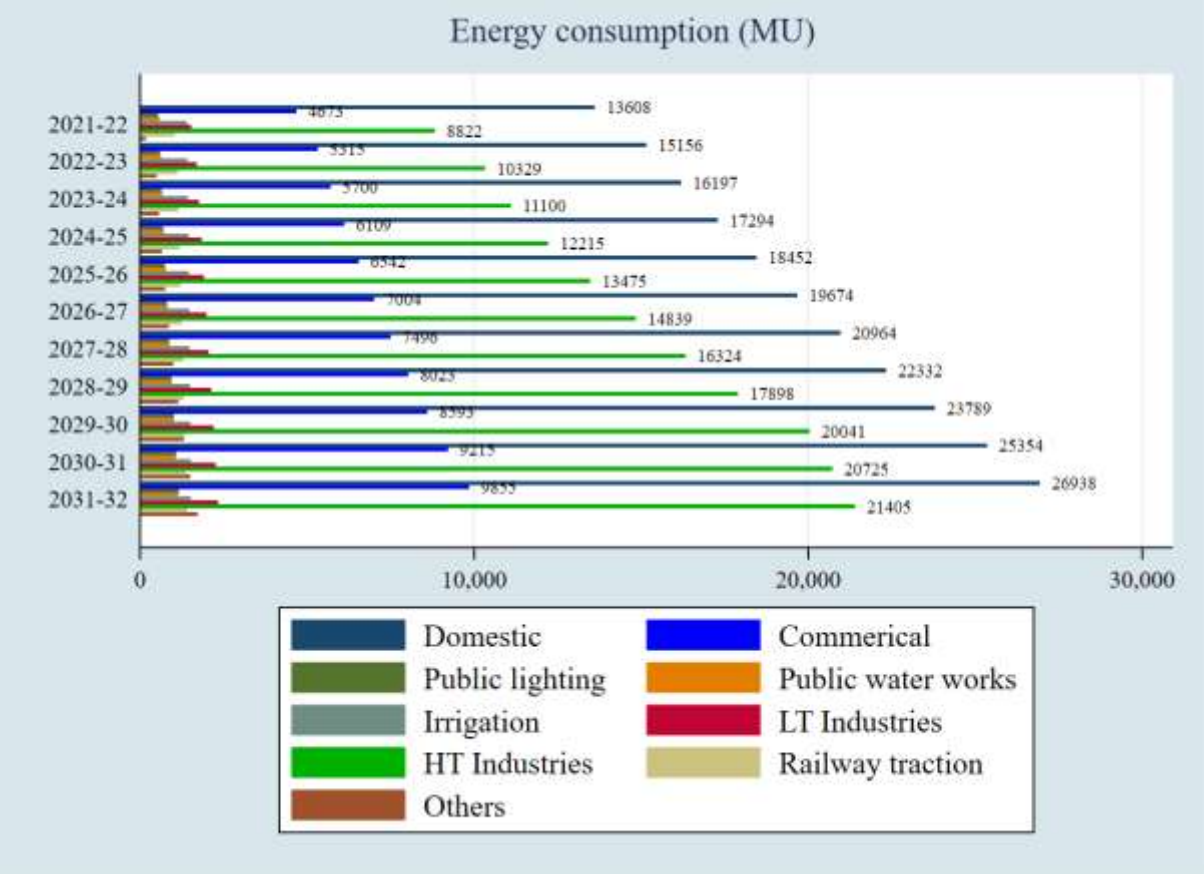
Table 5 outlines the energy requirement, availability, and the corresponding shortfall in West Bengal from 2020 to 2024. In 2020, the state's energy requirement was 4,145.32 GWh, while only 4,136.77 GWh was available, resulting in a deficit of 8.56 GWh. This gap narrowed in 2021 to 4.73 GWh, with demand rising to 4,553.92 GWh and availability at 4,549.20 GWh. Over the subsequent years, the shortfall remained minimal—5.92 GWh in 2022 and 6.88 GWh in 2023—indicating the state's growing ability to meet increasing energy demands consistently. By 2024, the gap will be further reduced to just 4.39 GWh, as energy availability (4,714.80 GWh) closely matches demand (4,719.19 GWh).

Cumulatively, from 2020 to 2024, the total energy requirement stood at 4,789.98 GWh, with an overall availability of 4,783.59 GWh, resulting in a modest shortfall of 6.39 GWh. These figures suggest that West Bengal has been largely successful in maintaining a narrow energy deficit over this period. While the minor shortfalls indicate occasional supply constraints, the overall trend points to effective energy management and system resilience.

The steady rise in energy demand until 2023 reflects the state's ongoing industrial growth, urbanisation, and economic expansion. The slight decline in demand observed in 2024 may indicate either a temporary deceleration in consumption or early signs of stabilisation. Although the deficits have been small, they can still pose challenges, especially during periods of peak demand in critical sectors. Nevertheless, the decreasing gap between energy requirement and availability signals improvements in energy efficiency, grid management, and capacity planning—likely resulting from targeted policy interventions aimed at reducing transmission losses and optimising generation and distribution systems.

Forecast for the Energy Demand of the State

Figure 2: Energy Consumption forecast (2021-2032)

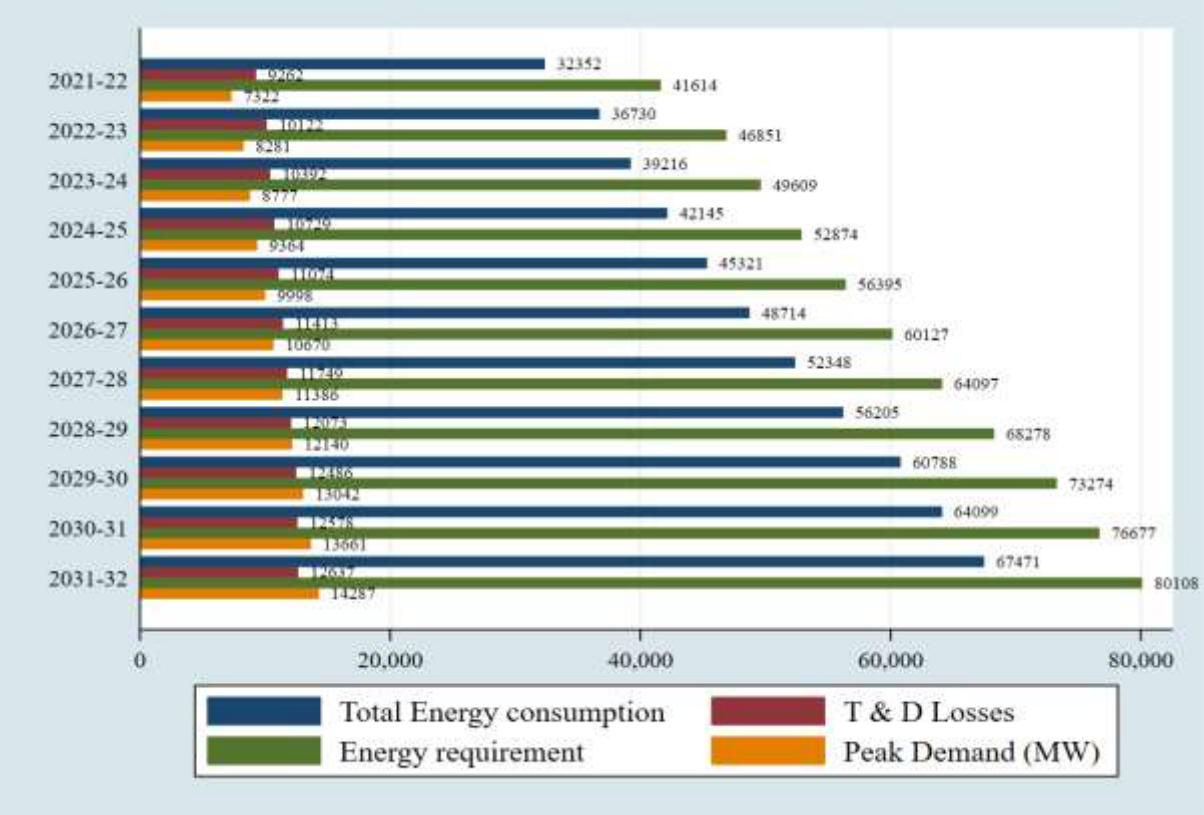


Source: 20th Electric Power Survey of India, 2022; **Note**: The projection has been made using the Partial End Use Methodology (PEUM), which combines time series analysis with the End Use Method. T&D – Transmission and Distribution. LT: Low Tech; H T: High Tech

Figure 2 depicts the energy consumption forecast across various categories in the state of West Bengal. The consumption of energy is higher for the domestic usage followed by HT industries and commercial activities. Notably, the consumption at the domestic has been increasing over the years starting from 2021-22, 13608 MU and expected to increase to 26938 by 2031-32 which is double fold during this time. The HT industries consume a second higher level of energy starting from 8822 MU in 2021-22 and expected to increase to 21405 MU in 2031-32. Similarly, the energy consumption for commercial activities expected to increase from 4673 MU to 9855 MU by 2031-32. These three sector are the dominant energy consumes in the state. Whereas the remaining fields like public lighting, public water works, irrigation, LT Industries, Railway traction and other activities have lower level of consumption as compared to those dominant three.

The demand for energy across these above fields Increase as the increasing population and urbanisation, consequently the overall energy consumption level increased year on year. However, this consumption level is lower than the energy requirement of the state in all the years and that has also been increased over the years. For instance, the forecasting estimation provided in Figure 3 depicts that the increasing level of energy requirement from 41614 MU in 2021-22 to 80108 MU by 2031-32. This pattern of increasing energy requirements poses several significant challenges on the social and economic development of the state. These challenges can impact state's economy, infrastructure, environment and the quality of life.

Figure 3: Energy Consumption, Requirement and Peak Demand forecast (2021-2032)



Source: 20th Electric Power Survey of India, 2022; **Note**: The projection has been made using the Partial End Use Methodology (PEUM), which combines time series analysis with the End Use Method. T&D – Transmission and Distribution.

West Bengal's readiness for energy transition

The Government of India expressed and represented the concerns of developing nations at the Conference of the Parties (COP26) to the United Nations Framework Convention on Climate Change (UNFCCC) in Glasgow, United Kingdom. India also presented the five key components (Panchamrit) of India's climate action, which are outlined below:

1. Achieve a 500 GWN capacity for non-fossil energy by 2030.
2. By 2030, renewable energy will meet 50% of the country's energy needs.
3. An anticipated reduction of one billion metric tonnes in global carbon emissions between now and 2030.
4. A reduction of 45% from 2005 levels in the economy's carbon intensity by 2030.
5. Reaching the goal of having no emissions by 2070.

In line with the nation's energy transition objectives, each state should develop its own energy policy and actively participate in it. Before delving into the specifics of the state-level energy policy, it is crucial to consider the national objectives and their intended direction for the state's involvement in the energy sector.

National Action Plan on Climate Change (NAPCC) 2008

India's climate change strategies have predominantly emphasised fostering synergies between developmental and climatic outcomes. India was among the few nations that enacted the Energy Conservation Act in 2001, which was amended in August 2022.

The formulation of eight national missions on climate change has taken place. The first two missions are pertinent to the energy sector.

1. National Solar Mission

2. National Mission for Enhanced Energy Efficiency

National Solar Mission (NSM) 2010

The aim of the National Solar Mission is to position India as a global leader in solar energy by facilitating the rapid dissemination of policy conditions nationwide. The Mission has a tripartite strategy: Phase 1 (up to 2012-13), Phase 2 (2013-17), and Phase 3 (2017-22).

The primary objective of NSM was to implement 20 GW of solar electricity by 2022. This was raised to 100 GW in early 2015. Various facilitative programs and initiatives under the Mission have propelled the grid-connected solar power installed capacity from 25 MW in 2010-11 to around 36.32 GW as of 31st October 2020. An extra 58.31 GW of solar generating capacity is presently undergoing installation or tendering procedures.

National Mission for Enhanced Energy Efficiency (NMEEE) 2011

NMEEE aims to enhance the energy efficiency market by establishing a supportive regulatory and policy framework, while promoting innovative and sustainable business models within the sector.

NMEEE comprises four initiatives aimed at enhancing energy efficiency in energy-intensive industries.

- Perform, Achieve, and Trade (PAT)
- Market Transformation for Energy Efficiency (MTEE)
- Energy Efficiency Financing Platform (EEFP)
- Framework for Energy Efficient Economic Development (FEEED)

Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY) 2014

The Government of India launched the Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) in December 2014 to facilitate comprehensive rural electrification. The scheme aimed to separate agricultural and non-agricultural feeders, strengthen and expand sub-transmission and distribution infrastructure, implement metering at distribution transformers, feeders, and consumer levels, and ensure the electrification of villages nationwide. Having achieved its intended objectives, the scheme has now been officially concluded.

States' Policies for Energy Transition and Achievement

Policy on Co-generation and Generation of Electricity from Renewable Sources of Energy 2012 (hereinafter referred to as PCGERSE 2012)

This section discusses some key points from PCGERSE 2012 and its impact on renewable energy in the state.

The power requirement met from Renewable Energy (RE) sources was 2% in West Bengal while formulating this policy. The total amount of electricity generated from the RE source reached 193 MW.

As a Renewable Purchase Obligation (RPO), West Bengal mandated that 4% of electricity consumption should come from RE sources by 2012–13. It's a policy regulation that mandates distribution companies (discoms) to purchase a minimum percentage of electricity from RE sources.

The policy aimed to accelerate development initiatives to promote alternative energy in the state.

Long-Term Objectives:

- Promote a significant increase in electricity generation from renewable energy (RE) sources.
- Encourage and sustain private sector investment in the development and expansion of renewable energy.
- Support the adoption and commercialization of emerging RE technologies such as wind, solar, tidal, and geothermal energy.

Short-Term Objectives:

- Identify priority areas and formulate technology-specific strategies for renewable energy development in the state.
- Develop detailed roadmaps for each renewable energy technology.
- Facilitate investments in renewable energy from both the public and private sectors.
- Define an optimal energy mix and establish a timeline aligned with Renewable Purchase Obligations (RPOs).
- Promote innovation and advancement in RE technologies through pilot projects.
- Establish the foundational framework—including regulatory, administrative, infrastructural, and institutional mechanisms—necessary to support renewable energy expansion.

Focus area and strategies of PCGERSE 2012

1. Wind Farms: Initial detailed wind resource assessments will be conducted by the Nodal Agency, and potential development locations will be made available. Government-owned wastelands in regions with a minimum annual mean wind power density (WPD) of 200 watts/m2 measured at a hub height of 50 meters would be available to set up wind projects.

2. Small, Mini, and Micro Hydel Projects: By 2017, it was planned to complete 120 MW of power through small and mini-hydro projects. Development won't be considered for mini-hydro projects that would reroute water flow and cause a stream or river portion to dry up.
3. Biomass Projects: Feedstock availability and cost are the key success factors for biomass plants. Energy plantations will be encouraged to ensure the availability of feedstock. Degraded forest land, wastelands, and barren government land must be made accessible for this. The West Bengal Green Energy Development Corporation Limited (WBGEDCL) would divide the high rice-producing areas into zones based on the volume of rice produced in these areas to guarantee the continuous availability of feedstock.
4. Solar Photovoltaic: By 2017, it was planned to use 82 MW of solar energy from grid-connected projects and 18 MW from rooftop and smaller solar installations. By creating a welcoming environment for potential solar developers, the state hopes to promote the growth of solar energy. The state aims to significantly increase capacity through rooftops, smaller solar installations, and grid-connected solar energy.
5. Rooftop and smaller PV installation: The solar systems can be as large as 5–10 MW and can power the majority of the building's non-fluctuating loads, depending on the available rooftop area and building loads. It will be mandatory for all public buildings to have solar devices in order to meet electricity requirements and other applications. All existing and upcoming commercial and business establishments having more than 1.5 MW of contract demand will be required to install solar rooftop systems to meet at least 2% of their total electrical load. Furthermore, all existing and upcoming schools, colleges, hospitals, large housing societies, and government establishments with a total contract demand of more than 500 KW will be required to install solar rooftop systems to meet at least 1.5% of their total electrical load. The policy stated that industrial parks, intelligent parks, etc. shall mandatorily employ rooftop PV installations to meet some part of the in-house demand.
6. RE Project Financing: Green Energy Fund shall be created by the Nodal agency of the state with the contribution by the government and international donor agencies. Eighty percentage (80%) of the penalty imposed for violating any statutory clearances shall also be channelled into the Green Fund. Furthermore, the obligated entities must contribute 50% of the penalty they impose for failing to meet the RPO to the Green Fund. Also, the finance for green energy projects meets through the West Bengal budget allocation.
7. Incentives: The Commission's Regulations will allow this policy exemption of demand reduction up to 50% of the installed capacity assigned for captive use purposes.

Table 6: Target set in the PCGERSE 2012

RE source	Potential (in MW)	Existing Installed Capacity (in MW)	Target Cumulative Capacity (in MW)	
			2017 (End of the 12th Plan)	2022 (End of the 13th Plan)
Wind Power	450	2	75	450
Mini & Small Hydro	394	97	220	394
Co-generation 1	600	69	355	600
Biomass	662	16	240	662
Waste to Energy 2	100	7	50	100
Solar	Under Preparation	2	100	500
Total	**2206**	**193**	**1040**	**2706**

Source: PCGERSE 2012

Table 7: Actual attainment (in cumulative capacity) of Renewable Energy in West Bengal FY 2017-18 and FY 2022-23

Year	Sector	Hydro (Renewable) (MW)	RES (MNRE) (MW)	RE (Total)
Actual installed capacity as of March 2018	State	986	91.95	1077.95
	Private	0	343.87	343.87
	Central	410	0	410
	Sub-Total	**1396**	**435.82**	**1831.82**
Actual installed capacity as of March 2023	State	986	121.95	1107.95
	Private	0	499.62	499.62
	Central	410	0	410
	Sub-Total	**1396**	**621.57**	**2017.57**

Source: Authors' estimation using data from the CEA dashboard

Between FY 2017-18 and FY 2021-22, the state had a bio-energy plant capacity of 1.36 MW, excluding small bio-gas plants. Additionally, it achieved a total installed capacity of 338.62 MW for biomass power, bagasse cogeneration, and non-bagasse cogeneration plants (MNRE, 2023). However, this capacity falls short of the 2012 PCGERSE target, which aimed for 240 MW by 2017 and 662 MW by 2022 (Table 6).

For wind energy, the state set a goal of installing 75 MW by 2017 and 450 MW by 2022. Yet, the actual capacity installed remains below these targets (Table 6). As of March 2018, the state had achieved 435.82 MW of renewable energy capacity, including solar and wind power (Table 7). About 15 MW is lower than the targeted one. Although the state has notable wind power potential, no considerable wind power is utilised. Additionally, there is a lack of data on RE source-wise parameters at the all-India and state levels. That hampers the source-wise impact assessment.

The overall target for renewable energy capacity installation was 1040 MW by 2017 and 2,706 MW by 2022 (Table 6). The actual attainment is 1831.82 in 2017, which is higher than

the targeted one. It shows a higher growth in capacity installation in the end of the 12th plan. The actual attainment of total renewable energy (RE) in 2022 was 2017.57 MW, whereas the target was 2706 MW, resulting in a shortfall of 688.43 MW by the end of the 13th plan (Table 7). This demonstrates the state's poor performance in renewable energy generation under the 13th plan. As per the latest electricity report as of August 2024, the state is able to attain 2040.83 MW (CEA, 2024) installation, even though the shortage of RE generation remains.

Between 2017 and 2022, private participation gradually assisted the state in achieving renewable energy installation. Notably, the private sector increased its installed capacity from 343.87 MW to 499.62 MW (Table 7), and it further increased to 528.88 MW by August 2024 (CEA, 2024). Thus, it is clearly evident that both the state and central sectors maintained a lower installed capacity during this period, with the private sector leading the installation. The lack of participation of the state and central is one of the major reasons for West Bengal struggling to meet its targeted level of 2706 MW RE capacity installation.

The PCGERSE 2012 established targets for the years 2017 and 2022, but during this time, the state and central sectors made only slow progress, leaving the private sector solely to take the responsibility of renewable energy installation in West Bengal.

West Bengal New and Renewable Energy Manufacturing Promotion Policy (NREMPP) 2023. (Key points are discussed here)

This policy aims to address the supply-side gap and incentivize renewable energy manufacturing units, including micro, small, and medium enterprises (MSMEs). It encourages large-scale industries to invest in this sector. It has been officially declared for a period of five years of validity.

Banglashree Prakalpa

Fiscal incentives for the expansion of existing MSMEs and newly established enterprises under the age of the MSME &T department. This is valid from 01.04.2109 to 31.03.2025.

To receive the benefit, one must obtain an endorsement letter from the NRES department before establishing the units[1], and the department must ensure a quality check in accordance with the NREMPP 2023 guidelines. This condition is exempt for those units that meet the WBPCB norms.

Applicability of the NREMPP 2023

[1] *According to the NREMPP 2023 "Unit" means any industrial project in large or MSME scale sectors engaged in manufacturing process for the purpose of manufacture of goods defined under "manufacture" in the National Industrial classification 1987 as amended from time to time as well as defined in section 2 of the Central Excise Act, 1944 having approval in the form of letter of intent, industrial license or registration certificate as the case may be under the Industries (Development and Regulation) Act 1951 (65 of 1951) or an acknowledgement in the form of IEM from DPII, Government of India in the private, cooperative and joint sectors as also companies/ undertakings owned or managed by State and the central government.*

The policy is only applicable to those units that obtain certificate clearance from the West Bengal Director of Industries, Department of Industries, WB, and NRES. All clearances would be processed through a single window clearance.

Industrial Promotion Assistance (exemption)

a. *Land mutation and conversion fee*
b. *Stamp duty registration fee*
c. *Water cess*
d. *Electricity duty*
e. *Skill development subsidy*

Rural Electrification

The WBSEDCL Rural Electrification (RE) Department has already electrified 37,945 of the state's total 37,960 villages. Electricity has been delivered to 30,53,254 rural BPL/APL families, in addition to service connections provided to urban/rural households by various WBSEDCL Customer Care Centres.

West Bengal Rural Household Electrification Programme (WBREP):

The West Bengal government supported this program, which included the WBREP, WBREP (Supplementary), and WBREP (Balance) initiatives. The WBREP scheme included the Purba Medinipur, Bankura, Jalpaiguri, and North 24 Parganas districts. The WBREP (supplementary) plan included all 18 districts. The WBREP (balance) plan covered Jalpaiguri and Coochbehar districts.

Household electrification status as of December 10, 2018

Table 8: Household electrification

Total Households	Electrified Households as of 10th Oct 2017,	% of Unelectrified HHs as of 10th Oct 2017	Household Electrified w.e.f 11th Oct,2017	% of Balance Un-electrified HHs as of 10th Dec 2018	HH Electrification as on 10th Dec, 2018 (%)
15057882	14325592	5%	732290	0%	100

Table 9: Percentage of household customers for whom electricity is affordable

Disadvantaged	Resilient middle	Advantaged	Total
81%	99%	100%	83%

West Bengal has achieved 99.9 percent rural household electrification. As of 2020, the state still has to add 20,000 power connections to completely electrify the two isolated villages of Gorkhay and Samanden.

The official documentation only mentions a 99.9% accomplishment rate. In reality, with 20 hours a day, agricultural consumers report having the most supply. Repairs take days to complete once the electricity is out by thunder and lightning. Unplanned power outages occur frequently, which is a relatively normal occurrence. 54% of customers were satisfied with electrification, according to a joint report from Smart Power India (SPI), The Rockefeller Foundation, and NITI Aayog. The remaining 46% either expressed dissatisfaction or were neither satisfied nor unsatisfied.

Electric Vehicle Policy 2021

The mission of the policy is to ensure the electric mobility transportation ecosystem in West Bengal.

Objectives:

Promote innovation actively through grants and venture funds to research organisations, incubators, and start-ups working on next-generation battery technology, fuel cell technologies, EV power trains, and EV electronics.

Enable investment into charging/battery swapping infrastructure, and hydrogen generation and fuelling station development

Promote usage of EVs to enable transition to environmentally friendly cities.

Target:

- Target to attain the position of among the top three best states in India in terms of electric mobility penetration by the end of FAME II implementation year 2022 and further. Additionally, it aims to become the best state in electric mobility penetration by 2030.
- The goal is to have 10 lakh EVs across all vehicle segments during the implementation of the policy.
- To have 1 lakh public, semi-public charging stations during the policy implementation
- Achieve an EV/public charge point ratio of 8 by the implementation of policy. Create a robust infrastructure for EVs, including an adequate supply network of charging points with favourable power tariffs.
- Recycle and reuse used batteries, and dispose of the rejected batteries in an environmentally friendly manner to avoid pollution.

Actual attainment of electric mobility penetration in West Bengal

Though the national EV policies FAME-I (2015-2019) and FAME-II (2019-2024) intend to support the faster penetration of EVs across the states, the situation is different in West Bengal. During the FAME-I phase, the state had a significantly higher CAGR rate of 132.2%, whereas it sharply declined to 15.4% during the FAME-II phase. This phase II covers the state's EV policy for 2021, in which West Bengal again faces a higher rate of CAGR at 109.8%. This increase in growth rate is a result of both the additional state-level policy impact and the state's contribution to the national EV policy. In particular, incentives and infrastructure, such as EV charging stations, play a critical role in EV penetration. West Bengal has the highest number of charging stations, but their EV share is lower than Bihar's share among the eastern states (Das & Maheshkumar, 2024). Notably, West Bengal's EV policy for 2021 set a target of achieving a total of 10 lakh EVs in its total vehicles. However, even after adding all the vehicles from 2000 to 2024, the total still stands at only 88 thousand. There are still six years left to meet the 2030 deadlines for both national and state-level EV policies. At this speed of penetration level, it's quite challenging for West Bengal to attain its targeted number of EVs as well as become the best in EV penetration in India.

Table 10: Number and CAGR of total EVs in West Bengal

Year	EVs	Cumulative	CAGR
2000-01	15		
2001-02	1757		
2002-03	516		
2003-04	98		
2004-05	12		
2005-06	11		
2006-07	16		
2007-08	50		
2008-09	163		
2009-10	69		**FAME - I**
2010-11	130		(2015-2019)
2011-12	403		1.322
2012-13	103		132.20%
2013-14	15	(2000-2015)	
2014-15	3	3361	**FAME - II**
2015-16	617		(2019-2024)
2016-17	1680	(2000-2019)	0.154
2017-18	5470	18850	15.40%
2018-19	7722		
2019-20	15044	(2000-2024)	**WB EV 2021**
2020-21	8202	88086	(2021-24)
2021-22	6061		1.098

2022-23	13261	109.8
2023-24	26668	

Source: Author's estimation using

State-level Institutions on directing energy transition

West Bengal Renewable Energy Development Agency (WBREDA).

The West Bengal Renewable Energy Development Agency, which was established in 1993, is responsible for the promotion of renewable energy technologies and the setting of an environment that is conducive to their commercialisation through innovative initiatives. The corporate location of the agency, which is commonly referred to as WBREDA, is located in Kolkata, India. The State Nodal Agency for the implementation of non-conventional energy programs in West Bengal is the West Bengal Renewable Energy Development Agency (WBREDA).

To foster the widespread adoption of Renewable Energy Technologies and to establish an environment conducive to its implementation through innovative initiatives. To mitigate carbon footprints, various renewable energy initiatives, including solar, wind, biomass, biogas, and tidal, are being implemented.

West Bengal State Forest Development Agency (WBSDA)

Objective of the Action Plan of WBSDA:

- Proactively implement all mandates of the Energy Conservation (EC) Act in coordination with the Bureau of Energy Efficiency (BEE), the State Government, and other relevant stakeholders.
- Promote energy efficiency across all major commercial energy sources, including coal, oil, and electricity.
- Achieve reductions in energy consumption across the entire energy value chain—generation, transmission, distribution, and end-use—through efficiency improvements and the rational use of energy.
- Address issues such as energy and demand shortages by implementing targeted Demand Side Management (DSM) initiatives.
- Support the reduction of greenhouse gas (GHG) emissions across the state of West Bengal.
- Encourage the adoption of energy-efficient technologies, equipment, processes, and devices.
- Raise public awareness regarding the EC Act, energy efficiency practices, standards, and best practices.
- Promote understanding and implementation of the Energy Conservation Building Code (ECBC) and Standards & Labeling (S&L) programs.
- Reduce fuel consumption in the transport sector through enhanced efficiency measures.
- Lower energy usage in the domestic sector by educating and engaging consumers on energy-saving practices.

Future Plan

Installation of Roof Top Grid Connected Solar Photovoltaic Power Plant at an Additional 900 Nos. of Schools @ 10 kW each, 50 Nos. of Colleges @ 20 kW each, and a Cumulative Capacity of 10 MW. Total financial outlay for implementation of the project shall be Rs. 107.70 Crore.

Installation of 20 nos. Roof Top Grid Connected Solar Photovoltaic with a cumulative capacity of 1 MW and 2 BIPV Power Plants of a cumulative Capacity of 0.2 MW [Total: 1.2 MW]. Total financial outlay for implementation of the project shall be Rs. 6.86 Cr.

Observation of various days related to environment/science/energy sources, etc., in all districts in West Bengal. Total financial outlay for implementation of the project is estimated to be Rs. 1.50 Cr.

Waste to Energy Programme – target coverage is 5 pilot projects. Total financial outlay for the incentives shall be Rs. 1.00 Cr.

Decentralized Renewable Energy (DRE) for Livelihood Programme with specific applications useful for SHG, Fishery, MSME, and Agriculture Sectors, etc. Total financial outlay for the scheme shall be Rs. 5 Cr.

Wind Energy programme - survey and first phase of installation works at Mousumi Island, Sagar, Freserganj, Delo, Tonglu, Sandakphu –Falut, Panbu Dara, GiddaPahar. Total financial outlay for the programme shall be Rs. 5.00 Cr.

A new Renewable Energy Policy for the State of West Bengal is being formulated, i.e., NREMPP 2023.

West Bengal Green Energy Development Corporation Ltd. (WBGEDCL)

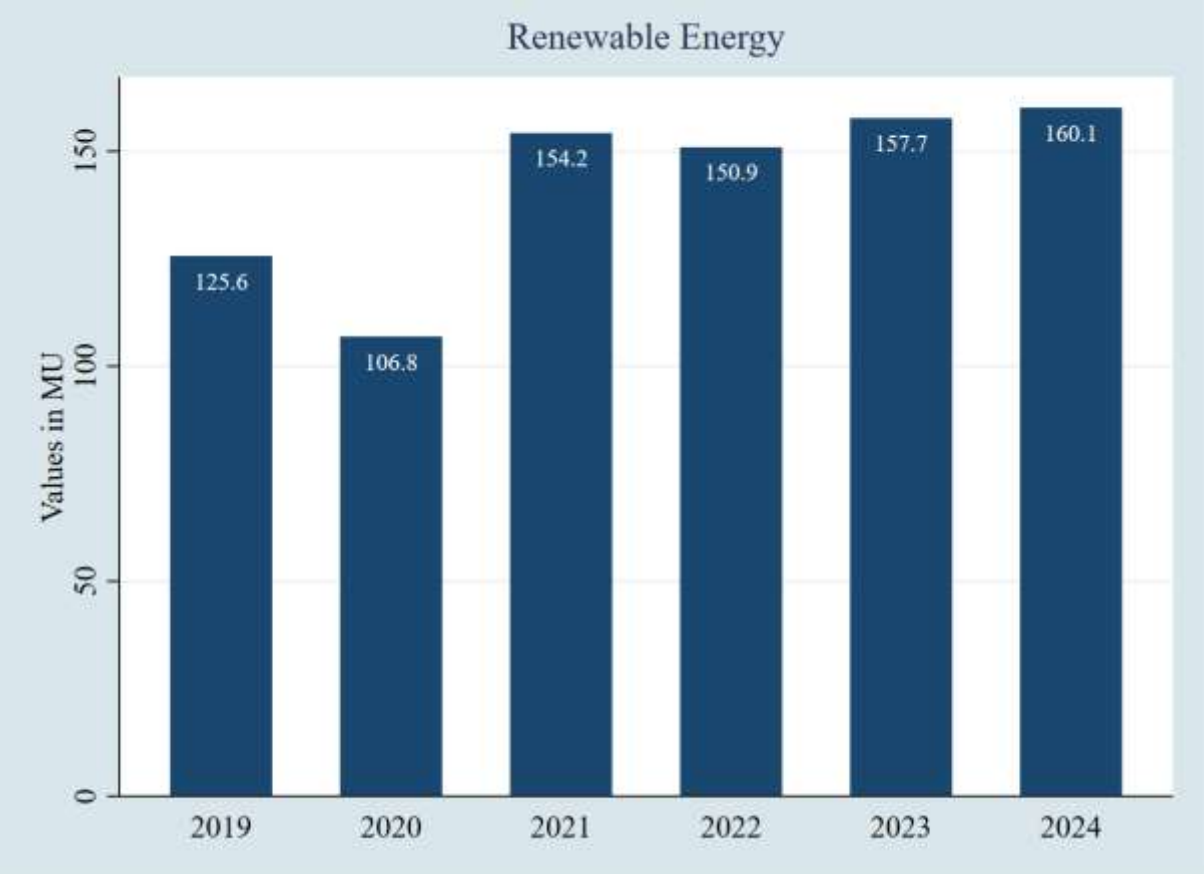
West Bengal Green Energy Development Corporation Ltd. (WBGEDCL) was established in accordance with the Companies Act, 1956. It was established by the Department of Power & Non-Conventional Energy Sources, Govt. of West Bengal, under the Companies Act, 1956, on December 26, 2007, as a joint venture company of West Bengal Power Development Corporation Limited (WBPDCL), West Bengal State Electricity Distribution Company Limited (WBSEDCL), and West Bengal Renewable Energy Development Agency (WBREDA). The equity share ratio of the company is 45:35:20.

The objective of WBGEDCL is to encourage investment in grid-connected renewable energy projects and various green energy sources, as well as to develop and execute renewable energy projects.

Renewable Energy: A Potential Future

Renewable energy sources, such as solar and wind, would be the most cost-effective, and they are untapped resources in the state of West Bengal. In particular, the state only has 6% of renewable energy sources installed, excluding hydropower. As a result, it has the most untapped RE sources, particularly solar and wind sources. This holds significant potential for the state in terms of its market scope and employment generation.

Figure 4: Renewable Energy trend in West Bengal



Source: Author's calculation based on data from the CEA dashboard.

Figure 4 presents the renewable energy output for West Bengal from 2019 to 2024, showing a fluctuating yet generally upward trend. In 2019, the renewable energy generation stood at 125.59 MU, which decreased to 106.84 MU in 2020. Temporary disruptions in energy production or capacity limitations may be the cause of this decline. However, from 2021 onwards, the state experienced a consistent rise in renewable energy output, with an increase of 154.18 MU in 2021, followed by 150.91 MU in 2022, and continuing to rise in 2023 and 2024, reaching 157.66 MU and 160.08 MU, respectively. The total average across these years is 147.12 MU, indicating a steady improvement in the state's renewable energy generation. This upward trend suggests that West Bengal is making progress in expanding its renewable energy capacity, likely driven by investments in infrastructure, technological advancements, and government support. The overall increase from 2021 onward may also reflect the

growing importance of sustainable energy in meeting the state's power demands while addressing environmental concerns. The positive trajectory indicates that the state is likely to continue increasing its renewable energy output in the coming years, contributing to a more sustainable and resilient energy sector.

Solar Energy

Among renewable energy sources, solar power makes a significant contribution in the state. The data from 2019 to 2024 reveals a consistent upward trend in solar energy generation. As illustrated in Figure 5, solar output in West Bengal has steadily increased over these years. In 2019, solar energy production stood at 5.2 MU, rising slightly to 5.4 MU in 2020. A notable surge occurred in 2021 when output jumped to 7.8 MU, followed by further growth to 9.0 MU in 2022. The upward momentum accelerated in 2023, reaching 12.7 MU, and projections suggest that solar generation will hit 16.3 MU by 2024. Throughout this period, the average annual solar energy output was 9.3 MU.

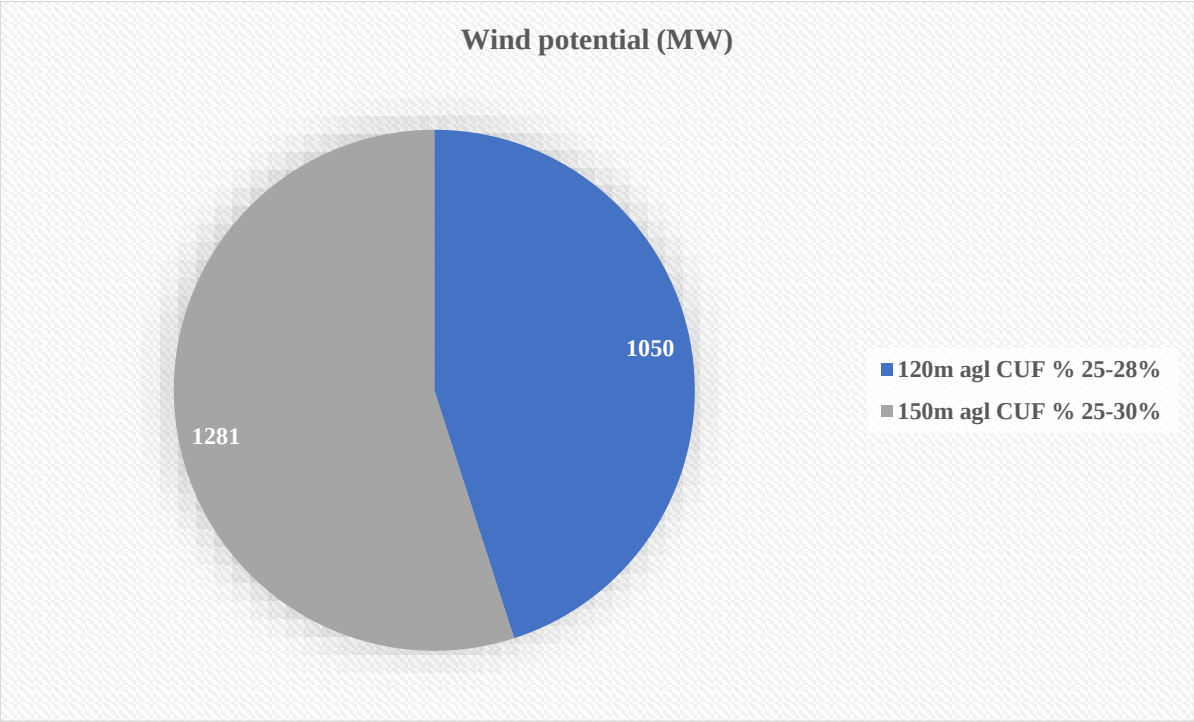
This data highlights strong growth in West Bengal's solar energy capacity, particularly after 2020. The rise reflects the ongoing expansion of solar infrastructure, likely driven by supportive government policies and increasing demand for clean energy. As solar power becomes an increasingly vital part of the state's energy portfolio, it will play a key role in reducing reliance on traditional energy sources and advancing West Bengal's sustainability and energy security objectives. The steady increase also points to significant potential for continued growth as investments in renewable energy continue.

Figure 5: Solar Contribution to Renewable Energy in West Bengal

Source: Author's calculation based on data from the CEA dashboard, with data available up to March 2024.

Wind Power

Figure 6: Wind Potential in West Bengal



Source: National Institute of Wind Energy (NIWE), 2019 & 2023.

Figure 6 shows the projection for West Bengal's wind energy potential. At the 150 m wind turbine height, the state has around 1281 MW capacity, and at the 120 m height, it has 1050 MW capacity. Exploration, investment, and strategic policy considerations would improve this sector and contribute more to renewable energy. The state should prioritise the potential of wind energy and implement more projects to ensure long-term energy security for both the state and the country.

Energy Transition

- Increase substantially the share of renewable energy in the global energy mix.
- 2% of total electrical energy consumption should be from renewable sources from plants installed
- Introduction of hydrogen-fueled heavy vehicles.
- Exploration of Geothermal Energy prospects.
- Energy efficiency enhancement by 5%.
- Electric buses run by city authorities for intra-city transport.
- 600 kWh power is being generated from one biomass converter unit, making use of segregated wet waste of 5 TPD.
- Solar benches and solar trees* have been installed in the city.
- Solar pavements are coming up in the town.
- New Town intends to have hydrogen-fueled vehicles.
- *A solar tree is a tree-like metal structure with solar panels attached to the branches. Solar energy is generated by solar panels connected to metal branches. Each of the 35 panels on the CMERI solar tree has a 330-watt capacity.

*A solar tree is a tree-like metal structure with solar panels attached to the branches. Solar panels connected with metal branches generate solar energy. Each of the 35 panels on the CMERI solar tree has a 330-watt capacity. One main and currently focused energy transition is shifting toward electric vehicles. Fossil fuels currently meet the majority of India's energy needs, with less than 1% of vehicles being electric. To address this issue, the Indian government has launched a number of programs to encourage the production and use of electric vehicles in India.

According to this goal, the West Bengal government published a complete electric vehicle strategy in June 2021, including the state's push for vehicle electrification. The policy aims to create 1 lakh public and semi-public charging stations and 10 lakh electric vehicles within five years. However, the number of registered Evs stands at just 16,202. On four-lane highways, the government intends to install one charging station every 25 km, and in urban areas, one station every 3 square km. Currently, 189 charging stations are operating. The New Town Kolkata Development Authority (NKDA) has installed 10 public charging stations for e-scooters and e-cars. The NKDA has installed these near the Kolkata gate, the Tata medical centre, and the eco parking area gates.As of July 2020, West Bengal has the maximum number of 4W Evs in the country, followed by Tamil Nadu.

People are hesitant to purchase EVs due to the high cost of batteries. Electric vehicles equipped with Li-ion batteries have a lifespan of 6-7 years, or approximately 8 years, after which the user must buy a new battery, which can cost nearly ¾ of the total vehicle price. Also, many people live in apartments, making it difficult to charge their vehicles. Also, one of the most crucial parts of an EV is the battery, which occasionally encounters issues like lower capacity or failure. Batteries can malfunction due to age, excessive use, or even the weather. Therefore, it is crucial to regularly monitor the vehicle's usage and the remaining battery life. Another issue that the people brought up was "range anxiety," which refers to the length of time one can go without recharging.

Kolkata, supports a deal that seeks to phase out fossil fuels fairly. It is only the third Asian city overall, and the first Indian city to do so. According to a statement by the municipal corporation, it joins 64 other cities and subnational governments around the globe that have endorsed the fossil fuel non-proliferation treaty, including cities like Paris, London, Sydney, and Los Angeles. The effort is a call to action for a global system to oversee a swift and equitable shift away from coal, oil, and gas. It intends to follow in the footsteps of earlier non-proliferation agreements, such as the nuclear weapons ban treaty and the WHO's framework for tobacco control.

Before the pandemic, diesel vehicles dominated the automotive industry, but they are no longer the most cost-effective option. In addition, the strict Bharat Stage VI emission standards have pushed numerous automakers to stop producing diesel cars. In Bengal, the number of registered diesel vehicles dropped from 1.1 lakh in 2018 to just 61,000 by 2021. Until July this year, the number of registered diesel vehicles exceeded 43,000. Despite a decrease in registration for gasoline-powered automobiles, the decline is not as severe.

Major Challenges for the Energy Transition in West Bengal

Switching to renewable energy can be difficult for a variety of reasons, including natural constraints such as low luminosity, which impedes solar power generation, or low wind speed, which impedes wind power production. In addition to maximising the potential already there, the policy can also search for opportunities for innovation, such as trading energy with high-potential states. Its dependence on coal can present another obstacle to the adoption of alternative sources. In addition to these requirements, embracing renewable energy also necessitates significant upfront costs and personnel reskilling.

Due to its location in the nation's coal region, West Bengal has historically relied heavily on coal as a source of primary energy and to power its thermal power plants. In the scenario of sea level rise owing to climate change, it is also one of the most susceptible states. As a result, the state must prioritise energy transition in its responsible policy-making. However, when examining the trends in renewable electricity production by the various states, West Bengal falls behind in getting its act together.

Despite all these challenges, the Government of West Bengal is pushing hard for all these energy transitions to occur. Before moving on to the energy sectors in detail, let us first look at the macro scenario in the context of energy.

Thermal Power Dependency

In West Bengal, a thermal spring near Bakreswar releases thermal water. Silica thermometry reveals that the computed base temperature in the aforementioned spring is likely 110 °C. The required steps are being made to generate electricity from this thermal spring. Different parts of West Bengal may contain this type of thermal spring, which has the potential to generate electricity. The Indian government's MNRE has taken the initiative to use this thermal spring for the aforementioned purpose.

Natural Resource Endowment, Employment, and Challenges in the Phase Down of Coal

West Bengal is a coal-rich state. Most thermal plants here use coal as their primary resource to generate electricity. West Bengal reported a lower coal production in 2022, at 29.070 Ton Mn., compared to the previous year’s 30.463 Ton Mn. This graph clearly shows the state’s dependence on coal, which has increased over the years.

It would be a messy and challenging process to switch from coal to more renewable energy sources, according to academics at the National Foundation for India (NFI). During a phaseout in these industries, some job profiles are more vulnerable than others, such as coal transport or coal handling at power operations. The state should consider the impact of the shift away from coal on workers across various industries, specifically focusing on contract/informal labour and their socio-economic profile. If excluded, a “significant chunk of the labour force” may not benefit from the shift. To successfully phase out coal use, the state must develop a road map that “accounts for the technical, social, and economic transition of coal to put the people at the center of its plan.” The roadmap must include

representation from trade unionists and community leaders, who will effectively serve as the communication link between management, governments, and the broader labour community. Without adequate early preparation, any of these plant closures will likely worsen livelihood opportunities in this district.

WBPDCL is West Bengal's leading power-generating company. Five thermal power plants make up its installed capacity of 4265 MW.

All these plants are coal-based. West Bengal is well-renowned for producing coal. Many areas of the state contain coal, and mining has been ongoing for the past 100 years. The Ministry of Coal, Government of India, has assigned WBPDCL 6 coal mines to supply coal to its end-use thermal power plants.

1. Pachhwara (North) Coal Mine (Location: Dist- Pakur, Jharkhand)
2. Barjora (North) Coal Mine (Location: Dist- Bankura, West Bengal)
3. Barjora Coal Mine (Location: Dist- Birbhum, West Bengal)
4. Gangaramchak & Gangaramchak- Bhadulia Coal Mine (Location: Dist- Birbhum, West Bengal)
5. Tara (East) & Tara (West) Coal Mine (Location: Dist- Paschim Burdwan, West Bengal)
6. Deocha- Pachami -Dewanganj –Harinsingha Coal Mine (Location: Dist-Birbhum, West Bengal)

It anticipates that the total coal demand for WBPDCL units in 2022-2023 will be around 21 million metric tonnes (mt), with the state's mines providing approximately 16 million mt and Coal India providing the remaining five million mt. In 2023–2024, the state-owned West Bengal Power Development Corporation's (WBPDCL) thermal power facilities could become independent of Coal India and stop sourcing coal from local mines.

Table 11: Operational capacity of the coal in West Bengal

Plant Name	Implementing Agency	Operational Units	Operational Capacity (MW)
Durgapur Projects (D.P.L.) TPS	Durgapur Projects Ltd.	7, 8	550
Farakka STPS	NTPC Ltd.	1, 2, 3, 4, 5, 6	2100
Kolaghat TPS	West Bengal Power Development Corp. Ltd.	3, 4, 5, 6	840
Titagarh TPS	Calcutta Electric Supply Corp. Ltd. (CESC Ltd.)	1, 2, 3, 4	240
Raghunathpur TPS	Damodar Valley Corporation (DVC)	1, 2	1200
Budge Budge TPS	Calcutta Electric Supply Corp. Ltd. (CESC Ltd.)	1, 2, 3	750
Sagardighi TPS	West Bengal Power Development Corp. Ltd.	1, 2, 3, 4	1600
Haldia TPP	Haldia Energy Ltd. (a subsidiary of CESC Ltd.)	1, 2	600
Santaldih TPS	West Bengal Power Development Corp. Ltd.	5, 6	500
Durgapur Steel TPS	Damodar Valley Corporation (DVC)	1, 2	1000
Bandel TPS	West Bengal Power Development Corp. Ltd.	2, 5	270
Southern Generating Power Station (Southern Repl. TPS)	Calcutta Electric Supply Corp. Ltd. (CESC Ltd.)	1, 2	135
Hiranmaye TPP	Hiranmaye Energy Ltd.	1, 2	300
Dishergarh TPS	India Power Corporation Ltd. (IPCL)/ DPSCL Ltd.	1	12
Bakreshwar TPS	West Bengal Power Development Corp. Ltd.	1, 2, 3, 4, 5	1050
Mejia TPS	Damodar Valley Corporation (DVC)	1, 2, 3, 4, 5, 6, 7, 8	2340

Source: NITI Aayog | India's Climate and Energy Dashboard (2024)

West Bengal has a total of 16 coal-based power stations, which is the second greatest number of such units among the eastern states, as seen in Table 10. According to the statistics from the India Climate Energy Dashboard (ICED) in 2024, Chhattisgarh has the highest number of coal power stations among the eastern states, with West Bengal following closely behind (ICED, 2024).

Problems Raised:

- No coal-based thermal power plants in West Bengal have implemented flue gas desulphurization (FDG), a method to remove sulphur compounds from exhaust emissions.
- The Centre for Research on Energy and Clean Air (CREA), an independent research organisation, found that while plants that account for 40% of the state's coal-based power generation capacity have not yet received contracts for FDG units, the remaining power production facilities were unable to complete the installation of the technology within the allotted time frame.
- According to the CREA report, despite warnings to limit emissions of sulphur dioxide, nitrogen oxide, and mercury, tighten standards for particulate matter emissions, and set water consumption limits, all coal-based power plants have made pitiful progress.

Recent Updates

Over the next seven years, Damodar Valley Corporation (DVC) intends to increase the amount of electricity it produces annually. To reach its goal of 15000 MW of annual power generation by 2030, it plans to increase yearly power generation by 8000 MW from the existing 7000 MW. To achieve this, the state will construct two solar power plants with a total capacity of 2,000 MW and three thermal power plants. The state will establish the thermal power plants in Raghunathpur (1,320 MW), Koderma (1,600 MW), and Durgapur (800 MW).

Challenges

By the end of 2022, the central government set a target of generating 5,336 megawatts (MW) of solar power, but the Government of West Bengal (GoW) opposed this goal for several reasons. One key concern was that the state receives significantly less solar radiation compared to states with more favorable climates, such as Gujarat and Rajasthan. Consequently, West Bengal's return on investment in solar power would be much lower than that of these western states. Additionally, the GoW argued that allowing private individuals to generate solar energy through rooftop installations of up to 5 kW could complicate pricing policies for distribution companies due to the increased supply. Distribution firms currently use a cross-subsidy model to make electricity affordable for small consumers by charging higher rates to heavy users. However, if urban homeowners reduce their grid consumption by installing rooftop solar panels, it could disrupt this tariff structure. An official told *The Mint*

that while the state is not against renewable energy, financial stability must be taken into account.

Moreover, the Mousuni Island solar microgrid—a 55 kW installation in the Sundarbans, commissioned in 2001—was shut down around 2012–2013. Approximately 20 such abandoned solar microgrid units remain scattered across several islands in India's Sundarbans, which initially relied on these systems as their sole power source, leading to their eventual failure.

The adoption of electric vehicles (EVs) in the state also faces challenges, with limited time remaining to meet the 2030 deadline under the national EV policy. The phase-out of initial incentives under the FAME-I schemes and the transition to FAME-II are expected to influence consumer preferences and impact the state's EV market negatively.

To unlock untapped renewable energy sources, particularly wind and solar, West Bengal requires additional financing. The state is already grappling with an energy shortage, which further complicates efforts to expand capacity. This shortage threatens power-dependent sectors such as high-tech industries. To address these challenges, the state must secure green financing from various stakeholders, including large private investors and international donors. Without such support, West Bengal risks financial difficulties in managing ongoing and future energy projects.

Regarding industrial power consumption, the exemption allowing demand cuts of up to 50% of installed capacity assigned for captive use means that industrial customers with captive power plants can reduce their contracted demand with distribution companies (Discoms) by half of their captive plant's capacity. Industrial consumers pay "demand charges" to Discoms based on the electricity capacity they commit to, regardless of actual usage. This exemption enables them to lower their contracted demand, thereby reducing fixed demand charges on their bills. It allows industries to use power from their captive plants while still relying on the grid for additional electricity, when necessary, without incurring heavy penalties for underutilizing their grid allocation. This policy makes captive power generation more attractive to industrial users by reducing financial risks linked to fluctuating power needs and lessening full dependence on the grid.

However, this reduction could decrease revenue for Discoms, as they lose a portion of fixed demand charges typically collected from industrial consumers, who generally pay higher tariffs. This potential revenue loss could further strain the financial health of Discoms (Sharma, 2019).

Recommendations and Conclusion

West Bengal continues to rely heavily on conventional energy sources, particularly coal, for its power generation. Phasing out outdated coal plants offers the potential for quick and significant financial benefits for both the state's DISCOMs and consumers. During this transition, the state is committed to ensuring a just and inclusive approach, recognizing that many informal workers depend on the coal sector for their livelihoods. By shifting to renewable energy alternatives, West Bengal can save costs by avoiding expensive upgrades to aging infrastructure and reducing power procurement expenses.

To effectively implement climate actions at the state level, West Bengal must explore and adopt low-cost, climate-friendly technologies. Despite the growing energy demand, the state still faces a persistent energy supply shortage that is projected to widen in the coming years. Currently, only about 6% of the state's electricity generation comes from renewable sources, highlighting a large untapped clean energy potential.

This unused potential represents a valuable opportunity. By prioritizing investments in renewable energy infrastructure and fostering its development, West Bengal can significantly reduce carbon emissions while simultaneously driving job creation and economic growth within the renewable energy sector. Wind energy, in particular, should be a key focus of state-level policy, given its identified potential. Encouraging investment and creating a supportive market environment for wind power could complement the state's considerable progress in solar energy.

In West Bengal, private sector participation dominates renewable energy generation, while government involvement, both at the state and central levels, remains limited. Stronger government initiatives are essential to fully harness the sector's potential, especially to maximize development in underutilized areas such as solar and wind energy.

Although the state experiences a relatively smaller energy shortage compared to others, its demand still exceeds the available supply. Even minor deficits can disrupt power-dependent sectors, especially during peak demand times. As more industries adopt captive power generation, DISCOMs face revenue losses, threatening their financial stability. Current policies help mitigate these impacts by addressing tariff fluctuations and allowing exemptions on demand cuts.

Looking ahead, West Bengal must prepare for rising electricity demand driven by both domestic and industrial growth. This will require concerted efforts to enhance energy infrastructure, with greater reliance on renewable sources playing a central role. Expanding renewables could not only eliminate supply shortfalls but also strengthen the state's overall energy security.

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