State Energy Efficiency Action Plan – West Bengal

MARCH 2023

विद्युत मंत्रालय
MINISTRY OF
POWER

श्रीकांत नागुलापल्ली, भा.प्र.से.
अपर सचिव, एमओपी एवं महानिदेशक, बीईई
SRIKANT NAGULAPALLI, IAS
Additional Secretary, MoP & Director General, BEE

सत्यमेव जयते

Azadi Ka Amrit Mahotsav

ऊर्जा दक्षता ब्यूरो
(विद्युत मंत्रालय, भारत सरकार)
BUREAU OF ENERGY EFFICIENCY
(Ministry of Power, Government of India)

Foreword

The Bureau of Energy Efficiency (BEE), under the Ministry of Power, Government of India, has been actively working to promote energy efficiency across various sectors of the Indian economy through initiatives like the National Strategic Plan for Energy Efficiency and the National Mission ROSHANEE. These efforts align with India's commitment to doubling its energy efficiency improvement rate by 2030, as declared at the G20 summit.

To harness the vast potential for energy efficiency in sectors such as industry, buildings, agriculture, and transport, the State Energy Efficiency Action Plan (SEEAP) has been developed. SEEAP aims to establish clear state-wise focus areas and develop actionable strategies to mainstream energy efficiency interventions.

This report provides valuable insights for policymakers, government agencies, and other stakeholders to implement effective programs and achieve India's climate goals. It also serves as a platform for knowledge sharing and scaling up energy efficiency activities nationwide.

I am pleased to announce that most States/UTs have formed State Level Steering Committees (SLSCs) under the leadership of Chief Secretaries. These committees will play a crucial role in developing mechanisms to implement the identified action plans.

I encourage all stakeholders to review this document and contribute their valuable feedback to further enhance its effectiveness in promoting energy efficiency at the state level.

October, 2024

(Dr. Srikant Nagulapalli)

चौथा तल, सेवा भवन, आर.के. पुरम, नई दिल्ली-110066 / 4th Floor, Sewa Bhawan, R.K. Puram, New Delhi-110 066
दूरभाष / Tel. : 91 (11) 26766701, 20867389, फैक्स / Fax : 91 (11) 20867396
ई-मेल / E-mail : dg-bee@nic.in, वेबसाईट / Website : www.beeindia.gov.in

RIGHT TO INFORMATION

Acknowledgement

The development of “State Energy Efficiency Action Plan (SEEAP)” is an important step towards the Central-State collaboration for mainstreaming energy efficiency at the state level to achieve India’s climate commitments. This strategic document has been prepared based on collaboration of Bureau of Energy Efficiency, Ministry of Power, Government of India along with State Designated Agencies and different stakeholder and ministries in the state level.

PwC extends its profound gratitude to Shri Pankaj Agarwal, Secretary of the Ministry of Power, Government of India, and Mr. Shrikant Nagulpalli, Director General of the Bureau of Energy Efficiency (BEE), for their exceptional leadership and guidance during the execution of the assignment. The team also recognizes and expresses its sincere appreciation to Mr. Milind BhikanraoDeore, Secretary of BEE, for his invaluable contributions and insights throughout the assignment's execution. The team acknowledges the cooperation and unwavering support provided by Mr. Abhishek Sharma, Joint Director of BEE, for his supervisory role during the entire execution phase. The team also expresses its appreciation to Mr. Vikash Kumar Jha, Project Engineer at BEE, for his continuous support and effective coordination with various stakeholders.

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Lastly, we would like to thank internal team members for their hard work, dedication, and professionalism. Their collective efforts, expertise, and commitment to excellence have been the backbone of this project. In conclusion, this project stands as a testament to what can be achieved through collaborative efforts and shared goals.

PricewaterhouseCoopers Private Limited

State Energy Efficiency Action Plan – East Zone

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Abbreviations

Abbreviation List	Full Form
BEE	Bureau of Energy Efficiency
BEEP	Buildings Energy Efficiency Programme
CAGR	Compound Annual Growth Rate
COP	Conference of parties
DC	Designated Consumer
DISCOM	Distribution Company
DMA	Directorate of Municipal Administration
DPIIT	Department for Promotion of Industry and Internal Trade
DSM	Demand side management
ECBC	Energy Conservation Building Codes
ECM	Energy Conservation Measures
EE	Energy Efficiency
ESCO	Energy Services Company
EV	Electric Vehicles
FAME	Faster Adoption and Manufacture of (Hybrid and) Electric Vehicles
FDI	Foreign direct investment
FO	Furnace Oil
FY	Financial Year
GCV	Gross calorific value
GSDP	Gross state domestic product
GVA	Gross value added
HDV	Heavy duty vehicle
HSD	High speed diesel
HVAC	Heating, ventilation and cooling
ICE	Internal combustion engine
IIT	Indian Institute of Technology
INR	Indian Rupee
LDO	Light diesel oil
LED	Light emitting diode
LPG	Liquified petroleum gas
MSME	Micro, small and medium enterprises
MTOE	Million tonnes of oil equivalent
MU	Million units
MW	Megawatt
NDC	Nationally determined contributions
NKDA	New Town Kolkata Development Authority
NTPC	National Thermal Power Corporation
PAT	Perform Achieve and Trade
PM	Prime Minister
PWD	Public works department
SAIL	Steel authority of India Limited
SDA	State designated agency
SEC	Specific energy consumption
SEEAP	State energy efficiency action plan
SEZ	Special economic zone
SME	Small and medium enterprise
TOE	Tonnes of oil equivalent
TPP	Thermal power plant
UJALA	Unnat Jyoti Affordable LED for all

ULB	Urban Local Bodies
UNFCCC	United Nations Framework Convention on Climate Change
UNNATEE	Unlocking National Energy Efficiency Potential
UT	Union Territory
WB	West Bengal
WBERC	West Bengal State Electricity Regulatory Commission
WBPDCL	West Bengal Power Development Corporation Ltd.
WBSEB	West Bengal State Electricity Board
WBSEB	West Bengal State Electricity Board
WBSEDCL	West Bengal State Electricity Distribution Company Ltd.
WBSETCL	West Bengal State Electricity Transmission Company Ltd

Executive Summary

India is a diverse country with diverse energy consumption patterns in different states/UTs. Broadly, the energy consumption is divided in five major sectors i.e., Buildings, Transportation, Municipalities and DISCOMs, Agriculture and Industries. Although India remains progressive and one of the front runners to achieve its Energy Efficiency (EE) potential, through innovative programmes such as the PAT scheme, Standards & Labelling, UJALA scheme, Energy Conservation Building Code, Electric Vehicle mission and Smart metering etc. However, at a state level, there is still an immense potential to be realized from large-scale implementation of EE interventions in various afore-mentioned demand sectors.

Therefore, there is a dire need for a focused sector-based energy efficiency approach by states/UTs. In view of this, the Bureau of energy efficiency has taken on this endeavor to state specific Energy Efficiency Action Plan through identification of focus sector, undertaking gap analysis, adopting best practices followed in peer group with implementation plan strategy; that can act as platform for developing State's Energy Policy and Programms.

The overall scope of work for this assignment is as follows:-

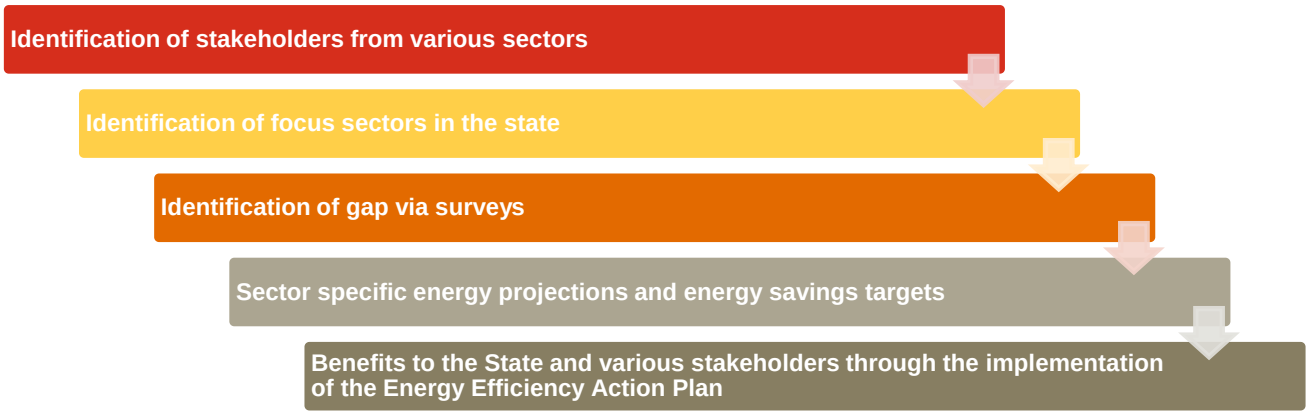


Figure 1: Broad scope of work

State context

West Bengal is one of the 29 States in India, lying in the eastern part of the country with a population of approximately 10 Cr. It has only 2.7% of the total landmass of the country. The State is divided into 23 administrative districts and has international borders with Bangladesh, Nepal and Bhutan and has common boundaries with the States of Odisha, Jharkhand, West Bengal, Sikkim and Assam. West Bengal is highly dependant on agriculture as majority of the state population are cultivators and agricultural labours.

From an energy standpoint - oil in the form of LPG, Petrol, Kerosene, HSD, LDO & FO is the most prominent source of energy followed by coal (coal for thermal power plant and non-power activities). Following figure illustrates the energy supply and consumption flow in the state: -

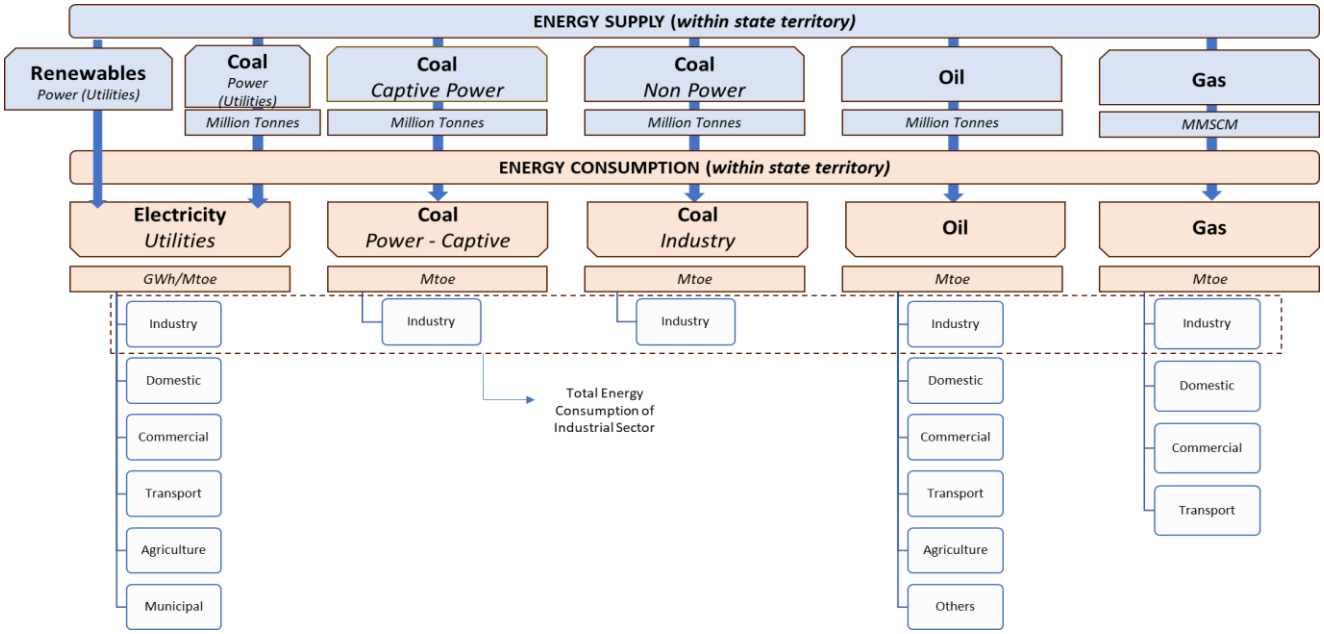


Figure 2: Energy flow in the state (supply and consumption)

From a consumption standpoint - the total energy consumption of West Bengal for the year 2019-20 has been estimated to be approximately 18.68 Mtoe for the year 2019-20. It is pertinent to mention here that oil consumption is the major contributor to this estimate at 8.06 Mtoe followed by coal (domestic and imported) at 6.26 Mtoe and electricity at 4.34 Mtoe. Following figure illustrates the same: -

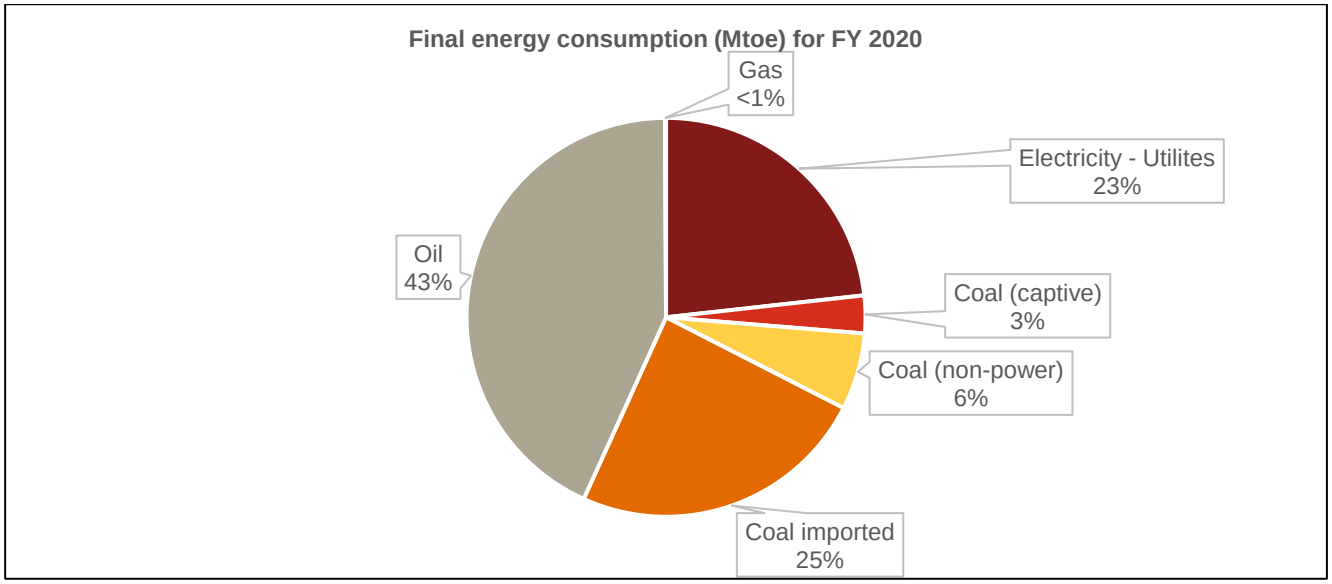


Figure 3: Fuel-wise split of total final energy consumption in West Bengal

Identification of focus sectors

For identifying the major energy guzzling sectors in the state, energy consumption data of a number of sectors was researched and analyzed. This data was gathered via primary consultations with the various stakeholders and through secondary domain research.

Based on this assessment, following sectors were identified as the most energy intensive in the state: -

Figure 4: Identified focus sectors

Projection and forecasting

It has long been axiomatic that economic growth and energy demand are linked. As an economy grows – its energy demand increases; if energy is constrained, GDP growth pulls back in turn. Following graph forecasts West Bengal's GSDP and its energy consumption from 2015 to 2030:-

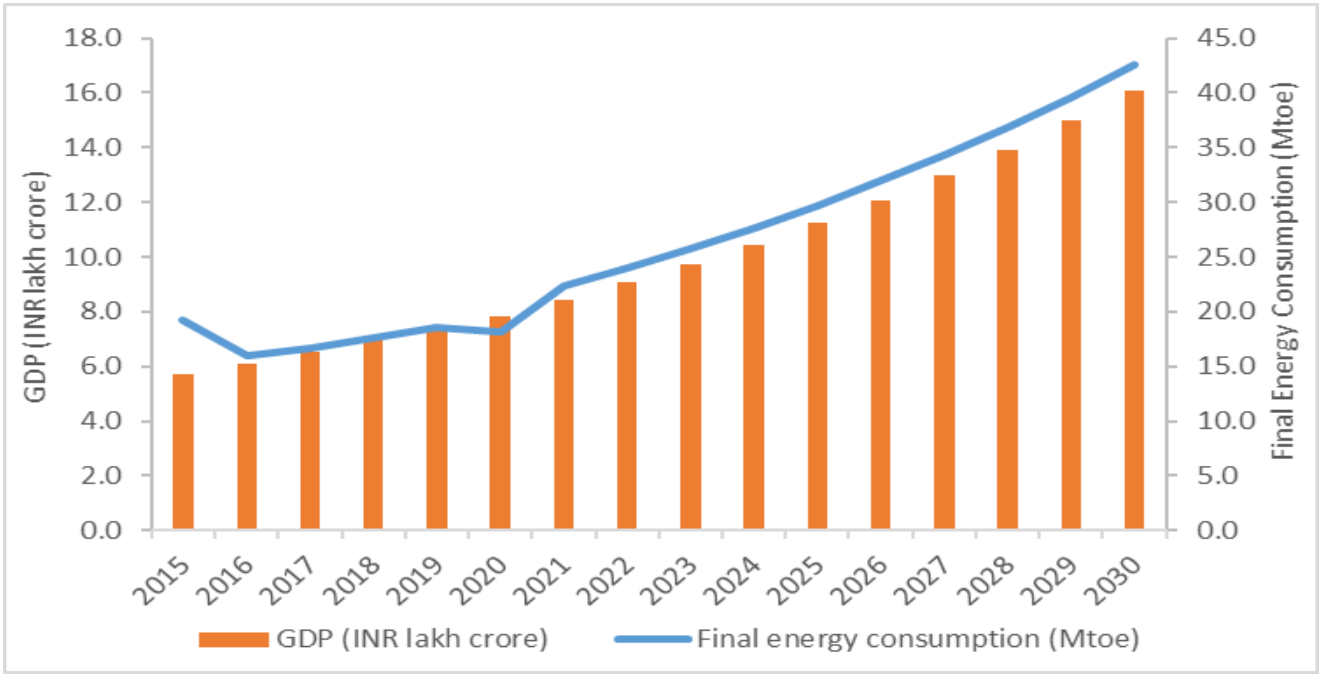


Figure 5: Energy consumption and GDP forecasting of West Bengal

The baseline energy consumption intensity for FY2020 was calculated (2.61) and multiplied with forecasted GSDP to obtain final energy consumption trend till 2030.

Focus sector 1 - Industries

Current scenario

The industries sector of West Bengal contributes 25%[1] to the state GDP. The major industries of West Bengal in terms of GVA is basic iron and steel, basic chemicals, food processing, textiles and metal casting, refined

1 Centre for Budget and Governance Accountability, India, 2018

petroleum products. From an energy perspective – industrial sector in West Bengal is one of the highest consumers in the state.

Energy efficiency potential in the sector

The estimated energy efficiency potential projected for the year 2030 in the industrial sector in West Bengal is as follows: -

Action Plan	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)
Action plan 1 (Deepening of PAT sectors)	0.0608	0.2179
Action plan 2 (EE in Non-PAT sectors)	0.106	0.298

The afore-mentioned moderate and ambitious scenarios have been discussed in detail in section 4.2 of the report.

Energy efficiency strategies in the sector

1. Action plan 1 - Deepening of PAT scheme: It is recommended that the threshold for the PAT criteria in terms of energy consumption may be lowered so as to accommodate more cement and sponge iron units present within the state. Following table illustrates the energy efficiency that can be achieved via this strategy:-

Baseline SEC (toe/tonne)	Moderate SEC (toe/tonne)	Ambitious SEC (toe/tonne)	Production in 2030 (tonnes)	Energy saving in moderate scenario (toe)	Energy saving in ambitious scenario (toe)
Cement	0.0708	0.0676	3601068	**1440**	**10082**
Iron and steel	0.55	0.4	1187952	**59397**	**207891**

(Note: For the moderate and Ambitious SEC assigned to cement and iron and steel units units - It is assumed that all the existing units will achieve the moderate SEC target in 50% units and achieve ambitious SEC target in 70% units.)

2. Action plan 2 - **:** Manufacturing MSME may be looked at more carefully from the lens of energy efficiency. A number of MSME industry clusters are there in West Bengal that are energy intensive. It is recommended that clay fired brick, brick and coke oven sectors may be incentivized or prompted to adopt energy efficient technologies. Following table illustrates the energy efficiency that can be achieved via this strategy:-

Baseline SEC (toe/tonne)	Moderate SEC (toe/tonne)	Ambitious SEC (toe/tonne)	Production in 2030 [2] (tonnes)	Energy saving in moderate scenario (toe)	Energy saving in ambitious scenario (toe)
Refractory	0.1378	0.0636	138627	5143	14400
Bricks	0.031	0.028	57018529	99430	278403
Foundry	0.093	0.0885	862106	106692	298738

(Note: For the moderate scenario it is assumed that 50% penetration of zig-zag in brick sector, tunnel kiln in refractory units and melting furnace in foundry units will take place. For the ambitious scenario it

[2] https://ibm.gov.in/IBMPortal/

is assumed that 70% penetration of zig-zag in brick sector, tunnel kiln in refractory units and melting furnace in foundry units will take place)

Focus sector 2 – Commercial and domestic buildings

Current scenario

The buildings sector in encompasses different types of buildings present in West Bengal i.e, domestic (households) and commercial (health facilities, commercial complexes, public buildings etc.). The domestic sector consumes more than 30% of the total electricity consumption in 2019-20 while the commercial buildings sector consumed around 14% of the total electricity.

Energy efficiency potential in the sector

The estimated energy efficiency potential projected for the year 2030 in the buildings sector in West Bengal is as follows: -

EE Strategy	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)
Strategy 1	0.253	0.441
Strategy 2	0.0006	0.0009
Strategy 3	0.015	0.030

Energy efficiency strategies in the sector

1. Action plan 1 – Replacement programme for inefficient appliances: Replacement of inefficient appliances with their efficient counterparts can be considered as a low hanging fruit from and energy efficiency implementation standpoint. This strategy can be implemented in both domestic as well as commercial buildings. As part of the strategy, following appliances have been identified that can be in the contention for replacement:-

Following table illustrates the energy efficiency that can be achieved via this strategy:-

Appliance	Inefficient stock in FY2020	Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
Fan	21941100	0.08	0.13
Air conditioner	3413060	0.027	0.044
Refrigerator	10970550	0.082	0.136
Washing Machine	9020230	0.008	0.014
Television	12677080	0.004	0.006

LPG cookstove	22672470	0.057	0.114

(Note: In moderate scenario, it is assumed that 30% of appliances will be replaced with efficient appliances and 10% switch to electric cookstove. In ambitious scenario, it is assumed 50% appliance replacement with efficient appliance and there will be a 20% switch to electric cook stove)

2. Action Plan 2 - it is recommended that the new and upcoming commercial and domestic buildings (having a connected load of minimum 100 kW) may be mandated as per the energy conservation buildings code (ECBC) in the state. Following table illustrates the energy efficiency that can be achieved via this strategy:-

2030 energy consumption in new commercial building more than 100 kW (Mtoe)	Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
0.002474	**0.0006**	**0.0009**

(Note: In moderate scenario, it is assumed ECBC will be implemented in new commercial buildings more than 100 kW connected load and lead to 25% savings. In ambitious scenario, ECBC is assumed to be implemented in new commercial buildings more than 100 kW and lead to 35% savings)

3. Action plan 3 - Under this strategy, it is recommended that periodic energy audits may be carried out at public/commercial buildings on load basis. Directives may be issued to government departments to carry out detailed energy audits at their respective building facilities. Following table illustrates the energy efficiency that can be achieved via this strategy: -

2030 energy consumption in commercial and public buildings sector (Mtoe)	Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
0.991	**0.015**	**0.030**

(Note: In moderate scenario, it is assumed 5% buildings will have energy audit and in ambitious scenario, it is assumed 10% of buildings will get energy audit. In ambitious scenario, it is assumed that energy audit recommendations implementation will lead to 30% savings.)

Focus sector 3 – Transport

Current scenario

The transport sector is one of the major consumers of energy in West Bengal and contributes to approximately 27% of the total energy consumption in the state from a sector perspective.

Energy efficiency potential in the sector

Following table estimates the energy efficiency potential projected for the year 2030 in the transport sector in West Bengal:

Strategy	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)
Strategy 1 (Transition from ICE to EV)	0.115	0.215

Strategy 2 (20% ethanol blending)	1.5582

Energy efficiency strategies in the sector

1. Action Plan 1: **Transition of existing fleet to electric vehicles:** Under this strategy, it is recommended to transition the existing ICE (Internal combustion Engine) fleet (two wheelers, three wheelers, four wheelers, bus and heavy vehicles) to electric vehicles. Following table encapsulates both the aforementioned scenarios and demonstrates the energy efficiency potential in the year 2030 as per this strategy of transition from ICE to electric vehicles :-

Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
0.115	**0.215**

(Note: As per NITI Aayog projections, 80% EV penetration in two-wheelers, 80% EV penetration in three-wheelers, 30% EV penetration in four-wheelers, 40% EV penetration in buses and 20% EV penetration in HDV in moderate scenario. 100% EV penetration in two-wheelers, 100% EV penetration in three-wheelers, 60% EV penetration in four-wheelers, 80% EV penetration in buses and 40% EV penetration in HDV in ambitious scenario)

2. Action plan 2: **Ethanol blending programme:** Under this strategy - it is recommended that, as per the national target, ethanol blending in conventional fuels may be executed. The target already set in this segment is 20%. Following table encapsulates both the aforementioned scenarios and demonstrates the energy efficiency potential in 2030 as per this strategy: -

2025 energy consumption in transport (Mtoe)	Energy saving as per policy (Mtoe)
	1.5582

Focus sector 4 – Agriculture

Current scenario

The agriculture sector is a major area of economic activity in West Bengal and accounts for 18.33% of the state GSDP and 59% (5.2 million hectares) of state geographical area is under agriculture. This is considered as a focus area as it employs majority of the population in the state. From and energy consumption standpoint - most of the energy consumption in agriculture sector of West Bengal can be attributed to irrigation pumps and tractors.

Energy efficiency potential in the sector

Following table estimates the energy efficiency potential projected for the year 2030 in the transport sector in West Bengal:

Strategy	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)
Strategy 1 (Replacement of diesel pumps with solar based pumps)	0.068	0.093

Strategy 2 (Replacement of inefficient pumps with BEE 5 star efficient pumps	0.0100	0.0232

Energy efficiency strategies in the sector

1. Action Plan 1 - **Transition of existing diesel pumps to solar based pumps:** Under this strategy, it is recommended that the existing stock of diesel-based pumps may be replaced by solar based pumps by 2025.

   Following table encapsulates both the aforementioned scenarios and demonstrates the energy efficiency potential in the year 2030 as per this strategy of transition from diesel pumps to solar based pumps :-

Diesel pumps estimated inventory by 2025	Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
330,000	0.068	0.093

   (Note: By 2025, moderate scenario assumes 75% replacement of diesel pumps with solar pumps. By 2025, ambitious scenario assumes 100% replacement with solar pumps)

2. Action plan 2 - **Replacement of inefficient electric pumps with efficient electric pumps:** Under this strategy, it is recommended that the existing stock of inefficient electric pumps may be replaced by solar based pumps by 2025.

   Following table encapsulates both the aforementioned scenarios and demonstrates the energy efficiency potential in 2030 as per this strategy:-

Inefficient pumps estimated inventory by 2030	Inefficient pumps replaced by Star-Rated pumps in ambitious scenario by 2030	Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
442182	**132655**	309528	0.0100

Introduction

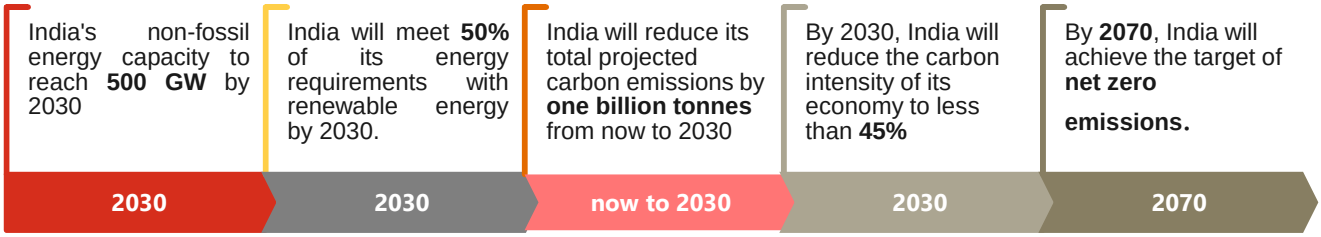
Background and about State Energy Efficiency Action Plan

The objective of the **State Energy Efficiency Action Plan (SEEAP)** is to ensure that the allocation of resources is as per the requirement of the state and to estimate the potential of energy conservation in sectors that are predominant in the region. The current assignment envisions the following:

- Identification of stakeholders from various sectors,
- Identification of focus sectors in a state,
- Identification of gaps through surveys,
- Sector-specific energy projections and energy savings targets
- Benefits to the State and various stakeholders through the implementation of the Energy Efficiency Action Plan

India's Nationally Determined Contributions and Mission LiFE

India's first NDC in **Paris Agreement on Climate Change - 2016** called for **33-35%** reduction of emissions intensity of GDP by 2030 compared to 2005. However, this target has been increased to **45%** in the recent COP26. The five ambitions, also known as **Panchamrit,** that India announced in the recent Conference of Parties (COP-26) at Glasgow, UK, are as follows:



What is Mission LiFE?

Mission LiFE is an India-led global mass movement to nudge individual and community action to protect and preserve the environment. At the 26th session of the Conference of the Parties (COP26) to the United Nations Framework Convention on Climate Change (UNFCCC) held in Glasgow, United Kingdom, India shared the mantra of LiFE - Lifestyle for Environment - to combat climate change. India is the first country to include LiFE in its Nationally Determined Contributions (NDCs).

Need for this assignment

With the energy efficiency agenda gaining traction and momentum in India, there is a need to continuously evaluate institutional capacity, policies, programs, and markets at the state level to identify best practices and promote cross learning. Developing State Specific Energy Efficiency Action Plan through identification of **focus sector**, **undertaking gap analysis**, **adopting best practices** followed in peer group with **implementation plan strategy**; that can act as platform for developing State's Energy Policy and Programs. This assignment aims to develop State Specific Energy Efficiency Action Plans for the state of West Bengal.

India is a diverse country with diverse energy consumption patterns in different states/UTs. Broadly, the energy consumption is divided in five major sectors i.e., **Industries, Buildings, Transportation, Agriculture, Municipalities and DISCOMs.**

Though energy efficiency is a multi-dimensional subject, defining key focus areas to bridge gaps is the need of the hour. For instance, there may be states with lesser urbanized areas and therefore lesser number of high

energy consumption buildings. Such a state may need more focus on energy efficiency in sectors such as Transportation, Agriculture, or others.

As a part of the assignment, there has identification of stakeholders from various sectors, identification of focus sector in the state of West bengal, identification of gaps in the sector, providing best practices and identification of designated agency to carry out efficiency activity in the sector in consultation with state for preparation of a short-term plan till the year 2025 and a medium-term plan till the year 2030. The plan also highlights the benefits derived from these initiatives to the state.

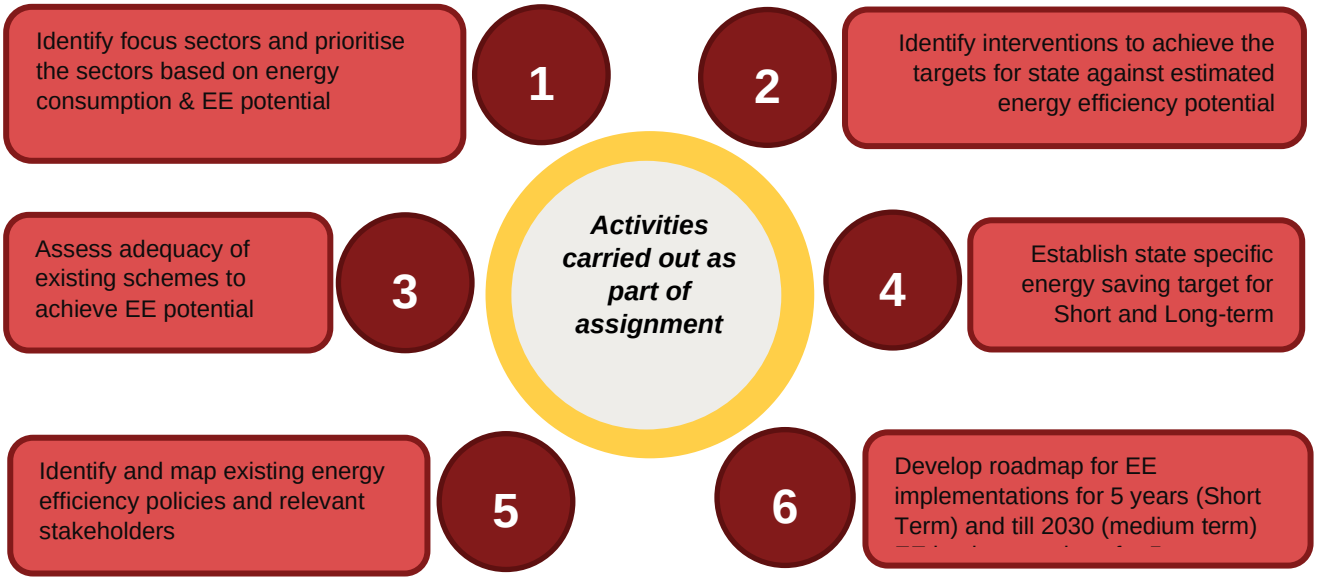


Figure 6: Key activities of the project

State profile

Situated in the eastern part of India and shares international borders with Bangladesh, Bhutan and Nepal - It is the fourth most populated state (constitutes 7% of the country's total population) in India with a total population of approximately 9 million and a literacy rate of 77.1%. It has navigable waterways with 950 km of waterfront and constitutes 13% of the national coastline. It is richly gifted with natural maritime advantages. It also has a vast road network of 3,15,404 km and a road density of 333.5 km per 1000 sq. meters. It has the second-largest metro rail network in the country and a leading rail density with approximately 4000 km of railway tracks. Key sectors in West Bengal are:

Figure 7: Key sectors in West Bengal

Moreover, following table provides a cursory glance at the state profile compared to India:

Table 1: Key socio-economic, physiographic and natural resource profile of West Bengal[3]

S.No.	Parameter	West Bengal	India
1.	Number of Districts (2016)	23	640
2.	Number of Blocks (2011)	341	6,612

[3] Statistical Abstract 2015

Bureau of Applied Economics & Statistics, GoWB

Directorate of Census Operation, West Bengal

Office of the Registrar General, GoI

Paschim Banga Sarva Shiksha Mission

Department of Higher Education, GoWB

State of Environment Report, West Bengal, 2016

Department of Power and Non-Conventional Energy Sources, GoWB

Chief Inspector of Factories, West Bengal

Public Works (Roads) Department, GoWB

WRIDD. Flood Report 2016

3.	Gross State Domestic Product at constant prices (2014-15)	₹3,98,387 Cr	106.44 lakh crore
4.	Per Capita Income (2014-15) at constant prices (2011-12)	₹38,624	₹74,193
a.	Share of Primary Sector in GSDP	24.87%	18.7%
b.	Share of Secondary Sector in GSDP	14.93%	31.7%
c.	Share of Tertiary Sector in GSDP	60.19%	49.6%
5.	Population (2011)	91.28 million	1.247 billion
6.	Population Density (2011)	1,028 per km^2	382 per km^2
7.	Urban Population (2011)	31.38%	31.16%
8.	Rural Population (2011)	68.62%	68.84%
9.	Life Expectancy at Birth (2011-15)	70.7 years	66.90 years
10.	Number of Health Units (2015)	13,859	-
11.	Literacy Rate (2011)	76.3%	74%
12.	Number of Schools (2014-15)	64,970	-
13.	Number of Colleges (2014-15)	1,125	-
14.	Employment	38.08%	35%
15.	Cultivators	14.71%	9.3%
16.	Agricultural Laborers	29.32%	9.5%
17.	Household Industry Workers	7.09%	-
18.	Land Area (km^2)	88,752	32,87,000
19.	Forest Area (2014-15)	13.5%	7,01,763
20.	Cultivable Area (2014-15)	65.14%	286,613
21.	Area not available for cultivation, excluding forests	21.33%	638518
22.	Number of Mines	121	-
23.	Installed Power Generation Capacity (2014-15)	12,679.61 MW	329,226 MW
24.	Energy Generated (2014-15)	66,149.35 MU	1,048,673 MU
25.	Number of Registered Factories (2015)	17,636	-
26.	Estimated length of Road (2015)	17,253 km	5,472,144 km
27.	Average annual Rainfall	1,795mm	
28.	Flora	> 6,000 species	
29.	Fauna	>11,000 species	
30.	Total River Basin Area	88,752 km^2	
31.	Number of main rivers	3	22
32.	Number of sub basins	39	
33.	Coastal length	157.5 km	
34.	Annual Surface Water Available	77.06 bcm	
35.	Annual Replenishable Ground Water availability	31.72 bcm	

Energy supply and consumption scenario

Energy supply

From an energy supply standpoint – oil in the form of LPG, Petrol, Kerosene, HSD, LDO & FO is the most prominent source of energy followed by coal (coal for thermal power plant and non-power activities). Following flowchart illustrates energy supply and consumption scenario in West Bengal:-

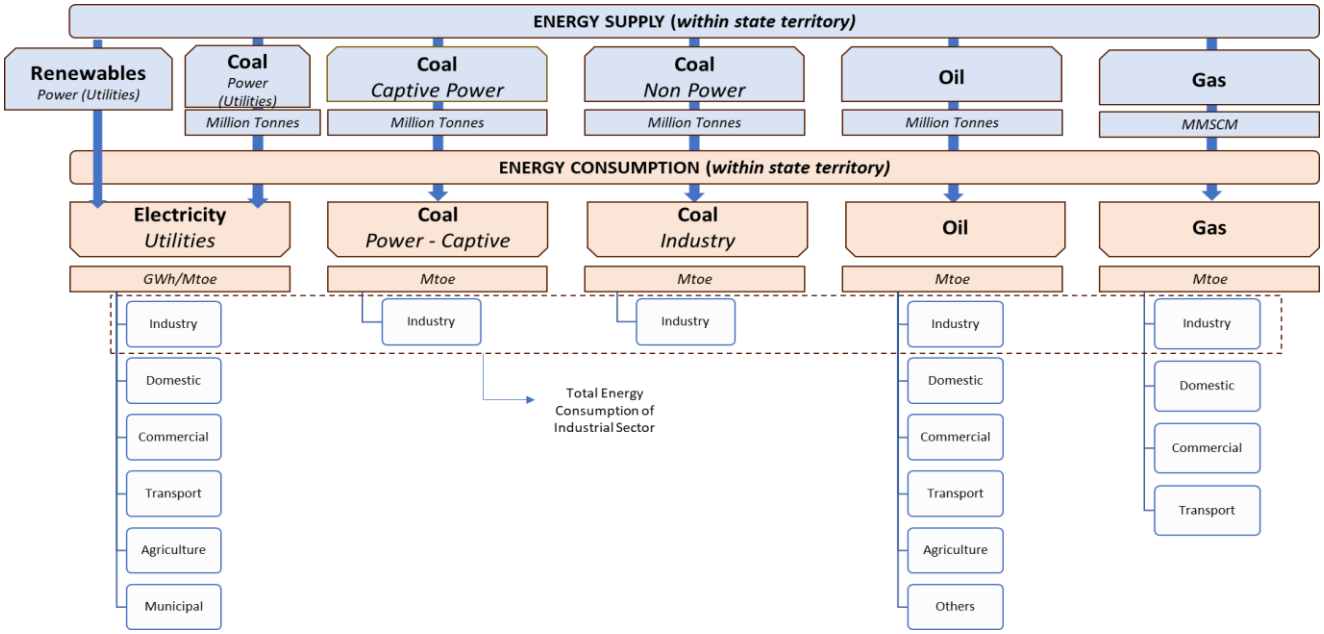


Figure 8: West Bengal's energy supply and consumption characteristics

As illustrated in the above figure – Oil (LPG, Petrol, Kerosene, HSD, LDO, FO) electricity (generated from the thermal power plants and renewable sources), coal (TPP, captive power and Non-power) is utilized across critical sectors such as Industries, Domestic, Commercial, Transport, Agriculture and Municipal (public lighting, water treatment plants, municipal water pumps etc.).

Energy Consumption

From a consumption standpoint - the total energy consumption of West Bengal for the year has been estimated to be approximately 18.46 Mtoe for the year 2019-20. It is pertinent to mention here that oil consumption is the major contributor to this estimate at 8.06 Mtoe followed by coal (domestic and imported) at 6.26 Mtoe and electricity at 4.34 Mtoe. Following figure illustrates the same: -

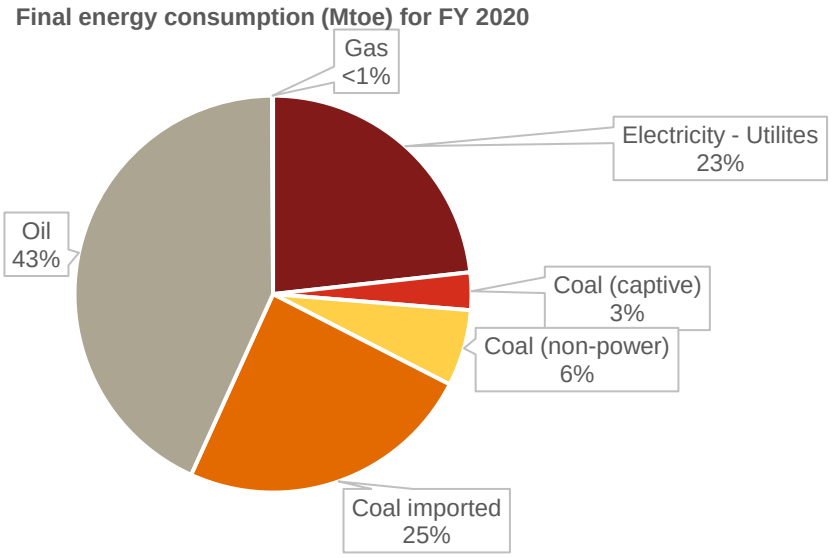


Figure 9: West Bengal's final energy consumption (fuel wise)

As specified above, majority of energy consumption in the state can be attributed to primary energy (mainly oil and coal) along with secondary energy (primarily electricity). It is pertinent to mention here that West Bengal has seen a gradual increase in energy consumption ranging from 7.35 Mtoe in 2015 to 10.11 Mtoe in 2020. This consumption encapsulates electricity, oil and coal (non power).

Following table illustrates the final energy consumption of West Bengal (in Mtoe) between 2015 and 2020:-

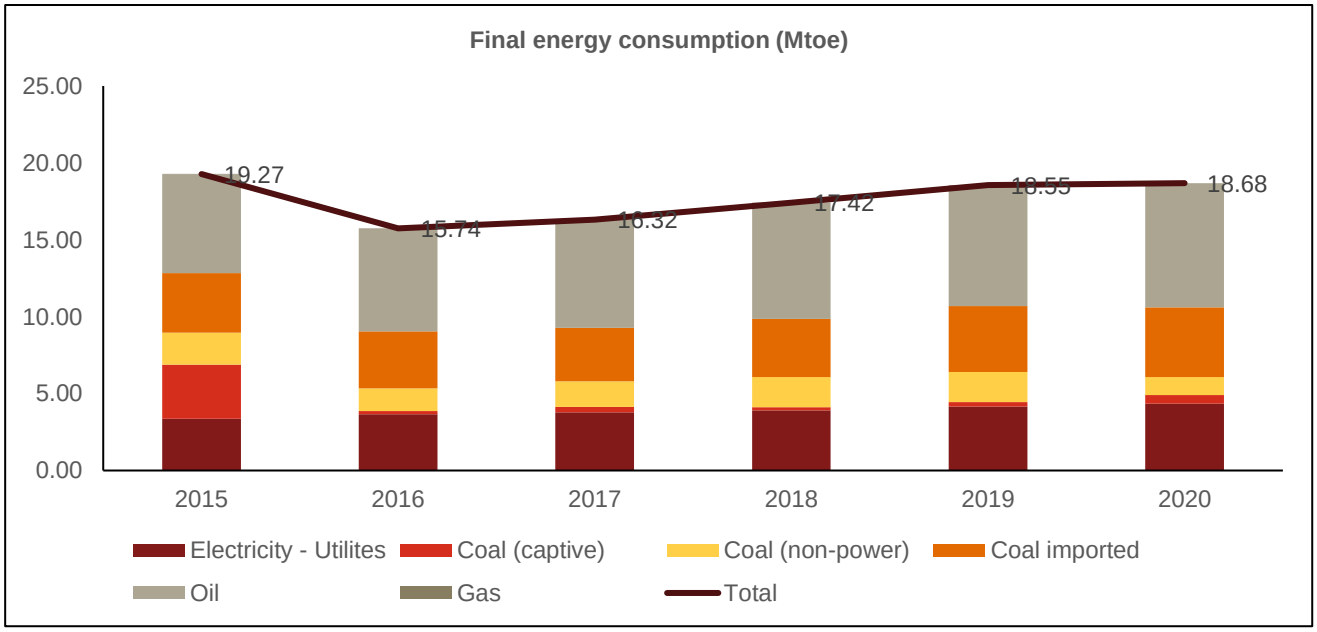


Figure 10: Final energy consumption

Electricity Scenario

Installed capacity

West Bengal’s total installed capacity at the end of 2019-20 FY was 11027 MW. It is pertinent to mention here that the power availability in the state has increased from 9576 MW in 2014-15 to 11027 MW in 2019-20 with the growth being by 15%.

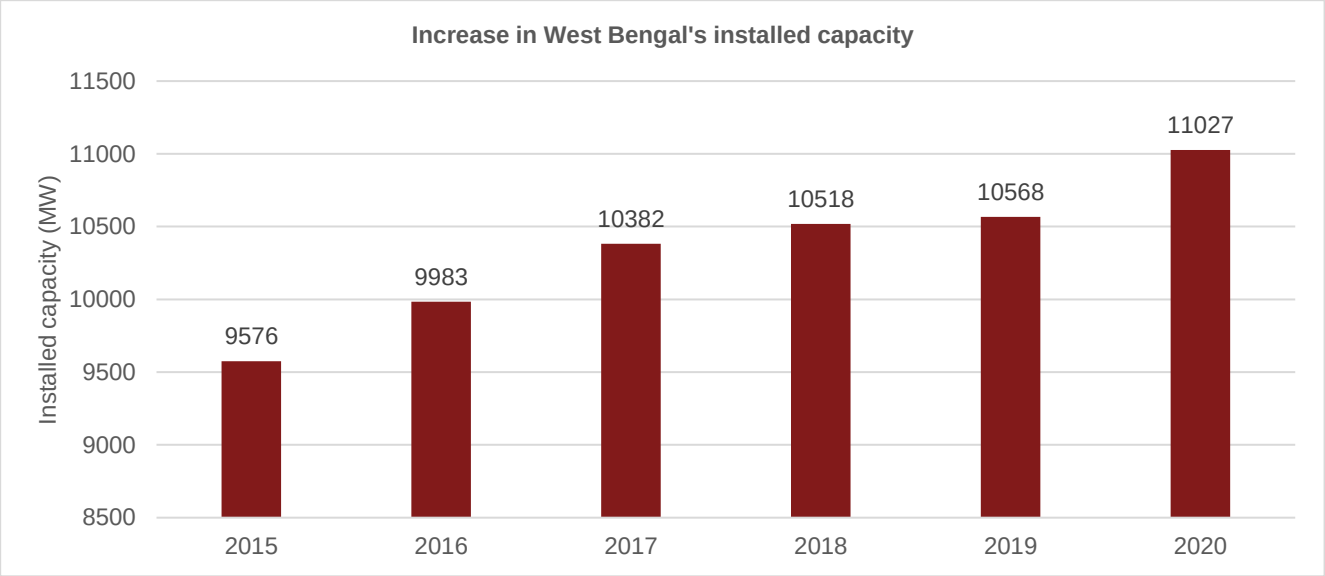


Figure 11: Increase in West Bengal's installed capacity for electricity generation over the years

Electricity peak demand in the state

In the context of power availability, over the years West Bengal has undertaken several measures related to energy capacity addition, improvement of transmission and distribution network as well as energy conservation. As a result, West Bengal's peak demand has increased over the years:

Table 2: West Bengal's peak demand trend

	Peak Demand Projection (MW)
2014-15	5321
2015-16	5282
2016-17	6047
2017-18	6152
2018-19	6351
2019-20	6482

Electricity consumption in West Bengal has increased along a steady growth path especially for industrial and domestic consumers. Following graph depicts rise in West Bengal's per capita power consumption: -

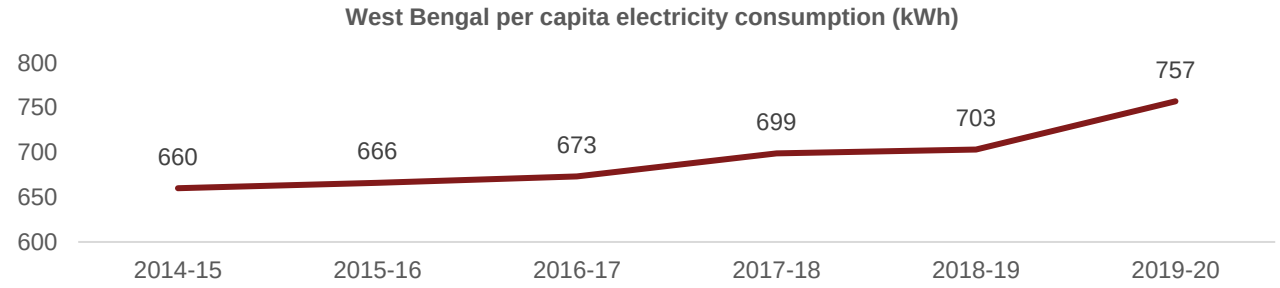


Figure 12: Per capita electricity consumption in West Bengal

Renewable energy scenario

As on 2020, the total estimated installed capacity of renewable power in the state of West Bengal is around 460[4] MW. However, the potential of renewable energy is much higher (7198 MW[5]) his can be broken down as:

Table 3: Total estimated renewable energy potential[6]

Source	Estimated Potential (in MW)
Wind Power	2
Small hydro power	392
Biomass power	396
Waste to energy	148
Solar Energy	6260
Total	**7198**

Further, the monthly renewable energy generation in the state between April 2019 to February 2020 (in MU) can be broken down as:

Overview of Institutional framework and stakeholder mapping

The Department of Power under the Government of West Bengal became full-fledged on 19th September 1972.

On 18th April 2001, the Non-conventional Energy Sources wing was transferred from the Department of Science & Technology to this department to ensure better coordination and integration of renewable energy in the overall development of the sector. The Department has drawn up ambitious plans for installing 100 MW Grid Connected Ground Mounted Solar PV Power Plant and Grid Connected Rooftop Solar PV Power Plants.

In 2005, the process of reforms in the power sector in West Bengal began, with the restructuring of the erstwhile West Bengal State Electricity Board (WBSEB) into the Transmission and Distribution utilities in 2007:

- **West Bengal State Electricity Distribution Company Ltd. (WBSEDCL) – Distribution Company**
- **West Bengal State Electricity Transmission Company Ltd. (WBSETCL) – Transmission Company**

In 1985, West Bengal Power Development Corporation Ltd. (WBPDCL) was established as a separate entity, under which the generation function was organized. It is responsible for thermal power generation in the State, while hydro generation being undertaken by the then WBSEB till the time of unbundling has been currently transferred to WBSEDCL.

In 1999, the State Regulatory Commission, West Bengal State Electricity Regulatory Commission (WBERC) was established.

[4] https://pib.gov.in/Pressreleaseshare.aspx?PRID=1564039

[5] Energy statistics India 2021

[6] Energy Statistics India 2021

Moreover, from an end consumer perspective – a number of other departments were also consulted as part of this study. Following figure illustrates the various departments were involved as a part of the study: -

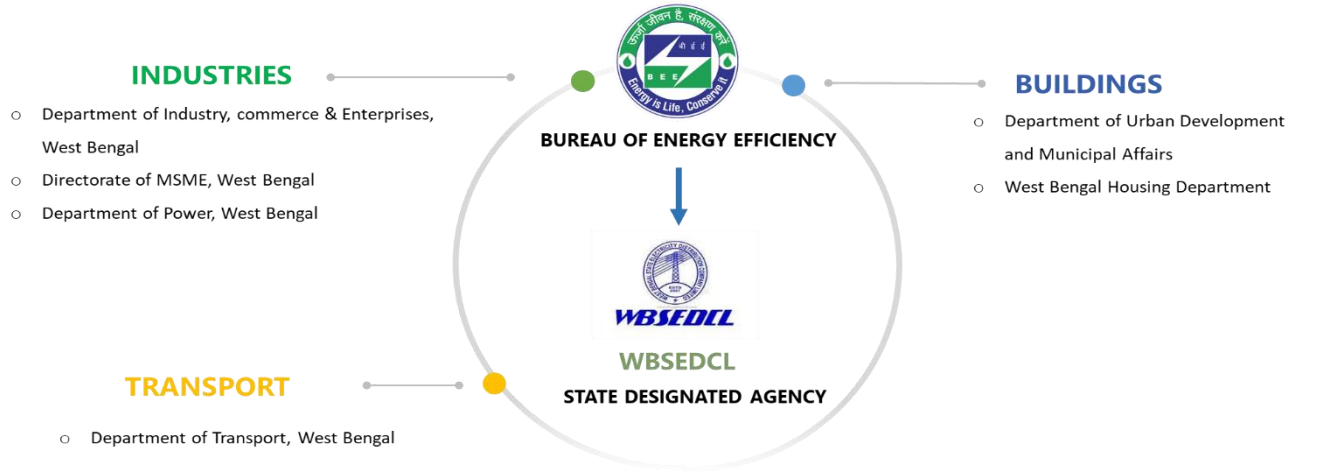


Figure 14: Departments representing Industries, buildings and transport

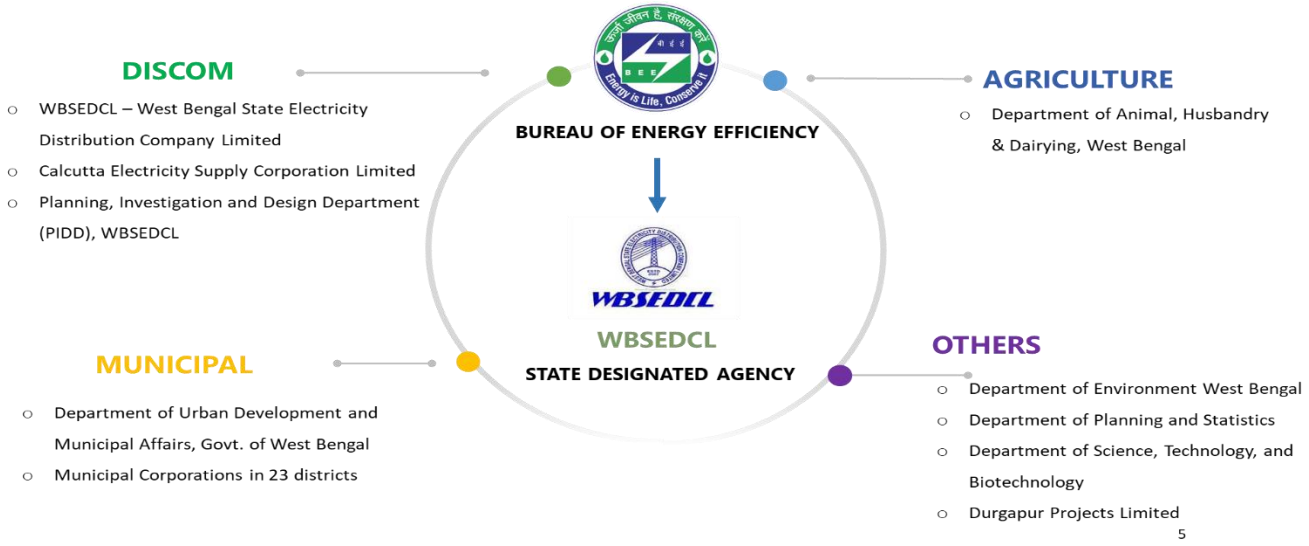


Figure 13: Departments representing DISCOMs, agriculture, municipal and others.

Identification of focus sectors

India has remained progressive and one of the front runners to achieve its Energy Efficiency (EE) potential, through innovative programmes such as the PAT scheme, Standards & Labelling, UJALA scheme, Energy Conservation Building Code, Electric Vehicle mission and Smart metering etc. However, at the country level, there is still an immense potential to be realized from large-scale implementation of EE interventions at state level in various demand sectors- industries, MSMEs, agriculture, transport, municipal, domestic & commercial buildings.

These states are also at different stages of progressiveness towards adoption of EE interventions in various demand sectors, which necessitates the need to identify focus sectors, evaluate existing policies and institutional capacities. This section identifies the key energy consuming sectors in West Bengal.

Methodology of focus sector identification

For identifying the major energy guzzling sectors in the state, energy consumption data of a number of sectors was researched and analyzed. This data was gathered via primary consultations with the various stakeholders and through secondary domain research. In this regard, following sectors were analyzed:-

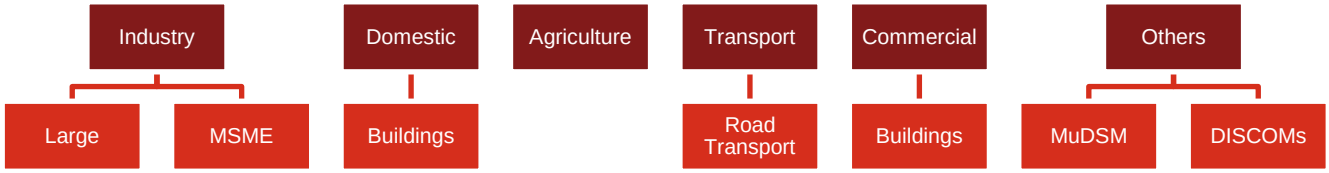


Figure 15: Areas assessed as part of focus sector identification

Identified focus sectors

Upon analyzing the energy consumption data gathered via primary exercise and secondary research, following focus sectors have been identified:

In the year 2019-20 the industrial sector of West Bengal consumed **45% (8.36 Mtoe)** of the total final energy consumption followed by the transport sector at **27% (5.07 Mtoe)**, domestic sector at **21% (3.97 Mtoe)** and the remaining by the commercial, agriculture, municipal and others.

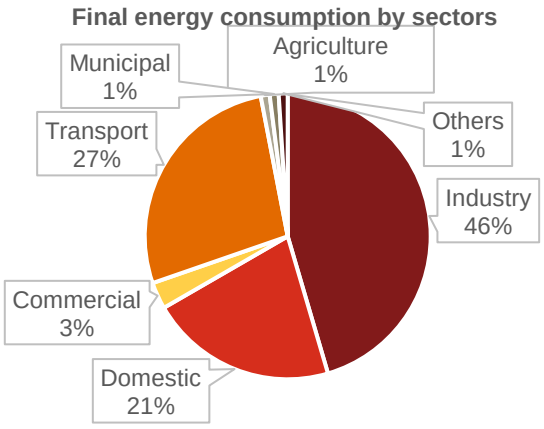


Figure 16: Final energy consumption by sector

In this regard, the afore-mentioned sectors have been selected based on their total final energy consumption in 2019-20.

Projections and forecasting

It has long been axiomatic that economic growth and energy demand are linked. As an economy grows – its energy demand increases; if energy is constrained, GDP growth pulls back in turn.

In view of the above, this section explores the past trends related to West Bengal's **energy consumption** and its GDP and at the same time projects future trajectory of the aforementioned critical elements and explores their correlation i.e., energy intensity.

Forecasting of West Bengal's GDP

Following figure captures West Bengal's GDP over the years (between 2014/15 to 2019/20). West Bengal's GDP varies from **INR 5.74 Lakh Cr** in 2015 to **7.84 Lakh Cr** in 2020 at a CAGR of 6.4%. This figure also projects the increase in GDP from 2020 to 2030. This has been projected till 2030 using 80% weightage to historic trend of 6.4% and 20% weightage to the forecast of 7.4% as per the latest West Bengal Economic Survey.

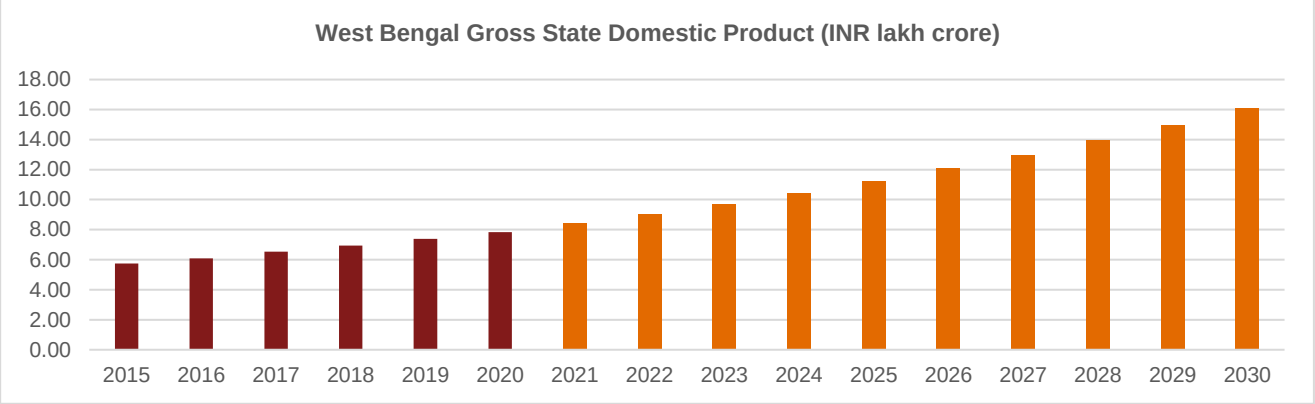


Figure 17: West Bengal's GDP projection

Forecasting of final energy Consumption

The final energy consumption in West Bengal varies from 19.27 Mtoe in 2014-15 to 18.68 Mtoe in 2020 and is projected to go up to 42.46 Mtoe in 2040. The baseline energy consumption intensity for FY2020 was calculated (2.64) and multiplied with forecasted GSDP to obtain final energy consumption trend till 2030. Following figure illustrates this information:

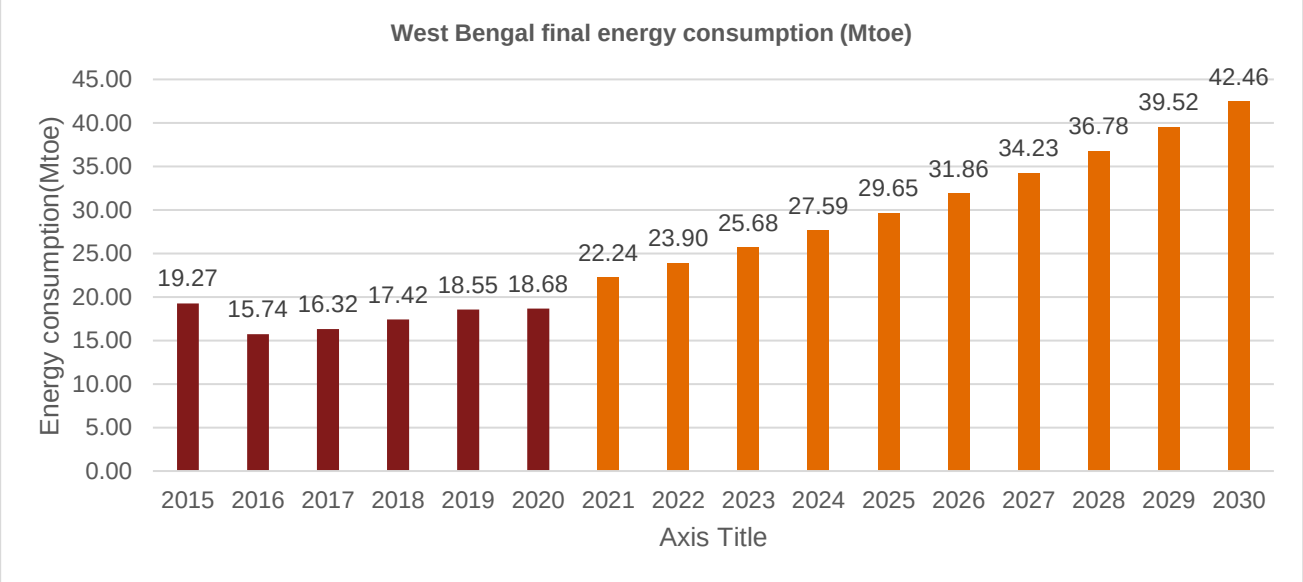


Figure 18: Year-wise projection of final energy consumption

Focus sector 1 – Industry

This section assesses the present scenario of this sector, energy efficiency potential, EE strategies in the sector (existing and proposed) along with setting of energy savings targets and its monitoring mechanism.

Current scenario

Brief description of the sector

The industries sector of West Bengal contributes 25%[7] to the state GDP. The major industries of West Bengal in terms of GVA is basic iron and steel, basic chemicals, food processing, textiles and metal casting, refined petroleum products. Major industrial areas of West Bengal are Haldia, Kolkata, Asansol-Durgapur region and Kharagpur. As of July 2018, West Bengal had 21 SEZs; of which, 7 are operational, 5 are notified, 7 are formally approved and 2 have in-principle approval (IBEF, 2018). In West Bengal, there are close to 52.7 lakh MSME establishments, the highest in the country.

Following table encapsulates the key highlights of the industrial sector in West Bengal[8] [9] [10]:-

Table 4: Key highlights of the industrial sector in West Bengal

Key highlights	
Share in overall energy consumption	45%
Major sectors in West Bengal	basic iron and steel, basic chemicals, food processing, textiles and metal casting, refined petroleum products
Designated Consumers for PAT scheme	18
Stakeholders	Department of Industry, Commerce and enterprises, West Bengal West Bengal Industrial Development Corporation West Bengal Chamber of Commerce & Industries Patliputra Industries Association Bengal Chamber of Commerce & Industries Directorate of Mines and minerals, West Bengal

From an energy perspective - It is pertinent to mention here that a major portion of the energy consumption of the industrial sector comes from coal and the share is expected to remain constant. The use of oil (especially diesel) is also expected to remain an important source of energy. Gas use in the sector is very limited mainly due to lack of availability in the market as well as limited work in expanding gas usage for industries.

Energy efficiency potential in the sector

The estimated energy efficiency potential projected for the year 2030 in the industrial sector in West Bengal is as follows: -

EE Strategy	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)

7 Centre for Budget and Governance Accountability, India, 2018

8 Unlocking National Energy Efficiency Potential, Bureau of Energy Efficiency

9 All India Electricity Statistics 2021, Central Electricity Authority

10 Department of Industries, West Bengal

Strategy 1(Deepening of PAT)	0.0608	0.2179
Strategy 2 (EE in Non-PAT)	0.106	0.298

The energy savings potential has been estimated based on the following two scenarios: -

- Moderate scenario
- Ambitious scenario

The afore-mentioned two scenarios have been devised across the various type of industries. This will be discussed in detail in the next section.

Energy Efficiency Strategies in the Industrial sector

To realize the energy efficiency potential in the industrial sector in West Bengal, as set out in the previous section, a number of strategies and polices have to fall in place. Moreover, apart from the estimated EE potential in the state, the Unlocking National Energy Efficiency Potential (UNNATEE) report published by the Bureau of Energy Efficiency has laid out the energy saving target of West Bengal by segregating the total energy saving potential for each sector. The energy saving target for industrial sector is 2.881 Mtoe by 2031.[11]

Keeping the above in hindsight, this section explores the present policies/strategies pertaining to energy efficiency in West Bengal as well as recommend various energy efficiency strategies (policy as well as technological) in order to realize the state's energy savings potential.

Present schemes/policies in place pertaining to energy efficiency

From an industries sector perspective – West Bengal has two main national level schemes which are being administered through the Bureau of Energy Efficiency. This is detailed as below:

- **Perform Achieve and Trade (PAT) scheme:** Under this scheme, acceleration of energy efficiency is targeted in energy intensive industries through the issuance of tradable instruments which are known as "Energy Saving Certificates" or "ESCerts". As part of this scheme, the notified energy intensive industrial units (which are also known as designated consumers) are required to reduce their energy consumption by undertaking energy efficiency measures. In West Bengal - The PAT scheme includes the following sectors: Pulp and paper, Iron and steel, Textile, Railway production, Petrochemical.
- **BEE-SME programme:** The BEE SME programme is the 1st national level initiative to be carried out for energy efficiency in the SME sector and includes extensive study for specific sectors. Apart from bringing in energy savings in the highly fragmented and informal SME sector, the programme will also help generate energy related data for the sector which is otherwise mostly unavailable. Under this programme, 25 clusters were selected from a group of 35 clusters across India where adoption of Energy Efficiency (EE) technologies and practices will be undertaken through knowledge sharing, capacity building and development of innovative financing mechanisms. Of these 25 clusters, 1 cluster from West Bengal viz. Howrah wire drawing and galvanizing cluster has been selected for further action. Currently, a cluster manual containing energy use and technology analysis of the clusters has been prepared and investment in implementation of energy efficient opportunities is expected to commence in the near future.

Additionally, the state government, through its industrial policies, has provided energy related incentives to increase investment in industries as well as promote energy efficiency.

- **MSME Policy incentive**: Under MSME policy 2013-18, there is provision for waiver of electricity duty and subsidy on power costs for specified period (Department of MSME, Govt. of West Bengal, 2013). The policy also has provisions to provide 50% reimbursement of the cost of energy audit undertaken by a certified agency and 25% reimbursement of the cost of installations for energy conservation as per energy audit, subject to a ceiling of INR 2 Lakh for micro and small enterprises

11 UNNATEE report, Bureau of Energy Efficiency 2019

- **West Bengal state support for Industries scheme:** The policy, as part of providing incentives to attract investment in industrial sectors, provides waiver of electricity duty to particular industrial units, as specified in the policy document. (WBIDC, 2014). It is expected that in the near future, use of natural gas will increase in the industrial sector, as exploration and extraction of shale gas from Raniganj block increases. Also use of technology and appropriate data analytics techniques that help monitor and optimize energy use in various industrial processes will gradually increase.

Recommended schemes/policies to achieve the state's energy efficiency potential

1. **Action plan 1 – Deepening of PAT scheme:** It is pertinent to comprehend that some of the existing manufacturing units of the already notified sectors (cement and iron & steel) does not fall under the purview of the PAT scheme. In this regard, it is recommended that the threshold for the PAT criteria may be lowered so that some of the existing cement and sponge iron units like ACC Damodar, Nuvoco Vistas Corp., Ramsarup loha udyog, and New Metaliks ltd.. may be added to the PAT scheme. The savings have been calculated using the moderate and ambitious scenario which is defined in this case as follows:-

Moderate scenario

- For moderate scenario - It is assumed that all the existing units will achieve the moderate SEC target in 50% units.

Ambitious scenario

- For the ambitious scenario - it is assumed that all existing units will achieve ambitious SEC target in 70% units.

Following table encapsulates both the aforementioned scenarios and demonstrates the energy efficiency potential in the year 2030 as per this strategy of deepening the PAT scheme:-

Baseline SEC (toe/tonne)	Moderate SEC (toe/tonne)	Ambitious SEC (toe/tonne)	Production in 2030 [12](tonnes)	Energy saving in moderate scenario (toe)	Energy saving in ambitious scenario (toe)
Cement	0.0708	0.0676	3601068	1440	10082
Iron and steel	0.55	0.4	1187952	59397	207891

(Note: The baseline, moderate and ambitious specific energy consumption has been assumed based on various studies on the secondary domain along with the consultant's previous experience in the industrial sector)

To achieve this potential, it is critical that this strategy is put into play. For this following are some of the recommended action points:-

Table 5: Action points for deepening of PAT scheme

S. No.	Action Plans for West Bengal state to achieve energy efficiency potential
1	Mandatory Standardized Energy Audits in every three years for all units that have energy consumption below PAT threshold, in all notified PAT sectors, excluding MSEs.
2	Creating enabling environment through B2B forums with global technology suppliers
3	State-level energy efficiency roadmap for key sectors to be prepared
4	Channelizing green/climate finance and leverage financing instruments including but not limited to risk guarantee programs
5	Encouraging demonstration and pilot projects through technical institutions like IIT, IISc

[12] https://ibm.gov.in/IBMPortal/

2. **Action plan 2: Energy efficiency in the Non-PAT sector:** Manufacturing MSME industries form the backbone of the Indian economy – so it is only justified that this sector may be looked at more carefully from the lens of energy efficiency. From secondary research – it was discovered that there are a number of MSME industry clusters that are energy intensive. It is recommended that clay fired brick, brick and coke oven sectors may be incentivized or prompted to adopt energy efficient technologies. In view of this, following scenarios are proposed:-

Moderate scenario

- For moderate scenario - 50% penetration of zig-zag in brick sector, coke dry quenching in coke oven units.

Ambitious scenario

- For the ambitious scenario - 70% penetration of zig-zag in brick sector and coke dry quenching in coke oven units

Following table encapsulates both the aforementioned scenarios and demonstrates the energy efficiency potential in 2030 as per this strategy of deepening the PAT scheme:-

Baseline SEC (toe/tonne)	Moderate SEC (toe/tonne)	Ambitious SEC (toe/tonne)	Production in 2030 [13](tonnes)	Energy saving in moderate scenario (toe)	Energy saving in ambitious scenario (toe)
Refractories	0.1378	0.0636	120600	5143	14400
Brick	0.031	0.028	49604009	99430	278403
Foundry	0.093	0.088	750000	2119	5935

(Note: The baseline, moderate and ambitious specific energy consumption has been assumed based on various studies on the secondary domain along with the consultant's previous experience in the industrial sector)

To achieve this potential, it is critical that this strategy is put into play. For this following are some of the recommended action points:-

Table 6: Action points to promotion of EE in non PAT sector

S. No.	Action Plans
1	Awareness on Energy conservations in brick, refractory and coke oven clusters
2	Periodic standardized energy audits for MSMEs on load basis and reimbursement of energy audit cost to include key units such as petrol pumps, goods carriers, restaurants, mining activity, brick units
3	Sector-specific policy development for financial assistance on implementation of ECMs suggested in energy audit.
4	Demonstration projects on latest Energy Efficiency Technologies in SME clusters
5	Technical and financial assistance for transition from Bull Trench Kiln to Zig-Zag Kilns, tunnel kiln in refractory and coke dry quenching in coke oven units
6	Encouragement of biomass blending in coal-fired brick kilns by strengthening the supply chain

[13] https://ibm.gov.in/IBMPortal/

Energy savings targets and monitoring mechanism

Energy savings targets

Taking into account the savings estimated based on strategy 1 & 2 recommended for the industrial sector, following table illustrates the overall energy savings targets envisaged for the industries in West Bengal in the year 2030:-

Action Plan	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)
Deepening and Widening of PAT scheme	0.06	0.21
Energy efficiency in non-PAT	0.106	0.298

Monitoring mechanism

Monitoring Mechanism

Implementing an energy savings monitoring mechanism is an important step for industries to track and measure their progress in reducing energy consumption and associated costs. This can involve a number of different steps, including:

- **Establishing a baseline**: The first step in monitoring energy savings is to establish a baseline of energy consumption. This can involve reviewing energy bills or conducting an energy audit to identify areas of high energy use. Identifying energy-saving opportunities: Once a baseline has been established, industries can identify areas where energy savings can be made. This may involve implementing energy-efficient technologies, optimizing processes or equipment, or changing behaviors.
- **Setting energy-saving targets**: Based on the energy-saving opportunities identified, industries can set specific, measurable, and time-bound targets for reducing energy consumption.
- **Monitoring and measuring progress**: Once targets have been set, industries can monitor and measure progress towards meeting these targets. This can involve tracking energy consumption and costs over time, analyzing data to identify trends, and comparing actual performance against targets.
- **Reporting and communicating results**: Regular reporting and communication of energy savings results can help to build momentum and engagement within an organization. This can involve sharing results with key stakeholders, such as management, employees, and customers, and celebrating successes along the way. In addition to these steps, it is also important to establish a culture of continuous improvement around energy management. This can involve training and awareness-raising programs, setting up energy teams or champions within an organization, and ensuring that energy-saving initiatives are integrated into wider business strategies. By implementing an energy savings monitoring mechanism and establishing a culture of continuous improvement around energy management, industries can make significant progress in reducing energy consumption, lowering costs, and improving sustainability performance.

Focus sector 2 – Buildings

This section assesses the present scenario of this sector, energy efficiency potential, EE strategies in the sector (existing and proposed) along with setting of energy savings targets and its monitoring mechanism.

Current scenario

Brief description of the sector

Buildings sector comprise all residential, commercial and institutional buildings across the state of West Bengal, both in rural and urban areas. Energy consumption in buildings is due to usage of lighting, household appliances and commercial heating, ventilation and air conditioning (HVAC) systems and primary source of energy is in the form of electricity. Diesel and kerosene are the 2 other sources of energy in this sector. Diesel generating sets are used as an alternative to electricity in case of power outage, while kerosene is the primarily used for lighting purposes in rural households without electrical connection. More so, the detrimental environmental effect of diesel and kerosene on the ambient air quality, coupled with rising fuel prices will further lead to reduction in consumption of diesel and kerosene for household consumption.

Within residential segment, the rural consumers account for nearly 38% of the total consumption (Power for all - West Bengal, 2016). Since the state has achieved 100% household electrification in 2018 (Prod to plug power losses, 2018), it is expected that share of rural consumption will grow further and as per Government estimates, the share of consumption from rural consumers is expected to reach 44% in FY19 (Power for all - West Bengal, 2016).

This sector can be considered as a low hanging fruit from the perspective of EE implementation as such programmes in this sector are relatively less complex as compared to industries. Following table depicts the key highlights for the building sector in West Bengal: -

Table 7: Key highlights for the building sector in West Bengal

Key highlights	
Share in energy consumption	24%
Types of buildings	Domestic, commercial and public buildings
Stakeholders	• Department of planning and statistics, West Bengal • Public Health Engineering Deptt. • Building Construction Department, West Bengal • West Bengal Urban Infrastructure Development Corporation Ltd (BUIDCO) • The West Bengal Housing Infrastructure Development Corporation, West Bengal

Present schemes/policies in place pertaining to energy efficiency

- **Energy conservation buildings standards:** The Government of West Bengal has laid down the West Bengal Energy Conservation Building Code (WB-ECBC), 2016 has laid down the technical standards that need to be adhered to the new and existing commercial buildings or building complexes that have a connected load of 100kW or greater or a contract demand of 120 kVA or greater. The code has been adopted from Energy Conservation Building Code, 2007, National Building Code 2005.
- **UJALA scheme:** UJALA, launched in 2015, is a Central Government scheme which aims to increase uptake of energy efficient appliances by households. It started with the distribution of the LED bulbs and has now expanded to LED tube light and energy efficient fans. Till date, around 93 Lakh LED bulbs, 6.7 Lakh LED tube lights, 0.6 Lakh EE fans have been distributed across the state.
- **Green city mission:** The Green City Mission is a flagship project by the Government of West Bengal, launched in 2017 to meet the growing challenge of rapid urbanization by building environment friendly, sustainable, liveable, energy positive, IT friendly and safe city with a focus on creation of jobs and building affordable housing for poor. In 2 years of its operation (Times of India Article, 2017), (Housing.com article,

2018) projects with a value of over INR 2000 crore has been sanctioned. The project is executed as a State Government sponsored project wherein there are multiple components under which activities will be implemented by concerned ULBs (125 nos.) and Development Authorities (20 nos.) with Urban Development & Municipal Affairs Department acting as Nodal Department.

Energy efficiency potential in the sector

The estimated energy efficiency potential projected for the year 2030 in the buildings sector in West Bengal is as follows: -

EE Strategy	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)
Strategy 1	0.253	0.441
Strategy 2	0.0006	0.0009
Strategy 3	0.015	0.030

The energy savings potential has been estimated based on the following two scenarios: -

- Moderate scenario
- Ambitious scenario

The afore-mentioned two scenarios have been devised across both domestic and commercial type of buildings based on different type of strategies. This will be discussed in detail in the next section.

Energy Efficiency strategies in the buildings sector

To realize the energy efficiency potential in the buildings sector in West Bengal, as set out in the previous section, a number of strategies and polices have to fall in place. Moreover, apart from the estimated EE potential in the state, the Unlocking National Energy Efficiency Potential (UNNATEE) report published by the Bureau of Energy Efficiency has laid out the energy saving target of West Bengal by segregating the total energy saving potential for each sector. The energy saving target for buildings sector is 0.988 Mtoe by 2031.[14]

Keeping the above in hindsight, this section explores the present policies/strategies pertaining to energy efficiency in West Bengal as well as recommend various energy efficiency strategies (policy as well as technological) in order to realize the state's energy savings potential.

Recommended schemes/policies to achieve the state's energy efficiency potential

1. **Action plan 1 – Replacement programme for inefficient appliances:** Replacement of inefficient appliances with their efficient counterparts can be considered as a low hanging fruit from and energy efficiency implementation standpoint. This strategy can be implemented in both domestic as well as commercial buildings. As part of the strategy, following appliances have been identified that can be in the contention for replacement:-

The savings estimated from the appliance replacement programme have been calculated using the moderate and ambitious scenario which is defined in this case as follows:-

14 UNNATEE report, Bureau of Energy Efficiency 2019

Moderate scenario

- In moderate scenario, it is assumed that 30% of appliances will be replaced with efficient appliances. For LPG cookstove, a 10% switch to electric cookstove in moderate scenario

Ambitious scenario

- In ambitious scenario, it is assumed 50% appliance replacement with efficient appliance. For LPG cookstove, a 20% switch to electric cookstove in ambitious scenario

Following table encapsulates both the aforementioned scenarios and demonstrates the energy efficiency potential in the year 2030 as per this strategy appliance replacement programme:-

Appliance	Inefficient stock in FY2020	Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
Fan	21941100	0.08	0.13
Air conditioner	3413060	0.027	0.044
Refrigerator	10970550	0.082	0.136
Washing Machine	9020230	0.008	0.014
Television	12677080	0.004	0.006
LPG cookstove	22672470	0.057	0.114

To achieve this potential, it is critical that this strategy is put into play. For this following are some of the recommended action points:-

Table 8: Action points for promoting appliance replacement EE programme

S. No.	Action Plans for West Bengal state to achieve energy efficiency potential
1	Development of state-specific implementation models and identification of relevant agencies for replacing all existing inefficient appliances in government offices and buildings with BEE Star Rated appliances
2	Phase-wise plan for replacement of existing inefficient appliances with BEE Star rated appliances in all buildings, through DSM schemes

2. **Action plan 2: Implementing ECBC:** Under this strategy, it is recommended that the new and upcoming commercial and domestic buildings (having a connected load of minimum 100 kW) may be mandated as per the energy conservation buildings code (ECBC) in the state. In view of this, following scenarios are proposed:-

Moderate scenario

- In moderate scenario, it is assumed ECBC will be implemented in new commercial buildings more than 100 kW connected load and lead to 25% savings.

Ambitious scenario

- In ambitious scenario, ECBC+ is assumed to be implemented in new commercial buildings more than 100 kW and lead to 35% savings

Following table encapsulates both the aforementioned scenarios and demonstrates the energy efficiency potential in 2030 as per this strategy of mandating the compliance of ECBC for new buildings:-

2030 energy consumption in new commercial building more than 100 kW (Mtoe)	Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
0.002474	**0.0006**	**0.0009**

To achieve this potential, it is critical that this strategy is put into play. For this following are some of the recommended action points:-

Table 9: Action points for promoting ECBC for energy efficiency in buildings

S. No.	Action Plans
1	Integrate ECBC in new building approval process
2	Setting-up of effective enforcement plan with ULBs and SDA as monitoring agencies
3	Development and maintenance of ECBC compliance portal, directory of energy efficient materials/technologies
4	Empanelment of building experts at the state level
5	Market Outreach for ECBC compliant Products, Radio Jingles, Social Media Awareness
6	Pilot project investment for Super ECBC as case studies (initial 20 Buildings)
7	Periodic upgradation of PWD Schedule of Rates (SoR) to incorporate latest energy efficient materials and technologies
8	Inclusion of curriculum on energy efficiency in buildings, in state universities and education boards

3. **Action plan 3: Energy audit for commercial and public buildings:** Under this strategy, it is recommended that periodic energy audits may be carried out at public/commercial buildings on load basis. Directives may be issued to government departments to carry out detailed energy audits at heir respective building facilities. In view of this, following scenarios are proposed:-

Moderate scenario

- In moderate scenario, it is assumed 5% buildings will have energy audit and in ambitious scenario, it is assumed 10% of buildings will get energy audit

Ambitious scenario

- It is assumed that energy audit recommendations implementation will lead to 30% savings

Following table encapsulates both the aforementioned scenarios and demonstrates the energy efficiency potential in 2030 as per this strategy: -

2030 energy consumption in commercial and public buildings sector (Mtoe)	Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
0.991	0.015	**0.030**

To achieve this potential, it is critical that this strategy is put into play. For this following are some of the recommended action points:-

Table 10: Action points to promote energy audit in buildings

S. No.	Action Plans
1	Issue directives to all government departments to conduct energy audits and target to achieve BEE Star Rating for public buildings more than 100kW connected load
2	Periodic energy audits for commercial buildings on load basis and incentives on achieving star rating for buildings
3	Capacity Building of Architects & Building Professionals and Developers
4	Market Outreach for Star & Shunya Rating by Radio Jingles, Social Media Awareness
5	Transformation of iconic government buildings to Net-Zero (10 nos)
6	Mandatory minimum set point of 24 degree for air conditioners in all government buildings

Energy Efficiency targets and Monitoring mechanism

Energy savings targets

Taking into account the savings estimated based on strategy 1 & 2 recommended for the industrial sector, following table illustrates the overall energy savings targets envisaged for the buildings in West Bengal in the year 2030:-

Action Plan	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)
Deepening of S&L in domestic buildings	0.315	0.549
Effective implementation of West Bengal ECBC 2022	0.0020	0.0027
Energy audit for commercial and public buildings	0.015	0.030

Monitoring mechanism

Monitoring Mechanism

Implementing an energy savings monitoring mechanism is an important step for industries to track and measure their progress in reducing energy consumption and associated costs. This can involve a number of different steps, including:

- **Establishing a baseline**: The first step in monitoring energy savings is to establish a baseline of energy consumption. This can involve reviewing energy bills or conducting an energy audit to identify areas of high energy use. Identifying energy-saving opportunities: Once a baseline has been established, industries can identify areas where energy savings can be made. This may involve implementing energy-efficient technologies, optimizing processes or equipment, or changing behaviors.
- **Setting energy-saving targets**: Based on the energy-saving opportunities identified, buildings can set specific, measurable, and time-bound targets for reducing energy consumption.
- **Monitoring and measuring progress**: Once targets have been set, buildings can monitor and measure progress towards meeting these targets. This can involve tracking energy consumption and costs over time, analyzing data to identify trends, and comparing actual performance against targets.

- **Reporting and communicating results**: Regular reporting and communication of energy savings results can help to build momentum and engagement within an organization. This can involve sharing results with key stakeholders, such as management, employees, and customers, and celebrating successes along the way. In addition to these steps, it is also important to establish a culture of continuous improvement around energy management. This can involve training and awareness-raising programs, setting up energy teams or champions within an organization, and ensuring that energy-saving initiatives are integrated into wider business strategies. By implementing an energy savings monitoring mechanism and establishing a culture of continuous improvement around energy management, industries can make significant progress in reducing energy consumption, lowering costs, and improving sustainability performance.

Focus sector 3 – Transport

Current scenario

Brief description of the sector

The transport sector of West Bengal comprises the vehicles used for transport of passenger and freight through land, sea, and air. The use of public transport is considerably prevalent in West Bengal, since 85% residents of Kolkata use public buses for their commute and a similar scenario is expected in other parts of the state as well Kolkata Metro Rail, having an annual passenger base of 21 crore passengers (2017-18), is also a significant mode of public transport in Kolkata. However, the state has witnessed an increase in passenger vehicles by CAGR of 12.86%, between 2009 and 2017. (Transport Department GoWB, 2019) It is expected that the planned expansion and upgradation of Metro lines across Kolkata, would help retain the existing share of public transport in the city.

Therefore, the transport sector is a major consumer of energy in West Bengal and contributes to approximately 27% of the total energy consumption in the state. Therefore, there needs to be a strong emphasis on electric vehicles to decarbonize this sector. The below table shows the key highlights of the transport sector in West Bengal.[15] [16]

Key highlights	
Share in final energy consumption	27%
Types of vehicles	ICE (2W, 3W, 4W, Buses and HDV) and Electric vehicles
Stakeholders	• Road transport department, West Bengal • West Bengal Highway development corporation limited

Present schemes/policies in place pertaining to energy efficiency

- **EV Charging infrastructure:** New Town Kolkata Development Authority (NKDA), under the initiative by HIDCO, has set up 10 charging docks in all three action areas of the township (Clean Future, 2018). The charging stations have two types of universal charging points to enable any e-vehicle to get charged. Also, Indian Oil's COCO (Company Operated Company Owned) smart outlet at Action Area 3 also has electric vehicle charging units. There are also three heavy duty charging stations located at the bus terminal near Pride Hotel, Action Area 3 bus-stand near Sukhobristi and Eco Urban Village in Action Area 2, for running the electric buses.
- **Introduction of electric vehicles in public transport:** Three electric buses have been introduced in New Town area of Kolkata (NKDA, 2018), which has reported more than 20000 passengers in the first 1.5 months of its operation. (Milleniumpost report, 2018). The buses are also able to regenerate 36% of the power from braking and use 0.8 electricity unit/km. (NKDA, 2018). Also 80 electric buses to be introduced in Kolkata Metropolitan region along 10 routes, utilizing the financial benefits provided under the FAME India (Faster Adoption and Manufacture of (Hybrid and) Electric Vehicles) scheme of Department of Heavy Industries, Government of India. (Transport Dept GoWB 2018, 2018). 17 charging stations have been built along the routes of these buses which will be operated and maintained by the Transport Department, Government of West Bengal (Transport Department, 2019)
- **Promotion of e-rickshaw:** Going ahead in future, the state has a strong vision of increasing penetration of electric vehicles and promoting ride sharing as well. While announcement of the FAME scheme by Government of India has provided financial stimulus to uptake of electric vehicles, state level efforts shall also help reduce carbon footprint of transport sector as well as reduce dependency on imported fossil fuels. In order to streamline implementation EV charging infrastructure, the Department of Power, Government of India has published guidelines and standards for charging infrastructure for EVs in

15 Unlocking National Energy Efficiency Potential, Bureau of Energy Efficiency

16 Department of Transport, West Bengal

December 2018[18]. In February 2019, the Ministry of Housing and Urban Affairs (MoHUA), Government of India has made amendments in Model Building Bye-Laws (MBBL) 2016 and Urban Regional Development Plans Formulation and Implementation (URDPFI) Guidelines 2014 to make provisions for establishing Public Charging Stations (PCS) for EV charging.

Energy efficiency potential in the sector

Following table estimates the energy efficiency potential projected for the year 2030 in the transport sector in West Bengal:

Strategy	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)
Strategy 1 (Transition from ICE to EV)	0.115	0.215
Strategy 2 (20% ethanol blending)	1.5582	

The energy savings potential has been estimated based on the following two scenarios: -

- Moderate scenario
- Ambitious scenario

The afore-mentioned two scenarios have been devised keeping in hindsight strategies like transition to electr vehicles and ethanol blending. This will be discussed in detail in the next section.

Strategies in the Transport sector

The rapid growth of vehicles numbers in the State has been accompanied by related problems including congestion and traffic snarls, lack of adequate parking spaces, high accident rates, environmental vehicular pollution rise, and inadequacy of road space for efficient public transportation. In this regard, there is dire need for the state government to decarbonize the sector in order to align with India's NDC and Net Zero commitments. Moreover, as per the Unlocking National Energy Efficiency Potential published by the Bureau of Energy Efficiency, the energy saving target for the state has been calculated by segregating the total energy saving potential for each sector. The energy saving target for transport sector in West Bengal is 0.551 Mtoe by 2031.[17]

Keeping the above in hindsight, this section explores the present policies/strategies pertaining to energy efficiency in West Bengal as well as recommend various energy efficiency strategies (policy as well as technological) in order to realize the state's energy savings potential in the transport sector

Recommended schemes/policies to achieve the state's energy efficiency potential

1. **Action plan 1 – Transition of existing fleet to electric vehicles:** Under this strategy, it is recommended to transition the existing ICE (Internal combustion Engine) fleet (two wheelers, three wheelers, four wheelers, bus and heavy vehicles) to electric vehicles. As of 2019-20, there are approximately 93 Lakh ICE [18]registered vehicles in the state. Out of this - 22.5 % are buses, 9.25 % are two wheelers, 8.53% are 4 wheelers, 8.24% are three wheelers and the remaining 1% of heavy-duty vehicles.

   As per this strategy – following scenarios have been adopted for the replacement of ICE fleet by electric vehicles:-

17 UNNATEE report, Bureau of Energy Efficiency 2019

18 MORTH

Moderate scenario

- As per NITI Aayog projections, 80% EV penetration in two-wheelers, 80% EV penetration in three-wheelers, 30% EV penetration in four-wheelers, 40% EV penetration in buses and 20% EV penetration in HDV in moderate scenario

Ambitious scenario

- 100% EV penetration in two-wheelers, 100% EV penetration in three-wheelers, 60% EV penetration in four-wheelers, 80% EV penetration in buses and 40% EV penetration in HDV in ambitious scenario

Following table encapsulates both the aforementioned scenarios and demonstrates the energy efficiency potential in the year 2030 as per this strategy of transition from ICE to electric vehicles :-

Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
0.115	0.215

To achieve this potential, it is critical that this strategy is put into play. For this following are some of the recommended action points:-

Table 11: Action points to promote transition to EVs in West Bengal

S. No.	Action Plans for West Bengal state to achieve energy efficiency potential
1	Establishment of regulatory mechanism to develop EV charging infrastructure
2	Set up Charging stations based on open-access
3	Pilot projects on Battery Swapping stations in 3 model cities
4	Pilot projects on Hydrogen Fuel Cell Vehicles

2. **Action plan 2: Ethanol blending programme:** Under this strategy - it is recommended that, as per the national target, ethanol blending in conventional fuels may be executed. The target already set in this segment is 20%.
Following table encapsulates both the aforementioned scenarios and demonstrates the energy efficiency potential in 2030 as per this strategy:-

2025 energy consumption in transport (Mtoe)	Energy saving as per policy (Mtoe)
7.791	1.5582

To achieve this potential, it is critical that this strategy is put into play. For this following are some of the recommended action points:-

Table 12: Action points to promote ethanol blending

S. No.	Action Plans
1	Encourage establishing biofuel production plants

Energy savings targets and monitoring mechanism

Energy savings target

Taking into account the savings estimated based on strategy 1 & 2 recommended for the industrial sector, following table illustrates the overall energy savings targets envisaged for the buildings in West Bengal in the year 2030:-

Action Plan	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)
Transition to electric vehicles	0.115	0.215
Ethanol blending	1.5582 (As per policy)	

Monitoring mechanism

Monitoring Mechanism

Implementing an energy savings monitoring mechanism is an important step for the transport sector to track and measure their progress in reducing energy consumption and associated costs. This can involve a number of different steps, including:

- **Establishing a baseline**: The first step in monitoring energy savings is to establish a baseline of energy consumption. This can involve reviewing fuel consumption data or conducting an energy audit to identify areas of high energy use.
- **Identifying energy-saving opportunities**: Once a baseline has been established, transport companies can identify areas where energy savings can be made. This may involve implementing energy-efficient technologies, optimizing routes, or changing behaviors. Setting energy-saving targets: Based on the energy-saving opportunities identified, transport companies can set specific, measurable, and time-bound targets for reducing energy consumption.
- **Monitoring and measuring progress**: Once targets have been set, transport companies can monitor and measure progress towards meeting these targets. This can involve tracking fuel consumption and costs over time, analyzing data to identify trends, and comparing actual performance against targets.
- **Reporting and communicating results**: Regular reporting and communication of energy savings results can help to build momentum and engagement within an organization. This can involve sharing results with key stakeholders, such as management, employees, and customers, and celebrating successes along the way. In addition to these steps, it is also important to establish a culture of continuous improvement around energy management. This can involve training and awareness-raising programs, setting up energy teams or champions within an organization, and ensuring that energy-saving initiatives are integrated into wider business strategies. By implementing an energy savings monitoring mechanism and establishing a culture of continuous improvement around energy management, transport companies can make significant progress in reducing energy consumption, lowering costs, and improving sustainability performance. Additionally, these improvements can lead to cost savings, improved air quality, and increased energy security.

Focus sector 4 – Agriculture

Current scenario

Brief description of the sector

The agriculture sector is a major area of economic activity in West Bengal and accounts for 18.33% of the state GSDP and 59% (5.2 million hectares) of state geographical area is under agriculture. The cropping intensity i.e. raising of a number of crops from the same field during one agriculture year, for West Bengal is 184%, while the national average is 142%. The state is the largest producer of paddy, jute, pineapple, brinjal, cabbage and the 2nd largest producer of potato, tea and fish. (Dept. of Agriculture, Govt. of West Bengal, 2019)

The sector is a focus area for the state considering the fact that it employs 57% of the state's workforce under various core and allied activities and 96% of Bengal's farmers are classified as small or marginal farmers. In order to improve the economic condition of workforce in agriculture sector, the state's has increased its expenditure in agriculture and allied activities by more than 6 times from INR 3029 Cr in 2010-11 to INR 20323 Cr in 2017-18. (Dept. of Agriculture, Govt. of West Bengal, 2019).

The major consumption of energy in agriculture sector in general is due to irrigation pumps, tractors, other farm mechanization equipment and post harvesting equipment.

From an energy consumption perspective, following table illustrates the key highlights of the agriculture sector in West Bengal:-

Table 13: Key highlights of agriculture sector in West Bengal

Key highlights	
Share in final energy consumption	0.8%
Major crops produced	Rice, maize, pulses, oil seeds, wheat, barley, potatoes, jute
Stakeholders	Department of Agriculture, West Bengal The **Department** of **Water Resources** Investigation and Development Department of food processing and Horticulture, West Bengal Sugarcane Industries Department Krishi Vigyan Kendra

Energy efficiency potential in the sector

- **West Bengal Accelerated Development and Minor Irrigation project**: WBADMIP is a project supported by World Bank which commenced in January 2012 and is scheduled to close in December 2019. The project aims to enhance agricultural production of small and marginal farmers in the project area by creation of minor irrigation (MI) schemes involving community-based institutions known as Water Users Associations (WUAs), which includes distribution of solar pumps. Proposed number of beneficiaries under the project is 100000 and proposed irrigated area is 75000 Ha spread across 19 districts of the state
- **Pradhan Mantri Krishi Sinchai Yojna:** PMKSY is a scheme developed by the Government of India to enhance the physical access of water on the farm and expand cultivable area under assured irrigation, improve farm water use efficiency to reduce wastage and increase availability both in duration and extent, enhance the adoption of precision - irrigation and other water saving technologies

Energy efficiency potential in the sector

Following table estimates the energy efficiency potential projected for the year 2030 in the agriculture sector in West Bengal:

Strategy	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)
Strategy 1	0.068	0.093
Strategy 2	0.0100	0.0232

The energy savings potential has been estimated based on the following two scenarios: -

- Moderate scenario
- Ambitious scenario

The afore-mentioned two scenarios have been devised across the agriculture sector. This will be discussed in detail in the next section.

Proposed energy efficiency strategies in the agriculture sector

As per the Unlocking National Energy Efficiency Potential of Bureau of Energy Efficiency, the energy saving target for a state has been calculated by segregating the total energy saving potential for each sector. The energy saving target for agriculture sector is 0.020 Mtoe by 2031[19]. From an energy consumption standpoint, it is estimated that presently there are more than 4 lakh diesel pumps in West Bengal[20] along with 2 Lakh electric pumps

Keeping the above in hindsight, this section explores the present policies/strategies pertaining to energy efficiency in West Bengal as well as recommend various energy efficiency strategies (policy as well as technological) in order to realize the state's energy savings potential in the agriculture sector

Recommended schemes/policies to achieve the state's energy efficiency potential

1. **Action plan 1 – Transition of existing diesel pumps to solar based pumps:** Under this strategy, it is recommended that the existing stock of diesel-based pumps may be replaced by solar based pumps by 2025.

   As per this strategy – following scenarios have been adopted for the replacement of existing stock of diesel pumps with solar based pumps:-

   Moderate scenario

   - By 2025, moderate scenario assumes 75% replacement of diesel pumps with solar pumps

   Ambitious scenario

   - By 2025, ambitious scenario assumes 100% replacement with solar pumps

   Following table encapsulates both the aforementioned scenarios and demonstrates the energy efficiency potential in the year 2030 as per this strategy of transition from diesel pumps to solar based pumps :-

Diesel pumps estimated inventory by 2025	Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
330600	**0.068**	**0.093**

19 UNNATEE Report, Bureau of Energy Efficiency 2019

20 https://static1.squarespace.com/static/5ad6d42a7e3c3a444757cf50/t/5d67b319e683a900014529ca/1567077151489/Electrifying+Agriculture+in+West Bengal_postreview_Final.pdf

To achieve this potential, it is critical that this strategy is put into play. For this following are some of the recommended action points:-

Table 14: Action points to promote replacement of diesel pumps with solar based pumps

S. No.	Action Plans for West Bengal state to achieve energy efficiency potential
1	Effective implementation of PM KUSUM Yojana

2. **Action plan 2: Replacement of inefficient electric pumps with efficient electric pumps:** Under this strategy, it is recommended that the existing stock of inefficient electric pumps may be replaced by solar based pumps by 2025. As per this strategy – following scenarios have been adopted for the replacement of inefficient electric pumps with energy efficient electric pumps: -

Moderate scenario

- Moderate scenario assumes 30% replacement with efficient Star-Rated pumps

Ambitious scenario

- Ambitious scenario assumes 50% replacement with efficient Star-Rated pumps

Following table encapsulates both the aforementioned scenarios and demonstrates the energy efficiency potential in 2030 as per this strategy:-

Inefficient pumps estimated inventory by 2030	Inefficient pumps replaced by Star-Rated pumps in ambitious scenario by 2030	Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
442182	**309527**	**0.0100**	**0.0232**

To achieve this potential, it is critical that this strategy is put into play. For this following are some of the recommended action points:-

Table 15: Action points to promote replacement of inefficient electric pumps with efficient 5 star pumps

S. No.	Action Plans
1	Phase wise plan to implement DSM scheme for replacement of existing inefficient pumps through ESCOs

Energy savings targets & Monitoring mechanism

Energy savings targets

Taking into account the savings estimated based on strategy 1 & 2 recommended for the industrial sector, following table illustrates the overall energy savings targets envisaged for the buildings in West Bengal in the year 2030:-

Strategy	Energy Savings in 2030 under moderate scenario (Mtoe)	Energy Savings in 2030 under ambitious scenario (Mtoe)

Replacement of diesel pumps with solar based pumps	0.068	0.093
Replacement of inefficient electric pumps with energy efficient electric pumps	0.0100	0.0232

Monitoring mechanism

Implementing an energy savings monitoring mechanism is an important step for the agriculture sector to track and measure their progress in reducing energy consumption and associated costs. This can involve a number of different steps, including:

- **Establishing a baseline:** The first step in monitoring energy savings is to establish a baseline of energy consumption. This can involve reviewing energy bills, conducting an energy audit to identify areas of high energy use, or using energy monitoring tools to track energy consumption. Identifying energy-saving opportunities: Once a baseline has been established, farmers and agricultural businesses can identify areas where energy savings can be made. This may involve implementing energy-efficient technologies, optimizing irrigation systems, or changing behaviors.
- **Setting energy-saving targets**: Based on the energy-saving opportunities identified, farmers and agricultural businesses can set specific, measurable, and time-bound targets for reducing energy consumption. Monitoring and measuring progress: Once targets have been set, farmers and agricultural businesses can monitor and measure progress towards meeting these targets. This can involve tracking energy consumption and costs over time, analyzing data to identify trends, and comparing actual performance against targets.
- **Reporting and communicating results**: Regular reporting and communication of energy savings results can help to build momentum and engagement within an organization. This can involve sharing results with key stakeholders, such as management, employees, and customers, and celebrating successes along the way. In addition to these steps, it is also important to establish a culture of continuous improvement around energy management. This can involve training and awareness-raising programs, setting up energy teams or champions within an organization, and ensuring that energy-saving initiatives are integrated into wider business strategies. By implementing an energy savings monitoring mechanism and establishing a culture of continuous improvement around energy management, farmers and agricultural businesses can make significant progress in reducing energy consumption, lowering costs, and improving sustainability performance. Additionally, it can lead to improved crop yields, reduced water usage, and increased profitability.

Investment potential

Taking into hindsight the energy savings potential that has been highlighted for each of the focus sectors – it is also pertinent that this study also takes into account the investment required to realize this potential. This section illustrates the investment required to execute each of the strategies.

Following table depicts the estimated energy & emission savings potential that can be achieved through each of the strategies along with its estimated investment potential: -

Sector	Energy saving in moderate (Mtoe)	Energy saving in ambitious (Mtoe)	Emission Saving (MtCO2)	Emission Saving (MtCO2)	Investment Potential (INR crore)
Industry	0.17	0.52	0.52	1.62	950.9
Buildings	0.27	0.47	0.84	1.48	868.7
Transport	1.67	1.77	5.24	5.55	3263.0
Agriculture	0.08	0.12	0.25	0.37	215.1
Total	**2.19**	**2.88**	**6.85**	**9.01**	**5297.7**

(Note: Market Potential calculated using cost of 1 tonne of oil equivalent as INR 18,402 and assuming a payback of 3 years)

Strategy wise investment required

Industries

The industrial sector of West Bengal contains a wide variety of sub-sectors, each of which provide multiple potential energy savings opportunities. For the EE recommended strategies (i. Deepening of PAT, ii) Implementation in SME sectors - These sub-sectors have been selected within the state which have the highest energy consumption.

Strategy	Investment area	Cost (INR)
Deepening of PAT (Inclusion of more Cement units like ACC, Ambhuja along with iron and steel units)	SEC reduction	400 Cr.
EE implementation in foundry, bricks and refractories	Implementation of zig-zag in brick sector, tunnel kiln in refractory units and melting furnace in foundry units	550 Cr.

Buildings

Investment required in buildings sector for complying with the state energy efficiency action plan, is primarily related to initiatives that lead to increased penetration energy efficient appliances like air conditioners, ceiling fans, induction cook stove etc. and increased construction of buildings compliant with ECBC and taking up energy audits. In order to calculate investments related to these initiatives, the existing volume of the market is required viz. number of appliances being used, floor area of commercial buildings in the state.

Strategy	Investment area	Cost (INR)
Buildings S&L (Appliance replacement)	Air conditioners, fans, television, induction cook stove, washing machine and refrigerators	812

Promoting ECBC compliance in new buildings	Construction of new buildings in compliance with ECBC codes	1.5
Promoting uptake of energy audits in buildings	---	54.7

Transport

The total investment required for implementing the strategies mentioned in the previously is provided in this section. The investment includes cost of acquiring a setting up of charging infrastructures, providing incentives for increasing EV adoption and cost for ethanol blending.

Strategy	Investment area	Cost (INR)
Transition from ICE to electric vehicles	EV adoption, setting up of charging infrastructure	395 Cr.
Ethanol blending	Blending of ethanol to conventional fuels	2867 Cr.

Agriculture Investment potential

The following table provides the investment required in terms of unit cost of replacement of diesel pumps with solar based pumps and replacing inefficient electric pumps with BEE 5 star rated pumps:

Strategy	Investment area	Cost (INR)
Replacement of diesel pumps with solar based pumps	Promoting uptake of solar based pumps	172 Cr.
Replacement of inefficient electric pumps with efficient electric pumps	Promoting uptake of efficient electric pumps	42 Cr.

Way forward

Following table summarizes the strategies put forward as part of this SEEAP report along with the action points required to enforce the same. Moreover, this table also points out the relevant departments that may take up the execution of the afore-said action points:-

Focus Sector	EE strategies	Action Points	Implementing agencies
Industries	Strategy 1: Deepening of PAT	1. Mandatory Standardized Energy Audits in every three years for all units that have energy consumption below PAT threshold, in all notified PAT sectors 2. Creating enabling environment through B2B forums with global technology suppliers 3. State-level energy efficiency roadmap for key sectors to be prepared 4. Channelizing green/climate finance and leverage financing instruments including but not limited to risk guarantee programs 5. Encouraging demonstration and pilot projects through technical institutions like IIT, IISc	Bureau of Energy Efficiency (BEE); WBSEDCL
	Strategy 2: EE in non-PAT sectors	1. Awareness on Energy conservations in brick, refractory and coke oven clusters 2. Periodic standardized energy audits for MSMEs on load basis and reimbursement of energy audit cost to include key units such as petrol pumps, goods carriers, restaurants, mining activity, brick units 3. Sector-specific policy development for financial assistance on implementation of ECMs suggested in energy audit. 4. Demonstration projects on latest Energy Efficiency Technologies in SME clusters 5. Technical and financial assistance for transition from Bull Trench Kiln to Zig-Zag Kilns, tunnel kiln in refractory and coke dry quenching in coke oven units 6. Encouragement of biomass blending in coal-fired brick kilns by strengthening the supply chain.	Bureau of Energy Efficiency (BEE); WBSEDCL
Buildings	Strategy 1: Appliance replacement programme	1. Development of state-specific implementation models and identification of relevant agencies for replacing all existing inefficient appliances in government offices and buildings with BEE Star Rated appliances 2. Phase-wise plan for replacement of existing inefficient appliances with BEE Star rated appliances in all buildings, through DSM schemes	Bureau of Energy Efficiency (BEE); WBSEDCL
	Strategy 2: Enforcing ECBC in new and upcoming buildings	1. Integrate ECBC in new building approval process 2. Setting-up of effective enforcement plan with ULBs and SDA as monitoring agencies 3. Development and maintenance of ECBC compliance portal, directory of energy efficient materials/technologies 4. Empanelment of building experts at the state level 5. Market Outreach for ECBC compliant Products, Radio Jingles, Social Media Awareness	Bureau of Energy Efficiency; WBSEDCL Urban Development and Housing Department

		6. Pilot project investment for Super ECBC as case studies (initial 20 Buildings) 7. Periodic upgradation of PWD Schedule of Rates (SoR) to incorporate latest energy efficient materials and technologies 8. Inclusion of curriculum on energy efficiency in buildings, in state universities and education boards	
	Strategy 3: Promoting energy audits for commercial and public buildings	1. Issue directives to all government departments to conduct energy audits and target to achieve BEE Star Rating for public buildings more than 100kW connected load 2. Periodic energy audits for commercial buildings on load basis and incentives on achieving star rating for buildings 3. Capacity Building of Architects & Building Professionals and Developers 4. Market Outreach for Star & Shunya Rating by Radio Jingles, Social Media Awareness 5. Transformation of iconic government buildings to Net-Zero (10 nos) 6. Mandatory minimum set point of 24 degree for air conditioners in all government buildings	Bureau of Energy Efficiency; WBSEDCL Urban Development and Housing Department
Transport	Strategy 1: Transition of existing fleet to electric vehicles	1. Establishment of regulatory mechanism to develop EV charging infrastructure 2. Set up Charging stations based on open-access 3. Pilot projects on Battery Swapping stations in 3 model cities 4. Pilot projects on Hydrogen Fuel Cell Vehicles	Department of Transport
	Strategy 2: Ethanol blending programme	1. Encourage establishing biofuel production plants	State Transport Department & Individual Government Departments

References

Energy Data

S.No.	Reference
1	Energy Statistics India 2021, Ministry of Statistics and Programme Implementation (MoSPI)
2	National Accounts Data, Ministry of Statistics and Programme Implementation (MoSPI)
3	Population Projections For India and States 2011-2036, National Commission on Population, Ministry of Health & Family Welfare
4	NITI Aayog: India Energy Dashboards
5	Small and Medium Enterprises: Energy Efficiency Knowledge Sharing A Platform for Promoting Energy Efficiency in SMEs (SAMEEKSHA)
6	Simplified Digital Hands-on Information on Energy Efficiency in MSMEs (SIDHIE), Bureau of Energy Efficiency (BEE), Ministry of Power
7	Impact Assessment of BEE's Standard & Labelling Program in India, Market Xcel Data Matrix Pvt Ltd.

Fuel calorific values

Fuel	Gross Calorific Value (GCV)	Unit of GCV
Coal	4,500	kcal/kg
Natural Gas	10,200	kcal/kg
Diesel	10,350	kcal/kg
Electricity	860	kcal/kWh

Units of conversion

Units	
1 tonne of oil equivalent (TOE)	1,00,00,000 kcal
	0.000001 MTOE
	11,630 kWh

Annexures

List of sources

Primary Source	Secondary Source
Department of Agriculture, West Bengal	Central Electricity Authority
Department of Transport, West Bengal	West Bengal Economic Survey
Department of Energy, West Bengal	Ministry of Statistics and Programme Implementation
Department of Industries, West Bengal	*West Bengal Renewable Energy Development Agency*
West Bengal Bijli Vitran Nigam Limited	Ministry of Road Transport and Highways
MSME Development Institute Kolkata	Bureau of Energy Efficiency
West Bengal State Housing Board	Energy Efficiency Services Limited
Housing and Urban Development Corporation Limited	NITI Aayog (Energy Dashboard)
Urban Development and Housing Department, West Bengal	Ministry of Micro, Small and Medium Enterprises
West Bengal State Building Construction Corporation Limited	Ministry of Steel
Building Construction Department	Ministry of Power
Municipal Corporations (ULB)	Ministry of New and Renewable Energy
Damodar Valley Corporation	India Brand Equity Foundation
Steel Authority of India (SAIL)	World Bank / Asian Development Bank
Directorate of Municipal Administration (DMA)	Indian Bureau of Mines, Ministry of Mines

List of stakeholders

Stakeholder
Department of Agriculture, West Bengal
Department of Transport, West Bengal
Department of Energy, West Bengal

Department of Industries, West Bengal
MSME Development Institute Kolkata
West Bengal State Housing Board
Housing and Urban Development Corporation Limited
Urban Development and Housing Department, West Bengal
West Bengal State Building Construction Corporation Limited
Building Construction Department
Municipal Corporations (ULB)