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GOVERNMENT OF INDIA

STATE ENERGY EFFICIENCY ACTION PLAN (SEEAP)

RAJASTHAN - ACTION PLAN

NOVEMBER 2023

State Energy Efficiency Action Plan (SEEAP) for Rajasthan

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Azadi Ka Amrit Mahotsav

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(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)

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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.

The ASSOCHAM team extends its profound thanks to Shri Pankaj Agarwal, Secretary, Ministry of Power, Government of India and Shri Srikant Nagulpalli, Director General, Bureau of Energy Efficiency (BEE), for their leadership and guidance during the execution of the assignment. The ASSOCHAM team recognizes and extends its sincere gratitude to Shri Milind Deore, Secretary, BEE, for his invaluable inputs provided during the execution of the assignment. The team acknowledges the co-operation and the support extended by Shri Abhishek Sharma, Director, BEE for supervising the assignment throughout the execution phase. The team appreciates Shri Vikash Kumar Jha, Project Engineer, BEE for his continuous support in coordination with various stakeholders.

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The ASSOCHAM team extends its sincere gratitude to all government and private sector participants of the physical survey whose inputs have been considered as part of the report. The team also extends its gratitude to the industry associations, building sector professionals and other stakeholders who were extensively consulted as part of the project.

Finally, ASSOCHAM is grateful to the in-house team of ASSOCHAM for their consistent efforts in bringing this report to fruition

Associated Chambers of Commerce and Industry of India (ASSOCHAM)

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ABBREVIATIONS

AAGR - Average Annual Growth Rate
ASSOCHAM - The Associated Chambers of Commerce and Industry of India
AgDSM - Agriculture Demand Side Management
AMRUT – Atal Mission for Rejuvenation and Urban Transformation
AVVNL - Ajmer Vidyut Vitran Nigam Limited
BEE - Bureau of Energy Efficiency
BLDC - Brushless Direct Current
CAGR - Compound Annual Growth Rate
CEA- Central Electricity Authority of India
DISCOM - Distribution Company
DSM - Demand Side Management
ECBC - Energy Conservation Building Code
ECSBC – Energy Conservation & Sustainable Building Code
EE - Energy Efficiency
EESL - Energy Efficiency Services Limited
EIA - Energy Information Agency
ENS – Eco Niwas Samhita
ESCO- Energy service companies
FY - Financial Year
GSDP - Gross State Domestic Product
JVVNL - Jaipur Vidyut Vitran Nigam Limited
JdVVNL - Jodhpur Vidhyut Vitran Nigam Limited
KUSUM - Kisan Urja Suraksha Evam Utthaan Mahabhiyan
HRIDAY – Heritage City Development & Augmentation Yojana
MEEP – Municipal Energy Efficiency Programme
LED - Light Emitting Diode
MNRE - Ministry of New and Renewable Energy
MOSPI - Ministry of Statistics and Programme Implementation
Mtoe - Million Tonne of Oil Equivalent
MU - Million Unit of Electricity (in kWh)
MuDSM - Municipal Demand Side Management
NEMMP - National Electric Mobility Mission Plan
NHPC - National Hydroelectric Power Corporation
NMEEE - National Mission on Enhanced Energy Efficiency
PMKSY - Pradhan Mantri Krishi Sinchai Yojana
RBI – Reserve Bank of India
RRECL - Rajasthan Renewable Energy Corporation Limited
RVUNL - Rajasthan Rajya Vidyut Utpadan Nigam Limited
RVPN - Rajasthan Rajya Vidyut Prasaran Nigam Limited

SLNP – Street Light National Programme
SEEAP - State Energy Efficiency Action Plan
SEEI - State Energy Efficiency Index
UNNATEE - Unlocking National Energy Efficiency Potential

Executive Summary

Increasing energy demand naturally strains the country's resources and impacts the environment. These warrants decoupling the country's economic growth and energy demand. This is also echoed through India's Intended Nationally Determined Contribution submitted in the run-up to the Paris Climate Conference, where the government has highlighted energy conservation as a key mitigation strategy. The Government of India in 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 in 2021, presented the five nectar elements (Panchamrit) of India's climate action including the target of net-zero emissions by 2070 and 50% of India's cumulative electric power installed capacity from non-fossil sources by 2030.

In meeting the national level targets, States/UTs play a vital role in transitions to low-carbon development pathways. Bureau of Energy Efficiency under the guidance of Ministry of Power developed state specific energy efficiency action plan to ensure that the allocation of resources is as per the requirement of State that will help in meeting state-specific goals on sustainable development.

The State Energy Efficiency Action Plan for a particular State developed by identifying focus sectors of the State and estimating the potential of energy conservation in sectors which are predominant in the region. The State Energy Efficiency Action Plan is developed for a short term-plan for a tenure of 5 years and a long-term plan targeting high-impact energy efficiency by the year 2030.

For the state of Rajasthan, SEEAP was developed under the guidelines of Bureau of Energy Efficiency, Ministry of Power, GOI and Rajasthan Renewable Energy Corporation Limited (RRECL) and inputs & suggestions from various government departments and sector experts were considered. The objective of the State Energy Efficiency Action Plan is to arrive at sector-specific approaches for energy efficiency for the state of Rajasthan.

In FY 2020, Rajasthan has total final energy consumption (TFEC) 28.45 Mtoe in which Non-power or Industrial coal consumption was 2.22%, followed by 36.73% oil consumption, 19.17% consumption in terms of coal in captive plants, 22.79% in terms of imported coal and 19.06% in terms of electricity.

Based on energy consumption and economic growth of state total final energy consumption of state is projected and it is estimated that TFEC of Rajasthan in FY 2031 will be 50.34 Mtoe. On the basis of projected GSDP of the state and projected energy consumption, Industry, Building, Transport and Agriculture sectors were identified as focus sectors and sector specific strategies were analyzed. List of sector specific focused strategies to ensure that the allocation of resources is as per the requirement of the State is listed below:

Industry Sector:

- Deepening and Widening of PAT Scheme in (Fertilizers & Chlor and Alkali)
- Energy Efficiency Intervention in Bricks, Limestone, Foundry, Oil & Steel Re-Rolling.

Transport Sector:

- Infrastructure development for EV charging stations and incentives to consumers for quick transition to EVs.
- Ethanol Blending program.
- Promotion of Standard and Labelling program of Tyres for Fuel Efficiency in Vehicles

Buildings Sector:

- Effective Implementation of Energy Conservation Building Code (ECBC) and Eco Niwas Samhita (ENS) or Energy Conservation & Sustainable Building Code (ECSBC-Once Notified).
- Replacement program for inefficient appliances
- BEE Star Rating and Shunya Rating of Buildings

Agriculture Sector:

- Transition of conventional diesel pumps to Solar powered pumps

This action plan will result in a total energy consumption reduction of 1.89 Mtoe in the moderate scenario and 2.84 Mtoe in the ambitious scenario in FY 2031. This plan will also create awareness at the mass level and create a market potential of approximate rupees 5,233 Crore in the field of energy efficiency and reduce the CO_2 emissions of 5.91 $MtCO_2$ in moderate scenario and 8.90 $MtCO_2$ in ambitious scenario by FY 2031.

1. Introduction

1.1. Background

India's economy is characterized by an emerging and developing market. In 2019, India became the fifth-largest economy in the world in nominal terms, surpassing United Kingdom and behind the United States, China, Japan and Germany. The size of the Indian economy in Fiscal Year (FY) 2020 was INR 145 Lakh Crores at constant prices of 2011-12[1]. With the growth of the Indian economy, the demand for energy has increased significantly, resulting in high energy levels in some sectors and increase in the country's emissions.

As per International Energy Agency's (IEA) World Energy Outlook 2021 report, India currently has a share of 6.1% in the global primary energy consumption, which is projected to increase to 9.8% by the year 2050[2]. India's Final Energy Consumption in FY 2020 was recorded at 533.44 Mtoe (as per Domestic Conversion Factors), with coal and crude oil being the largest contributors to the total energy consumption. India's per capita energy consumption and per capita emissions are well below the global average per capita emissions. However, India continuously taking steps to reduce the energy consumption and emissions and ensure sustainable growth of nation.

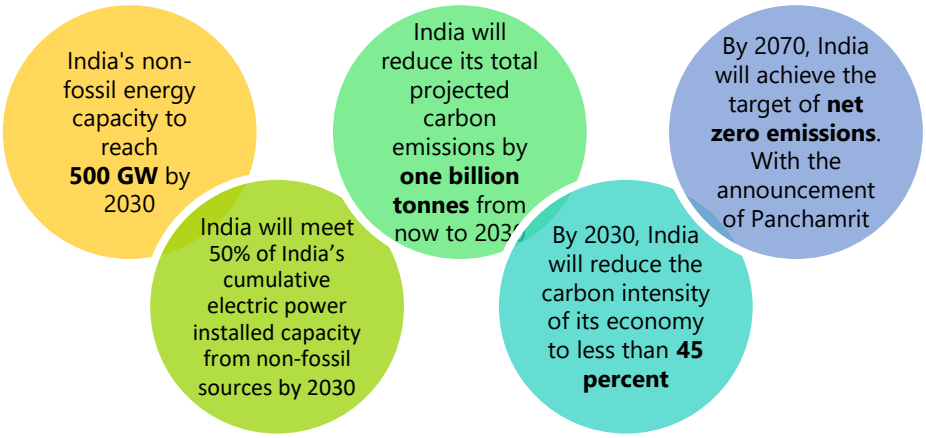
India has set ambitious economic goals for the future and achieving these goals is expected to result in significant increase in the country's energy demand and emissions. In view of this, India has also set ambitious goals for energy and climate performance. The country has also emphasized the importance of energy transition towards de-carbonization of the economy and has recently emerged as one of the world leaders in Energy Transition. States and Union Territories of the country have a key role to play in the fulfilment of these goals. The key strategy adopted by the Government of India is the efficient use of energy

[1] *https://mospi.gov.in/sites/default/files/press_release/PressNoteNAD_28feb23final.pdf*
[2] *https://iea.blob.core.windows.net/assets/4ed140c1-c3f3-4fd9-acae-789a4e14a23c/WorldEnergyOutlook2021.pdf*

resources and their conservation. This is essential since the efficient use of energy and its conservation is the least-cost option to meet the increasing energy demand, reduce wasteful consumption and in leading the country's economic growth in sustainable manner.

1.2. India's Nationally Determined Contributions (NDCs)

In the 2016 Paris Climate Conference, India in its Nationally Determined Contributions (NDCs) had committed that it will reduce the emission intensity of its GDP by 33% to 35% by 2030 from 2005 level. In the Conference of Parties (COP -26) at Glasgow, UK, India announced the Panchamrit, which lists down five ambitions:



Along with the idea of '**Lifestyle for the Environment (LiFE)**'. It is advised to individuals and institutions across the world to support LiFE as a global movement, aimed at promoting mindful and deliberate utilization instead of mindless and destructive consumption to safeguard the environment. This means making choices that are better for the environment, such as using renewable energy sources, reducing waste, and conserving resources. The program aims to teach people about the impact their daily actions have on the environment and provide them with the tools and resources they need to adopt eco-friendlier practices.

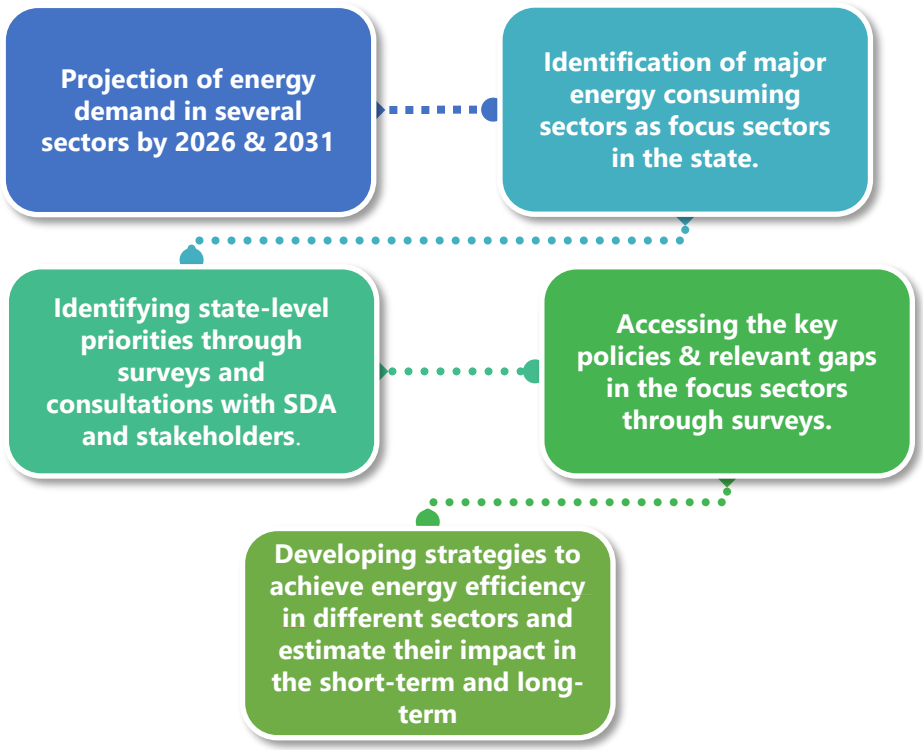
India's earlier target of 33% to 35% reduction in emission intensity from 2005 level by 2030 has been revised to approximately 45%. In view of the enhanced target under Panchamrit, India's energy efficiency efforts need to be increased and States and UTs have a vital role in India's energy efficiency policy

implementation and in meeting state-specific goals on sustainable development in the most energy-efficient way. It is imperative that the States and UTs actively participate in the schemes to facilitate the achievement of the overall goal of reducing the energy intensity of the country.

1.3. About SEEAP

The State Energy Efficiency Action Plan for the State of Rajasthan has been developed by identification of focus sector, to ensure that the allocation of resources is as per the requirement of the State of Rajasthan and estimate the potential of energy conservation in sectors that are predominant in the State of Rajasthan such as Industry, Buildings and Transport. The State Energy Efficiency Action Plan has been developed in two parts, a short term-plan for a tenure of 5 years and a long-term plan targeting high impact energy efficiency by the year 2030 to achieve the targets committed in COP-26. This State Energy Efficiency Action Plan has been developed under the guidance and support of stakeholder departments/agencies of the State of Rajasthan and will be implemented by them in the State after its adoption.

Expected Outcomes of State Energy Efficiency Action Plan (SEEAP)



1.4. State Profile

Rajasthan is area-wise largest state in India with a population of nearly 6.9 crore according to the 2011 Census of India. The population of the state in the year 2020 was projected to be 7.8 Crores.[3], having a share of 5.67% in India's total population. Rajasthan shares its borders with Punjab and Haryana on the North East, Delhi and Uttar Pradesh on the East, Gujarat on the South and Madhya Pradesh on the South East, and international border on the West and North West. The state constitutes of 33 districts (recently revised to 52) spread across an area of 3,42,239 sq. km. Majority of the state's population resides in the rural areas, which constitutes 75% of the state's total population.

Figure 1: Map of Rajasthan

Rajasthan's Gross State Domestic Product (GSDP) for FY 2019-20 was recorded at INR 6.80 Lakh crore, having increased from INR 5.22 Lakh Crore in FY 2014-15 at a CAGR of 5.44%. The share of Rajasthan's GDP in India's overall GDP is 4.7%. The state had a total installed power plant capacity of 25.06 GW [4] as of March 2020, which constitutes 6.77% of the country's total installed capacity as of March 2020. In line with the country's goals and the increasing shift to clean energy

[3] *https://main.mohfw.gov.in/sites/default/files/Population%20Projection%20Report%202020 11-2036%20-20upload_compressed_0.pdf*
[4] *http://www.niti.gov.in/edm/*

sources, Rajasthan also has a key focus on promoting renewable power in the state.

1.5. State Energy Scenario

The State of Rajasthan has seen a significant growth in power demand in the past decade[5]. The installed power plant capacity of the state inclusive of renewable and non-renewable sources has increased from 16,073 MW in FY 2015 to 25,058 MW in FY 2020. The state largely relies on coal-based thermal power plants for electricity generation, with coal-based power plants making up nearly 47% of the state's total installed capacity. Renewable Energy is being fast adopted by the state, with a share of 41% in the total capacity and an installed capacity of 10,339 MW in FY 2020, having increased from 4,106 MW in FY 2015 with a CAGR of 20.29%.

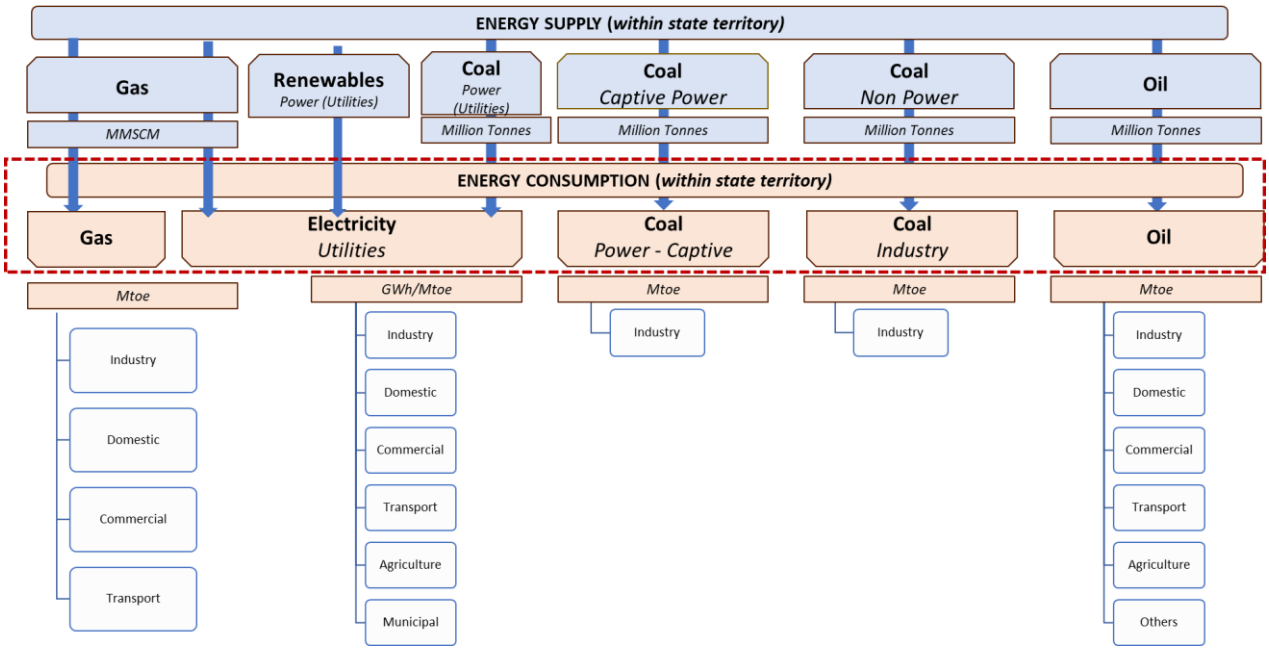


Figure 2 Energy Flow

[5] *http://www.niti.gov.in/edm/*

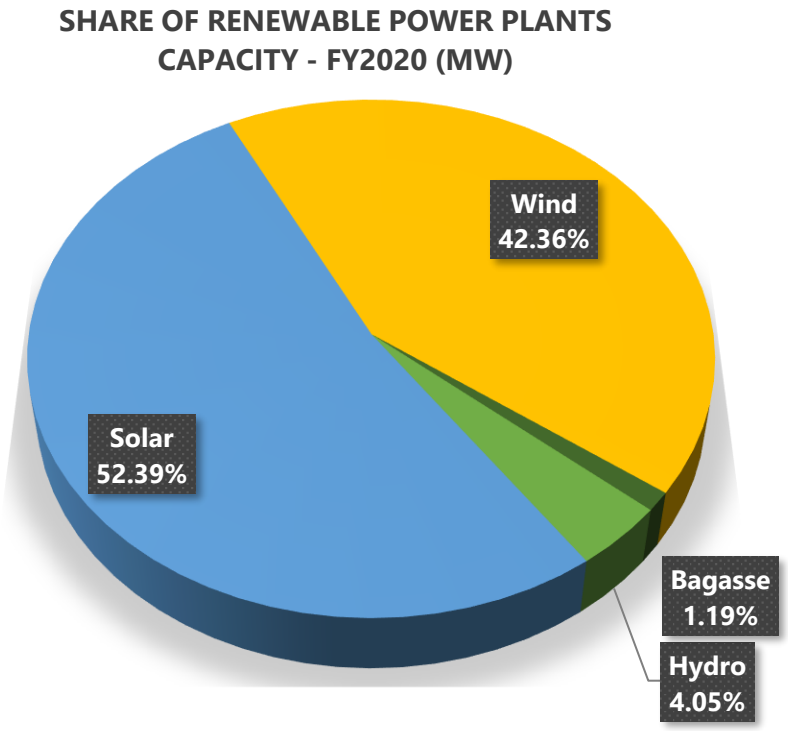


Figure 3: Share of Renewable Power Plant Capacity in Rajasthan

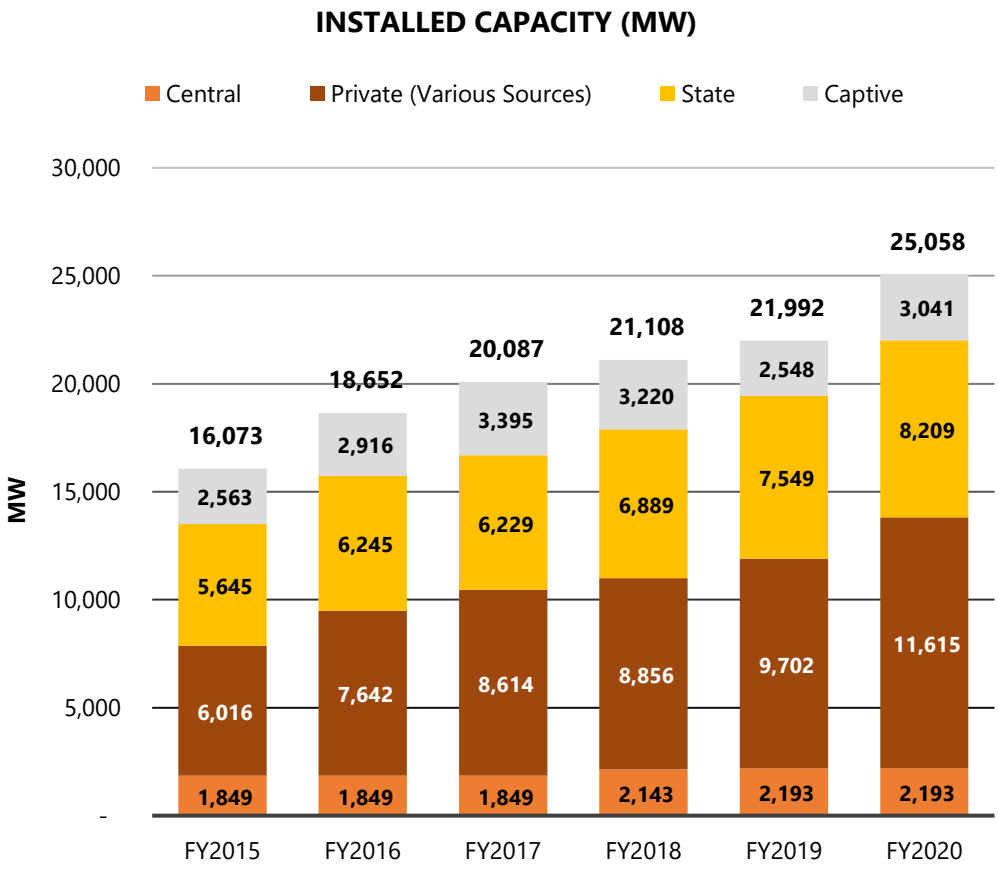


Figure 4: Installed capacity historic trend (MW)

Much of the increase in capacity for meeting the ever-increasing demand has taken place over the past two decades after the formation of the Energy Conservation Act, 2001. The total generation is from various sources including centrally-owned thermal and hydro power plants, state-controlled thermal power plants, Independent Power Producers (IPPs), Open Access (OA), and Renewable Energy Sources (RES). The figure below shows the share of ownership by these stakeholders in the installed capacity of Rajasthan. The largest share of installed capacity of power plants are state-owned (33%), while the central has a 9% share in the total installed capacity catering to the electricity demand of Rajasthan.

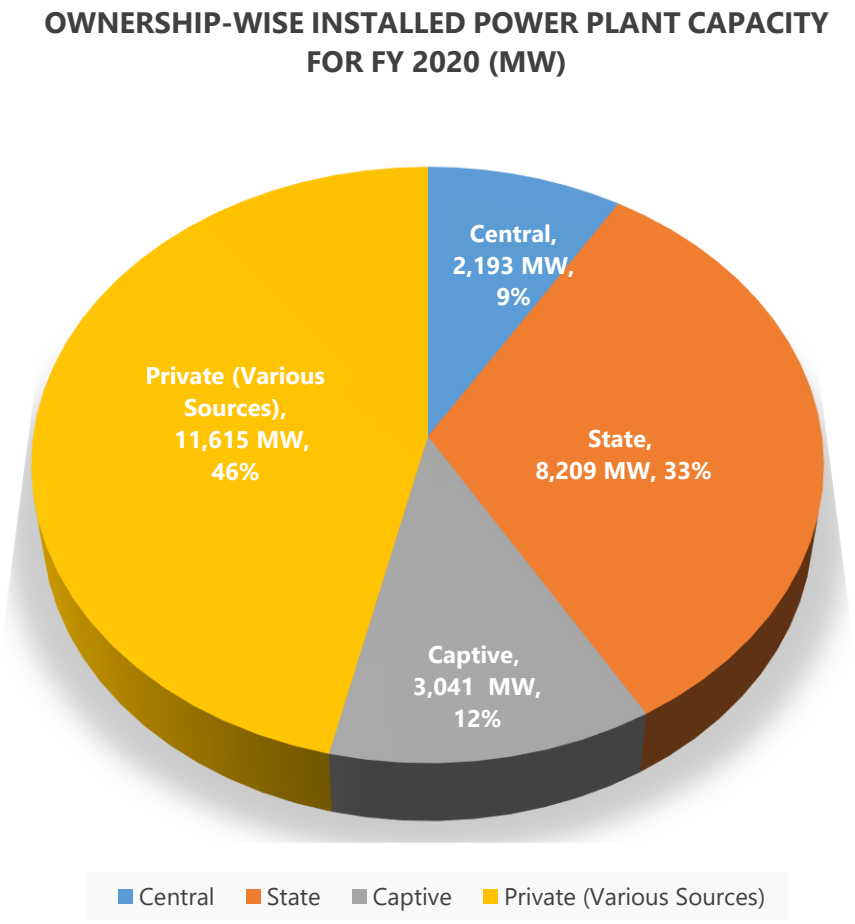


Figure 5: Ownership-wise installed power-plant capacity in Rajasthan for FY 2020

The state has a number of policies and programmes to promote renewable energy in the state:

Table 1: Policies regarding Renewable Energy

S.NO.	NAME OF THE POLICY	KEY HIGHLIGHTS
1	**RAJASTHAN RENEWABLE ENERGY POLICY, 2023**	**Policy Target:** This policy aims to promote renewable energy and its integration with the grid, with a focus on clean and green energy to address global warming and climate change concerns. It also aims to support stakeholders in the renewable energy sector while protecting consumer interests. The new policy aims to reach 65GW of solar capacity and 15GW of wind-solar hybrid by 2030. Following are the few key highlights of this policy: • 90,000 MW of renewable capacity by 2029-30, including 65,000 MW solar, 15,000 MW wind and hybrid, and 10,000 MW hydro and storage. • It also aims to promote rooftop solar, off-grid solar, manufacturing, etc. • Hybridization of Solar – Wind: A wind-solar power plant will be recognized as hybrid plant if the rated power capacity of one resource is at least 25% of the rated power capacity of other resource. This is against the national standard of 30% capacity threshold (solar/wind capacity being at 30% of the other component) • Decentralized Grid Connected Solar Power Projects: The State will promote setting up of decentralized solar power projects with a minimum capacity of 0.5 MW and maximum capacity of 5 MW (3 MW in previous policy) in the premises and vicinity of 33 kV Grid Sub-Stations for sale of power to DISCOMs.

1.6. Energy Consumption Scenario (TFEC):

The state of Rajasthan had 28.45 Mtoe total final energy consumption in FY 2020. TFEC is an energy consumption indicator which indicates the end use energy consumption in the respective energy guzzling sectors in the state and does not include the energy input in the power generation and transmission and distribution (T&D) losses. TFEC is a sum of total end-use primary energy and electricity consumption in the sectors. Coal has the largest share of TFEC at 44.18%, followed by oil at 36.73% and electricity at 19.06%. Gas consumption has the lowest share in the TFEC at 0.03%. The TFEC of the state has increased with a CAGR of 4.90% from FY 2015 to FY 2020.

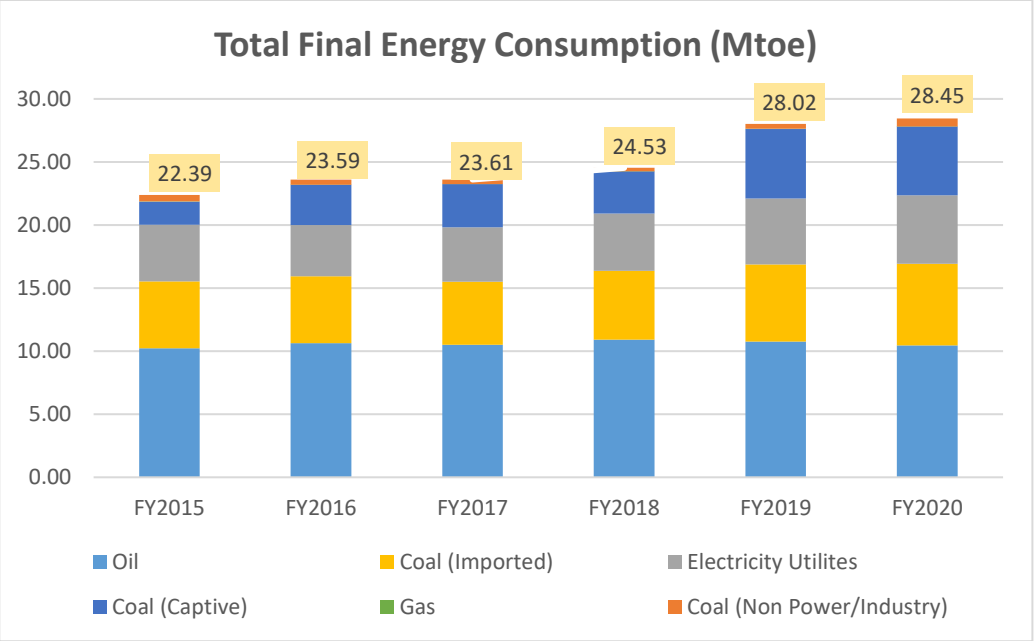


Figure 6: TFEC Trend for state of Rajasthan

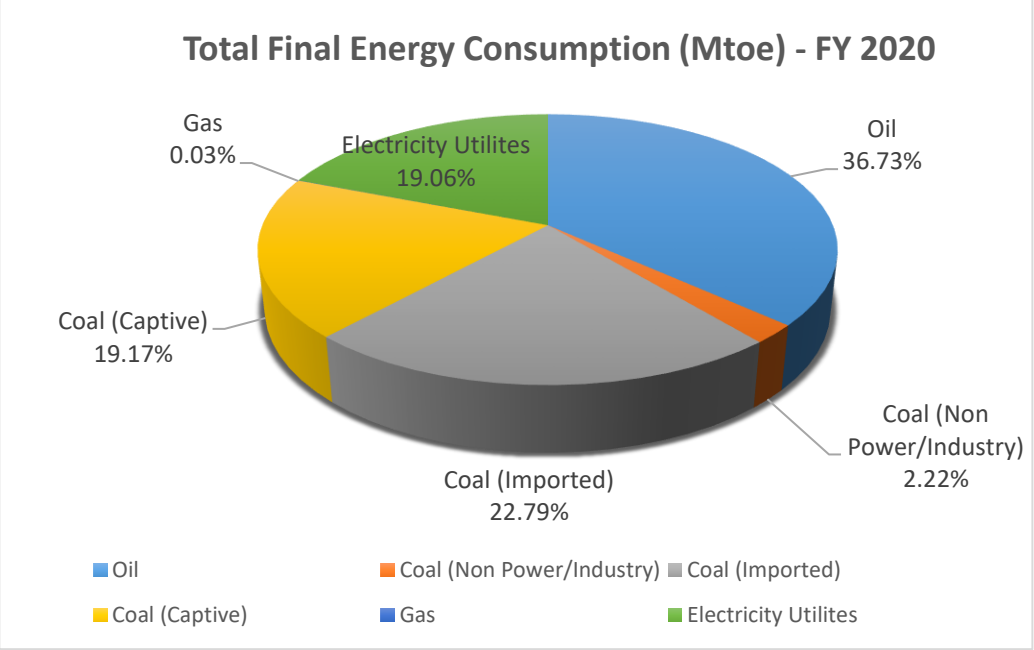


Figure 7: Share of TFEC

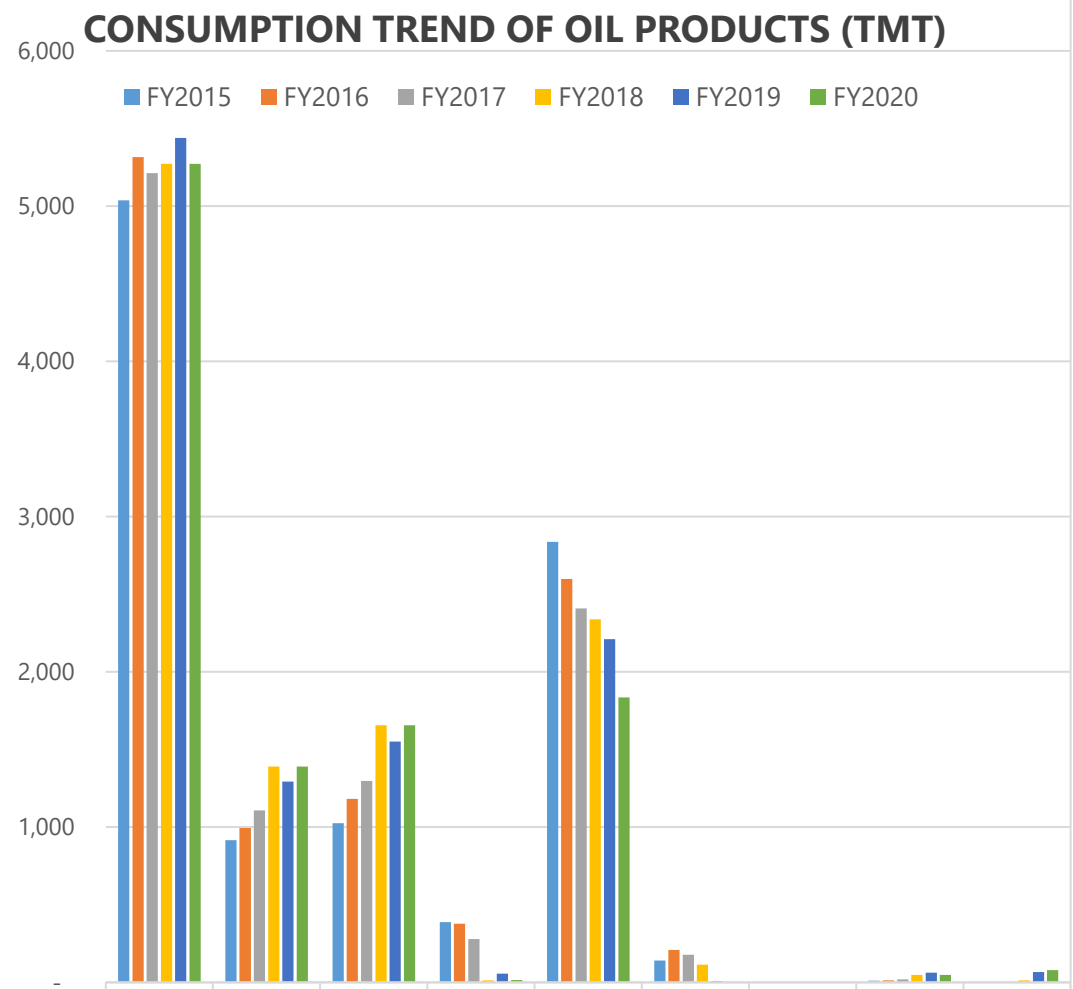
The coal consumption is classified into three different categories based on the purpose and the source of the coal:

1. Captive coal consumption refers to the use of coal by a company for its own consumption, rather than selling it to others. This can include coal used in industries for their own processes, such as in steel manufacturing,

cement production, or chemical industries. The share of Captive coal as a percentage of total TFEC in Rajasthan is about 19.17%.

2. Coal consumption in non-power sectors refers to the use of coal in sectors other than power generation. This can include various industries, such as steel, cement, chemicals, and others.
3. Imported coal consumption refers to the use of coal that is brought into the country from other countries, rather than being produced domestically. The calculation of the imported coal consumption for Rajasthan involves taking the average percentage of the Gross State Value Added (GSVA) of the industry sector in the state and multiplying it by the total coal import of India, which is 248 million tonnes. This method provides an approximation of the quantity of imported coal used by the industry sector in Rajasthan. Imported coal forms about 4.70% of national imports and about 22.79% of Rajasthan state's total coal consumption.

Oil consumption forms 36.73 percent of the total final energy consumption in the state. The majority of the oil consumption in the state is in the transport sector. The energy supplied from oil is in the form of different oil products, namely High-Speed Diesel Oil, Liquified Petroleum Gas (LPG), Petrol, Kerosene, Petcoke, Furnace Oil, Light Diesel Oil, Low Sulphur Heavy Stock and Naphtha. Oil consumption has seen an increased trend from FY2015-2020 with the majority of the consumption being High-Speed Diesel, LPG and MS (Petrol). Further, the use of clean cooking practice and aggressive outreach of LPG based cooking stoves leads to reduction in consumption of kerosene, petcoke and furnace oil from FY2015 to FY2020.



	High Speed Diesel	LPG	MS (Petrol)	Kerosene	Petcoke	Furnace Oil	Aviation Turbine Fuel (ATF)	Light Diesel Oil	Low Sulphur Heavy Stock
FY2015	5,038	917	1,025	389	2,837	141	-	10	-
FY2016	5,316	995	1,183	377	2,598	209	-	13	-
FY2017	5,212	1,108	1,298	279	2,409	178	-	20	-
FY2018	5,272	1,390	1,657	14	2,339	114	-	49	14
FY2019	5,440	1,293	1,551	57	2,211	9	-	62	68
FY2020	5,272	1,390	1,657	14	1,836	-	-	49	79

Figure 8: Oil Consumption Trend in Rajasthan

Increase in CNG fueling stations leads to increase in CNG vehicles in states which results increased rate of gas consumption in the state, with AAGR of 0.10% from FY 2015 to FY 2020.

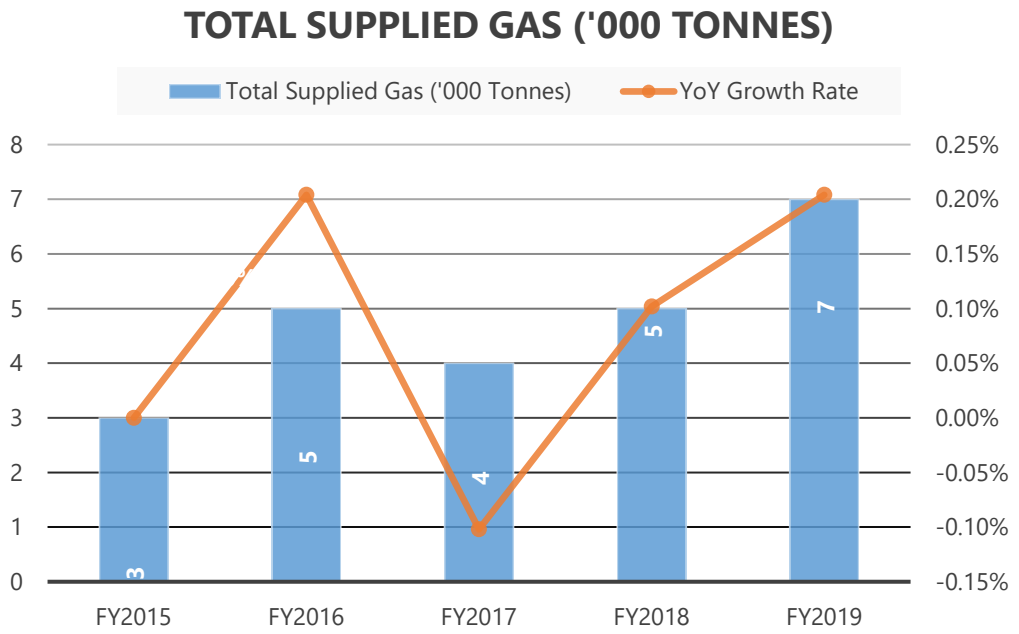


Figure 9: Total Gas Supplied in the state of Rajasthan

Electricity demand continues to increase in the state as new industry and building projects are in development and accessibility of electricity to the population is enhanced. The electricity consumption has shown an increase of nearly 48% in FY 2020 from its FY 2015 level, going from 52.049 TWh in FY 2015 to 63.040 TWh in FY 2020[6], with a CAGR of approximately 4 percent.

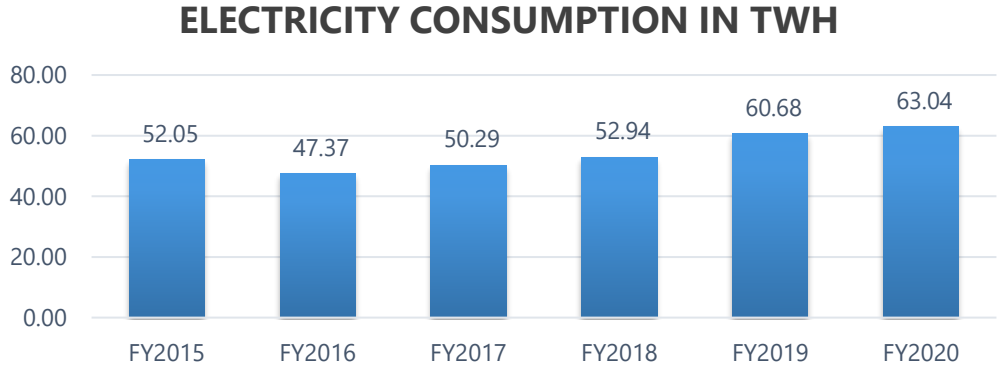


Figure 10: Rajasthan Electricity Consumption in TWh

[6]*https://cea.nic.in/wpcontent/uploads/general/2020/General_Review_2021.pdf*

1.7. Overview of Institutional Framework and Stakeholder Mapping

The Energy Conservation (EC) Act of 2001 establishes a legal framework for developing and executing energy efficiency (EE) policies and programs.

The Act authorizes the Bureau of Energy Efficiency (BEE) to develop national policies and programs, and State Designated Agencies (SDAs) to administer EE programs and enforce EE norms and regulations at the state level.

Rajasthan Renewable Energy Corporation Limited (RRECL) is SDA in Rajasthan and had been formed by merging erstwhile REDA (Rajasthan Energy Development Agency) and the Rajasthan State Power Corporation Ltd (RSPCL) in August 2002. The corporation co-ordinates the program activities between various programs on Non-Conventional Energy Sources and the Society. It is also engaged in creating awareness among people towards conservation of energy, protection of environment degradation through demonstration projects and other methods.

The Corporation under the control of Chairman is headed by Managing Director, who is assisted by Director (Tech), Additional Director, three General Managers, seven Project Managers in addition to other staff.

The corporation formulates and implements the programs for development of Non-Conventional Sources of Energy in the State. It has inter-alia following functions:

- Propagation of the concept of renewable sources of energy and energy conservation.
- Promoting the use of renewable energy systems and means of saving energy in various sectors.
- Research and development primarily of applied nature in the field of renewable sources of energy and energy conservation.

The agency deals in both, renewable energy and energy efficiency promotion and implementation in the state, and is working in the field of Solar Energy, Wind

Energy, Bio Energy, Micro Hydel and Energy Conservation besides energy planning and other aspects of energy management.

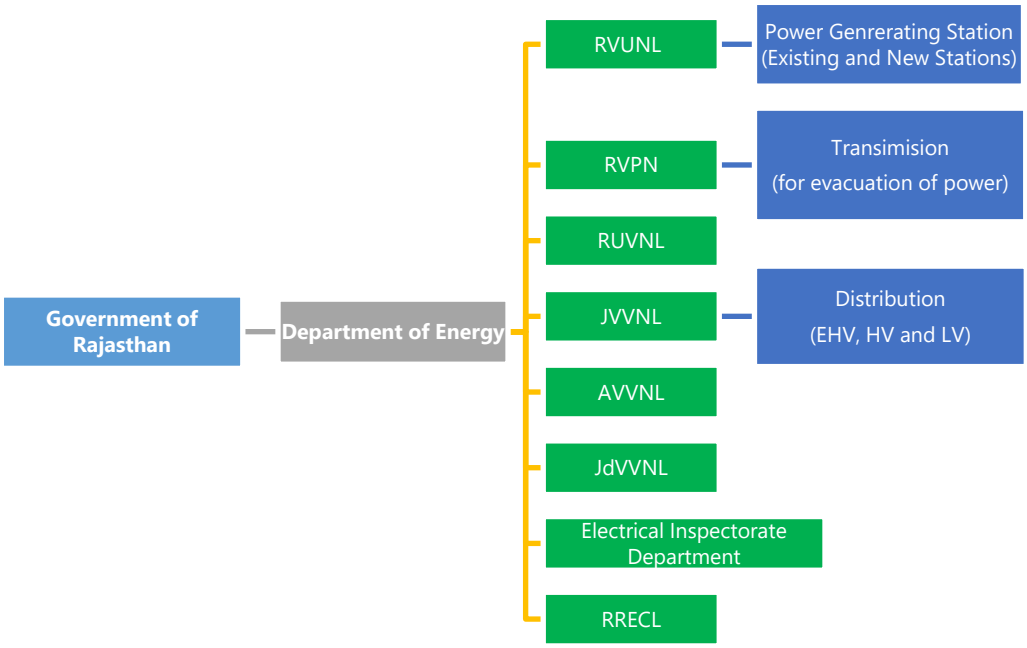


Figure 11: Institutional Framework of Rajasthan

The key stakeholders in the respective sectors were identified for Rajasthan. The stakeholder mapping is presented in the below figure.

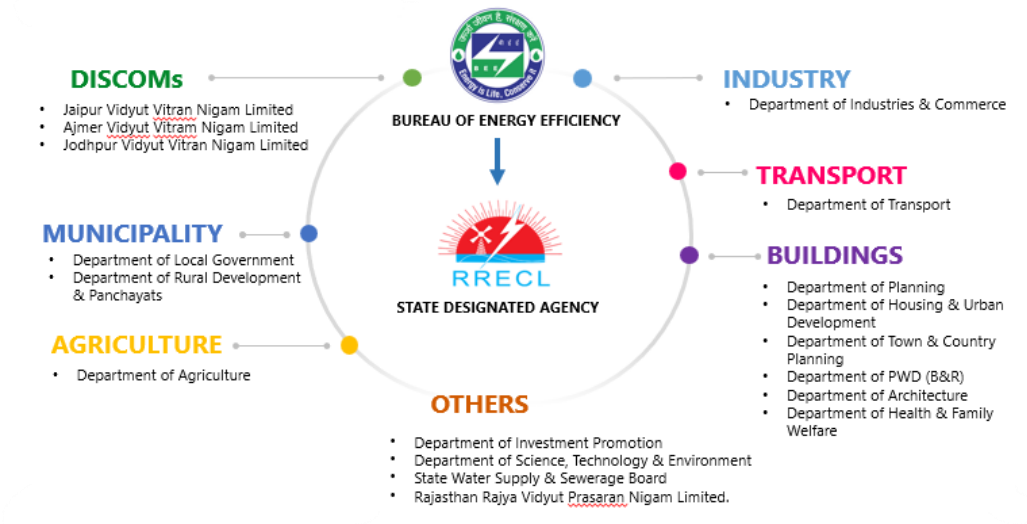


Figure 12: List of Stakeholders

2. Identification of Focus Sectors

The economic sectors of a state can be broadly classified into the sectors namely Industry, Building, Transport, Agriculture, Municipalities and DISCOMs, and Cross Sectors. These sectors can be further divided into sub-categories, as shown in the figure below.

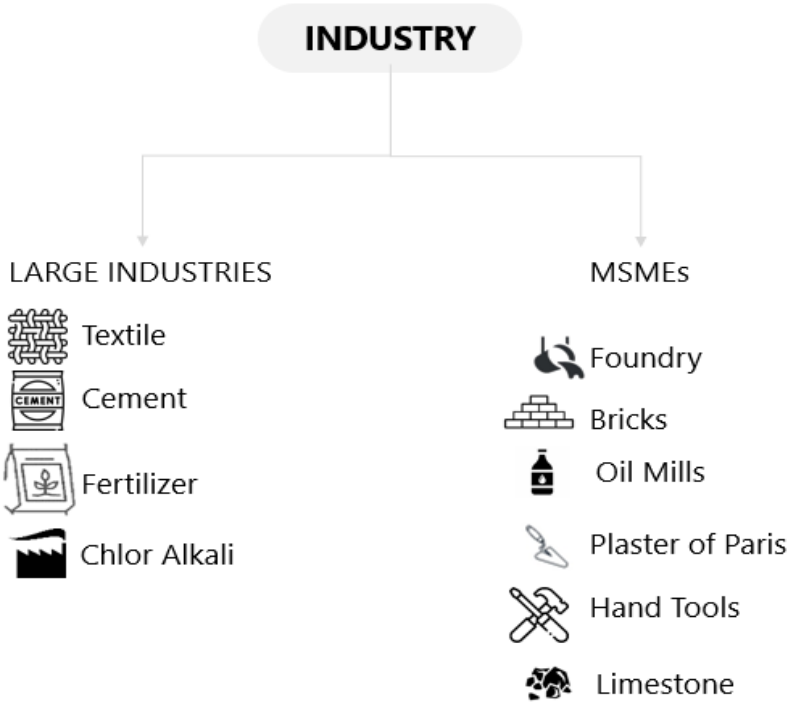


Figure 13: Sub-Sectors of Industries in Rajasthan

Identification of focus sectors or focus areas is important because it is a general characteristic of a state that a major portion of energy is being consumed by few energy-guzzling sectors. Focusing efforts towards these sectors is necessary to ensure that the allocation of resources is as per the state's priorities and towards sectors that have the highest potential of energy savings and emissions reductions.

The focus sectors of the state have been identified based on the share of energy consumption and emissions in the respective sectors, gap analysis of the respective sectors, inputs from stakeholder consultation, and priority areas of a state.

2.1. Methodology of Focus Sector Identification

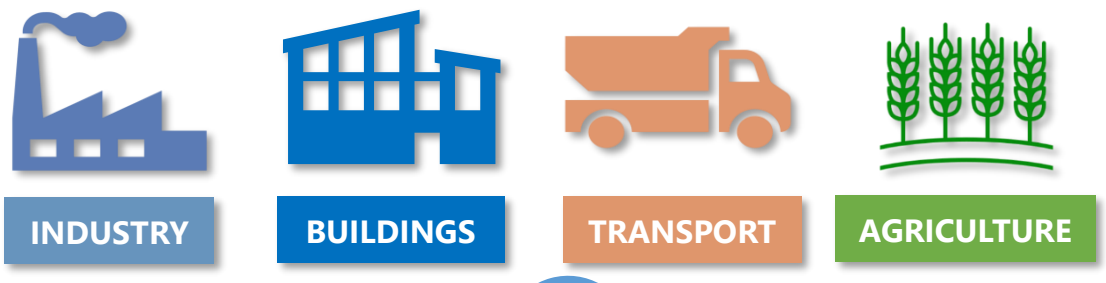
In order to arrive at the focus sectors, the various factors were analyzed namely the energy consumption, emissions, Gross State Value Addition (GSVA). Adding to that, gap analysis in respective sectors, potential for energy efficiency and emissions reduction, state has planned efforts in prioritized sectors, and SDA and stakeholder inputs have been considered to arrive at the focus sectors.

Gross State Value Addition (GSVA)

The Gross State Value Added (GSVA) of different economic categories was sourced from National Accounts Data, prepared by MoSPI. The GSVA sectors are not the same as the end use sectors used for the purpose of this report. However, these sectors have been used to deduce end use sectors for calculating imported coal and the same has been detailed in relevant sections. The GSVA sectors may also oftentimes not be representative of sectoral growth in terms of energy as the link between economic activity and energy use in several sectors is dependent on several factors, analyzing which is beyond the scope of this plan.

2.2. Identified Focus Sectors

Based on the TFEC, electricity consumption in the state and its sectoral distribution, focus sectors have been identified for the state. The focus sectors represent share of energy consumption through available data in Primary and Secondary Energy sources. It also reflects the views and recommendations of the stakeholders, existing and proposed policy infrastructure and vision of the state Government for different sectors. Based on the above parameters and other important considerations, the following have been identified as the focus sectors for devising energy efficiency strategies in Rajasthan. For the fiscal year 2020, the focus sector including Industry, Transport, Buildings, and Agriculture are estimated to have the highest share of the total energy consumption in the state.



3. Projections and Forecasting

Economic and energy projections for the state up to the target year FY 2031 are performed in order to predict the future growth patterns of the respective sectors and to assess the impact of possible energy efficiency interventions in these sectors. The Gross State Domestic Product (GSDP) projections and the sectoral energy consumption projections form the basis of the expected emissions and emissions intensity of the state in the target year FY 2031, which is important in developing the emissions reduction targets for the state and in aligning the state with the national goals.

Fiscal Year (FY 2020), implying the period from April 2019-March 2020 has been selected as the base year for projections in this study keeping in view the years FY 2021 and FY 2022 being pandemic years.

The Gross State Domestic Product (GSDP) of the State of Rajasthan was recorded at INR 6.80 Lakh Crore in FY 2020 and is projected to reach INR 12.17 Lakh Crore in FY 2031, at constant prices of 2011-12. The GSDP for the period FY 2023-FY 2031 is forecasted by taking the CAGR of the GSDP from FY 2015 to FY 2020. The historic and forecasted GSDP for the State of Rajasthan is shown in the figure below.

The Total Final Energy Consumption (TFEC) has been projected for all sectors up to FY 2031 taking into account the historic energy consumption trend from FY 2015 to FY 2020 along with the historic and projected GSDP growth for Rajasthan.

Using the above-mentioned factors, the Business-As-Usual (BAU) growth rate factors are calculated for all the sectors in order to project the future energy demand by FY2031. The Total Final Energy Consumption of the state in the Business-As-Usual (BAU) scenario is projected to reach 50.34 Mtoe in FY 2031 from 28.45 Mtoe in FY 2020, with a projected CAGR of 5.33%.

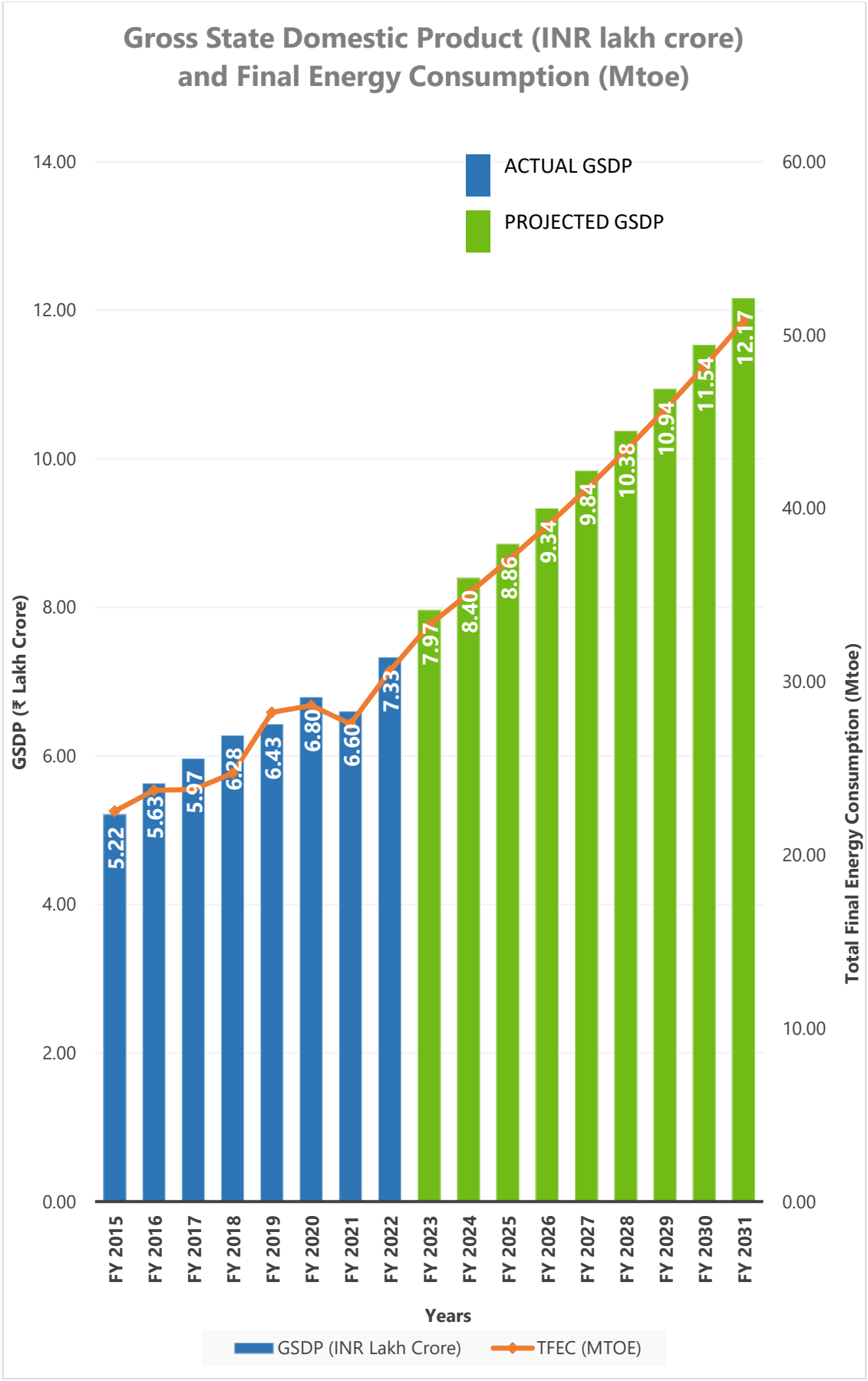


Figure 14: GSDP and TFEC Projection Trend

INDUSTRY SECTOR

4. Focus Sector 1: Industry

4.1. Current Scenario

The State of Rajasthan has witnessed rapid growth of industrialization after economic liberalization. Many industries have been developed in the state such as cement plants in Chittorgarh, Beawar, Sirohi and Kota region; textile and prints units in Bhilwara & Jaipur; Chlor-Alkali unit in Alwar; foundry in Jaipur; hand tools in Nagaur; Oil mills in Alwar; bricks kilns in Sawai Madhopur region. Ajmer, Alwar, Bhilwara, Chittorgarh, Jaipur, Jodhpur, Kota, Neemrana and Udaipur, etc. are the major industrial cities of Rajasthan.

As of March 2021, the State of Rajasthan has 274 Large Industries and 9,50,617 registered MSMEs employing 44.5 Lakh people. The prominent industrial sectors in the state in terms of their scale, investment, employment and share in energy consumption are namely Cement, Textile and Handloom, Chlor-Alkali, Fertilizer, Thermal Power Plants, Brick kilns, Limestone, Plaster of Paris, Oil mills, Hand tools and Foundry.

4.2. Energy Efficiency Strategies in the Industry Sector

This section presents the proposed strategies in the prominent sectors and focus areas identified in the industry sector along with their impact in terms of energy efficiency and emissions reduction. Strategies are proposed with their relevant action items.

Strategy #1: Deeping and Widening of Perform, Achieve and Trade Scheme

Implementation Timeline: Long Term (Till FY 2031)

The analysis performed to determine the coverage of Perform, Achieve, and Trade (PAT) in Rajasthan revealed that as of FY 2019, the industries covered under the PAT scheme have a share of 47.64% in the total energy consumption in the industry sector.

In the proposed strategy, it is recommended that the state enhance coverage of energy consumption in PAT industries (DCs) by deepening and widening the PAT

scheme in the state. Deepening and Widening of PAT scheme would imply notifying more industries as designated consumers under the current PAT sectors by lowering the threshold limit for eligibility (TOE/annum), as well as the inclusion of new sectors under the PAT scheme. Introduction of new sectors such as Dairy, Petrochemical industries, and hand tools & foundry. in the PAT scheme can be targeted for Rajasthan where these sectors are prominent.

Moderate and Ambitious SEC assigned to Fertilizers non-PAT units, and to Textile plants. It is assumed that the existing units of both sectors will achieve the moderate SEC target in 50% units and achieve ambitious SEC target in 70% units.

Table 2: Energy Savings in Moderate and Ambitious Scenario for Deepening and Widening of PAT Scheme

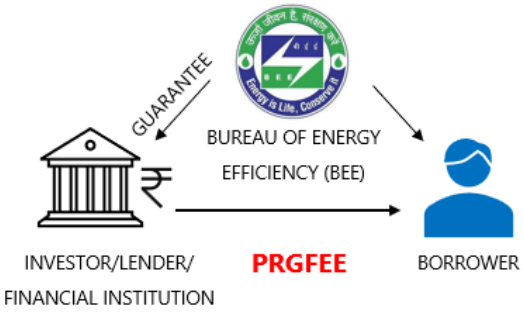
Sector	Baseline SEC (toe/ tonne)	Moderate SEC (toe/ tonne)	Ambitious SEC (toe/tonne)	Production in 2031 ('000 tonnes)	Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
Fertilizer	0.35	0.32	0.28	30021.75	0.0011	0.0021
Chlor Alkali	0.46	0.41	0.37	35995.08	0.0017	0.0033
Total					**0.0028**	**0.0054**

Implementation Agency: Bureau of Energy Efficiency, RRECL

Actionable items:

1. **Partial Risk guarantee program to encourage implementation of latest energy efficient technologies in the sectors (Over and above existing schemes with state contribution)**

   A Partial Risk Guarantee (PRG) program can be an effective tool for encouraging the implementation of the latest energy-efficient technologies in various sectors. The program



involves providing a guarantee to a lender or investor, which covers a portion of the risk associated with financing the adoption of energy-efficient technologies.

Under the program, the lender or investor can provide financing at a lower cost, as the risk is partially covered by the guarantee. This helps to reduce the cost of financing for the borrower, making it more affordable to implement energy-efficient technologies.

BEE, under its existing PRGFEE scheme has already released guidelines for partial risk guarantee that may be adopted by the state for effective implementation.

2. **Capacity Building of Energy Managers and Energy Auditors in PAT DCs and new probable sectors for compliance with scheme and new technologies.**

   Though its mandatory to go through a refresher training for all energy auditors and managers, it is important to attain knowledge of changing schemes and policies that could positively impact large consumers and help them implement schemes in their respective organizations.

3. **Mandatory Standardized Energy Audits in every three years for all units that have energy consumption below PAT threshold, in all notified PAT sectors, excluding MSMEs.**

   Though separate guidelines are issued for PAT industries, non-PAT, non-MSME industries could also benefit from energy audits. This shall not only ensure their improved energy performance, but also, ensure that if brought under PAT scheme at a later stage, they would be accustomed and more willing to participate in it. The audits will also improve competitiveness of these industries. A monitoring mechanism may be developed to see the impact of energy audits and advise industries in a constructive way from time to time.

4. **Development of mechanisms for B2B interaction with global technology suppliers.**

   Global technologies are often beyond the reach of domestic industries due to several reasons. A platform to improve competitiveness and

efficiency in energy may be provided under a structure to ensure advancement of manufacturing process and improvement in energy efficiency at the same time.

Strategy #2: Energy Efficiency Interventions in MSME Clusters

Implementation Timeline: Short Term (Till FY 2026) for lower coverage; Long Term (Till FY 2031) for higher coverage.

The strategy is proposed for the Small and Medium Enterprises (SME) sector, which consist of MSMEs in identified prominent sectors such as foundry, limestone, oil mills, bricks, plaster of paris etc. A PAT-like scheme is proposed under this strategy for the unorganized and small industries sectors, which would not meet the threshold energy consumption under the conventional PAT scheme. The strategy would involve the implementation of energy efficient technologies and new & innovative decarbonization technologies in the market in order to enable SMEs to meet their energy saving targets.

It was assumed that 50% industries will be able to adopt the strategy in moderate scenario and 70% industries will be covered in the ambitious scenario. The strategy is expected to result in energy savings of 0.085 Mtoe and 0.212 Mtoe in the moderate and ambitious scenarios respectively.

Table 3: Energy Savings in Moderate and Ambitious Scenario in MSME Clusters

Sector	Baseline SEC (toe/ ton)	Moderate SEC (toe/ ton)	Ambitious SEC (toe/ton)	Production in 2031 (tonnes)	Energy saving in moderate scenario (Mtoe)	Energy saving in ambitious scenario (Mtoe)
Bricks	1.84	1.65	1.47	194878	**0.043**	**0.128**
Limestone	0.03	0.026	0.023	630684	**0.002**	**0.004**
Foundry	0.36	0.32	0.29	2,11,800	**0.0198**	**0.0397**
Oil Mill	0.013	0.012	0.010	1,44,618	**0.0002**	**0.0004**
Re-rolling	0.05	0.04	0.03	20,16,616	**0.0202**	**0.0403**
TOTAL					**0.085**	**0.212**

Implementing agency(s): Bureau of Energy Efficiency, RRECL, Directorate of Industries

Actionable items:

A number of action items will need to be adopted by the relevant departments and implementing agencies to achieve the energy savings estimated for this strategy. These action items include:

1. **Carrying out energy and resource-mapping studies in MSME clusters -** For the industries not covered under PAT, there is a challenge in reporting accurate energy consumption data for individual clusters or sub-sectors. Understanding of energy consumption patterns in the clusters in necessary to ensure optimized allocation of resources and assess the feasibility of technology implementation in a particular cluster. Energy and resource-mapping studies are comprehensive studies on MSME clusters and sub-sectors that can give insights into the current status of technology implementation in the cluster, set benchmark energy consumption, design threshold limits for a PAT-like scheme, and analyze the future potential of technology implementation in terms of energy and cost savings. Energy and resource-mapping studies are proposed to be carried out in the prominent MSME clusters and industry sub-sectors of the state annually to set benchmarks and track progress in the implementation of this strategy.
2. **Implementation of Demonstration Projects on energy efficient technologies in SME clusters –** Demonstration projects are proposed to be carried out every year on a periodic basis in all prominent SME clusters to promote these technologies and make stakeholders aware about the monetary and energy performance impact of these technologies.
3. **Workshops on technology interventions for energy conservations in MSMEs –** It is proposed to organize cluster wise workshops for MSMEs on technology interventions that can be implemented in respective industries. It is important to disseminate technical information about new technologies among owners and maintenance team of MSMEs so that they can implement latest technologies in their units.
4. **Periodic standardized energy audits for MSMEs on load basis and reimbursement of energy audit cost with a maximum cap** – Government

of Rajasthan may develop a standard format of energy audit and issue notification for conducting mandatory periodic (in every 3 Years) energy audits by every unit above a certain limit of connected load. Government can also provide reimbursement of energy audit cost with a maximum cap of INR 75,000. Monetary support to small industries and MSMEs can be provided to maintain the standard of conducted energy audit.

5. **Sector-specific policy development for financial assistance on implementation of ECMs suggested in energy audit-** A policy may be developed at state level to provide the financial assistance for implementation of ECMs recommended in the energy audits. Policy development shall consider the sector specific requirements, energy saving potential of sector and its importance in state level GSDP.
6. **Issuance of directives for implementation of ISO 50001, Energy Management System in organizations on load basis-** ISO 50001 is an international standard that outlines the requirements for an energy management system (EnMS). It provides a framework for organizations to establish, implement, maintain, and improve energy performance and efficiency. State Government shall issue directive to all units in state which are above a limit of connected load, to implement ISO 50001 and adopt Energy Management System in organizations. Implementation of ISO 50001 can help organizations identify and address energy efficiency opportunities, reduce energy consumption and costs, and improve their environmental performance.
7. **Phase wise plan to implement DSM scheme for replacement of existing inefficient (non-star rated) pumps through DISCOMS-**

   State government department may develop a demand side management (DSM) plan to replace all existing pumps which are lower than 3 star rated or purchased/installed before 2015 with BEE 5-Star rated appliances. Phase wise plan can be executed through DISCOMs or listed ESCOs in the state.

8. Competitive Incentivization for MSME sectors-

Enabling and offering the financial incentives to the MSME sectors leads to an encouraging and greener business environment. Following sectors are targeted for the incentivization:

Bricks

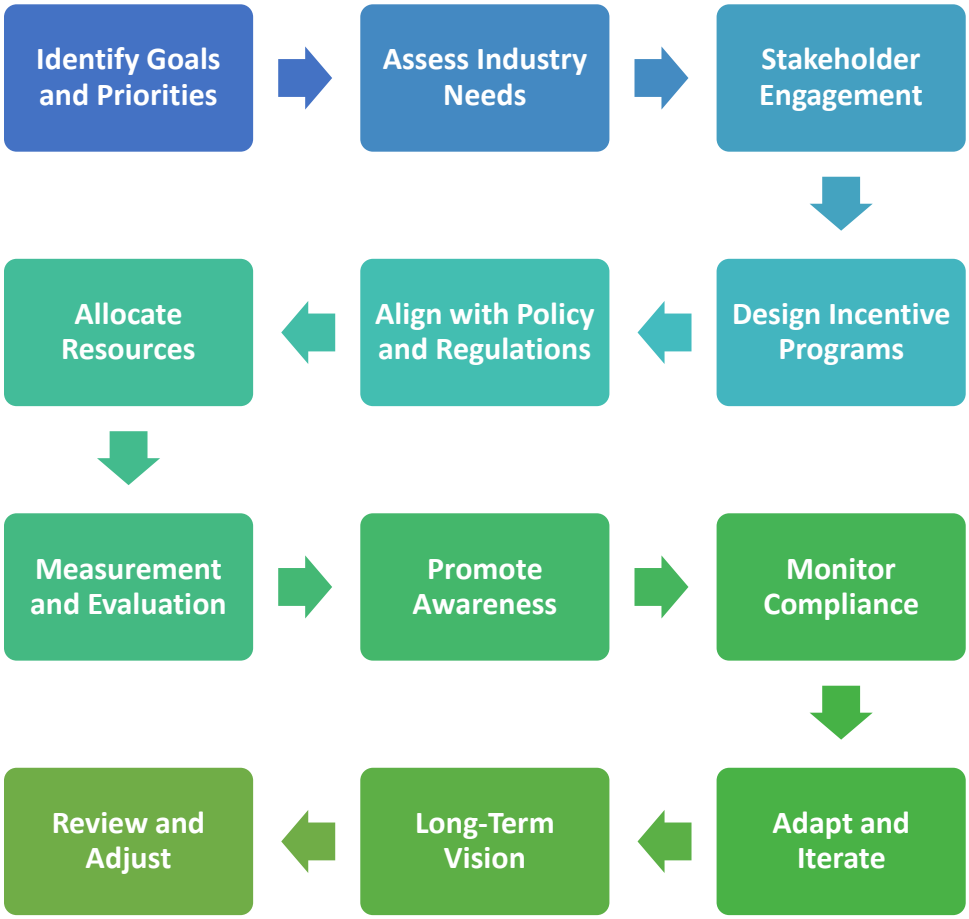
Limestone

Foundry

Oil Mill

Re-Rolling

Facilitating the offering of incentives for Micro, Small, and Medium Enterprises (MSMEs) to stimulate growth requires developing and implementing a structure that encourages businesses and individuals to direct their investments toward innovation, expansion, and environmentally conscious practices. Presented below are the steps for a sustainability focused doable roadmap:



Following are the references for incentives currently being offered by the State Government:

Rajasthan Investment Promotion Scheme 2022[7]		
1	Industries under Rajasthan Green Rating System	Upto 50% consent fee waiver
2	Captive Renewable Energy Generation	100% electricity duty exemption for 7 years

[7] *https://invest.rajasthan.gov.in/policies/rajasthan-investment-promotion-scheme-rips-2022.pdf*

Rajasthan Industrial Development Policy 2019[8]		
1	Incentives for manufacturing units adopting green measures	Investment support on SGST, employment subsidy, electricity duty exemption, stamp duty exemption, mandi fee exemption, etc.
2	Green Building and ecofriendly industries	Support from Government

4.3. Energy Saving Targets & Monitoring Mechanism

The proposed strategies for the industry sector, the total energy saving estimated is 0.09 Mtoe in the moderate scenario and 0.22 Mtoe in ambitious scenarios by FY 2031.

Table 4 Energy Savings in Moderate and Ambitious Scenario for Industry Sector

Action Plan	Energy Savings in 2031 under moderate scenario (Mtoe)	Energy Savings in 2031 under ambitious scenario (Mtoe)
Deepening and Widening of PAT Scheme	0.0028	0.0054
MSME Clusters	0.0850	0.2120
Total	**0.09**	**0.22**

Implementation Agency: Bureau of Energy Efficiency, RRECL

Monitoring Mechanism:

To effectively carry out the action plan, it is essential to establish a robust monitoring and verification system. While the State Designated Agency (SDA) holds the primary responsibility for overseeing progress, it is imperative for other stakeholders, including organizations engaged in building sector development

[8] *https://rajnivesh.rajasthan.gov.in/Uploads/a1786588-588a-46fc-8452-3ad89b2f59a2.pdf*

and planning, to actively engage in diligent monitoring and reporting. The suggested monitoring framework, outlining the steps to track the scheme's progress, is presented in the table below:

Type of Monitoring	Frequency	Nodal Agencies	Responsible Agencies
Reporting, Monitoring and Review of the scheme advance and implementation status	Quarterly	State Designated Agency	• State Designated Agency • Department of Industries and Commerce
Review of the scheme advancement and course correction, if required.	Half-yearly	State Designated Agency	• State Designated Agency • Department of Industries and Commerce
Review of the scheme advancement and policy interventions required	Yearly	State Designated Agency	• Department of Industries and Commerce • State Designated Agency • Bureau of Energy Efficiency
Progress reporting of scheme advancement	Monthly	State Designated Agency	• State Designated Agency

In conclusion, Monitoring mechanisms are essential for successful implementation of energy efficiency action plans, providing a way to track progress, identify areas for improvement, and evaluate energy efficiency measures. Moreover, monitoring mechanisms can also help to identify patterns and trends in energy consumption, allowing policymakers to develop effective energy efficiency strategies. Effective monitoring mechanisms are essential for achieving energy efficiency goals in the industry sector, leading to cost savings, improved comfort, and environmental benefits.

BUILDINGS SECTOR

5. Focus Sector 2: Buildings

5.1. Current Scenario

In Rajasthan, RRECL has notified the Energy Conservation Building Code for the state. Furthermore, Bureau of Energy Efficiency, GoI has launched Eco-Niwas Samhita (ENS) for residential buildings and residential part of mixed land used projects build on plot area ≥ 500 square meters in 2018. In the first phase minimum standards for the building envelop was launched to limit heat gain or heat loss of the residential building comprising adequate day lighting potential and ventilation. BEE, GoI developed Eco-Niwas Samhita Part–II for setting up minimum standards for the Electromechanical Equipment for efficient use of energy in residential buildings. The provisions of ENS must be incorporated in Unified Building Byelaws (UBBL).

A unified code for building sector "Energy Conservation and Sustainable Building Code (ECSBC)" has been introduced, however the code has not been launched and notified yet. The ECSBC code will be applicable for both commercial and residential buildings.

The buildings sector is one of the energy-guzzling sector in the state of Rajasthan. As per below graph it can be witnessed that the energy consumption in building sector is continuously increasing since FY 2015. The increase in urbanization is very rapid and the demand in domestic sector is major in the terms of buildings and electricity requirement.

The commercial sector plays a vital role in the urbanization of Rajasthan, but it contributes only 28.3% to the total electricity consumption of the building sector. Meanwhile, the domestic sector accounts for 71.7% of the total building electricity consumption, highlighting the need for a policy to promote energy efficiency in households. Implementing energy efficiency plans in even a small fraction of the domestic sector could significantly reduce electricity consumption.

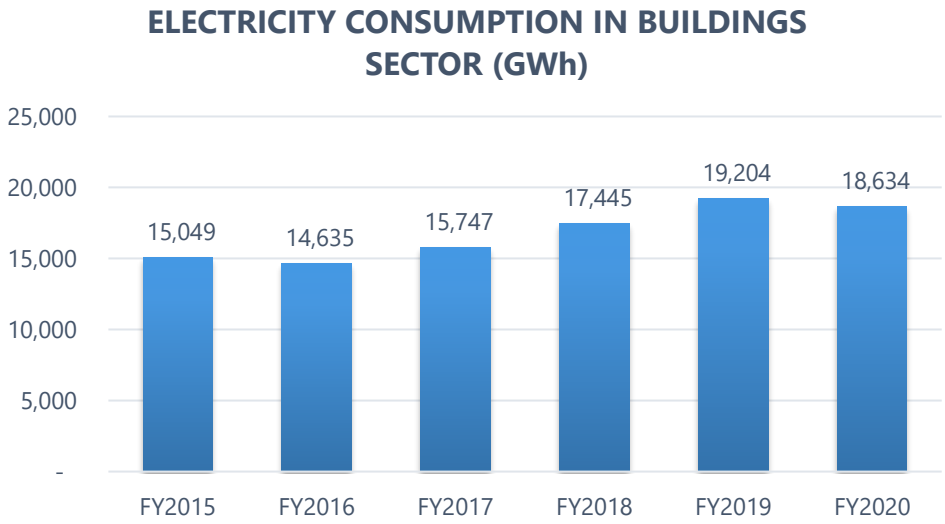


Figure 15: Electricity Consumption in Buildings Sector

The figure below illustrates the distribution of electricity consumption between the commercial and domestic sectors for the fiscal year 2020.

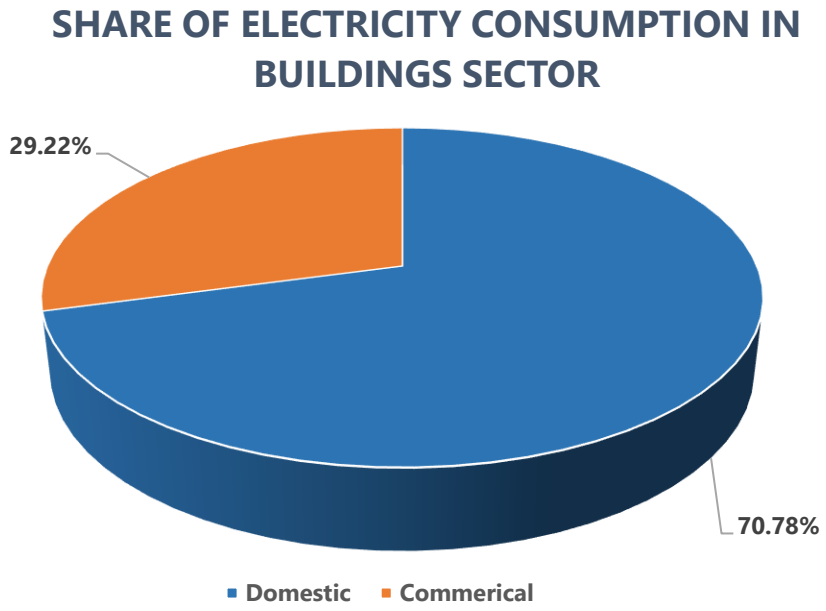


Figure 16: Share of Electricity in Buildings Sector for FY 2020

5.2. Energy Efficiency Strategies in the Buildings Sector

This section presents the proposed strategies in the domestic buildings and commercial buildings sector along with their impact in terms of energy saving potential. The following strategies are proposed in the building sector, as part of the State Energy Efficiency Action Plan:

1. Effective Implementation of ECBC and ENS.
2. Replacement Programme for inefficient appliances.
3. Promotion of BEE Star Rating and Shunya Rating of Buildings.

Although programs like Standards & Labelling and ECBC are prevalent in the state, the proposed strategies focus on enhancing the extent of their implementation by increasing the penetration of technology into the population and rate of implementation of these strategies.

Strategy #1 Effective Implementation of ECBC and ENS (will be known as ECSBC once notified)

The state of Rajasthan has already notified the Energy Conservation Building Code (ECBC) for commercial buildings and the state is in process of adopting ECO-Niwas Samhita (ENS) for residential buildings. However, in a recent EC Act Amendment 2022, unified code "Energy Conservation and Sustainable Building Code" (ECSBC) is introduced which will cover both commercial and residential buildings.

Effective implementation of ECBC and ENS compliant buildings in the state is proposed for upcoming commercial and domestic buildings in the state as a strategy for energy savings in the building sector.

In order to estimate the savings through ECBC, the electricity consumption of the commercial buildings sector was projected till FY 2031. After forecasting the energy demand in the commercial building sector from FY 2023 to FY 2031, the annual increment in the electricity consumption in the commercial buildings sector was projected keeping it in line with the CEA 20th Electric Power Survey Report.

The total incremental electricity consumption in the commercial sector of the state is projected to be 4,036 GWh between FY 2023 to FY 2031. This increment in electricity consumption accounts for all the categories of commercial buildings of varying loads. The Energy Conservation Building Code (ECBC) sets minimum energy standards for commercial buildings having a connected load of 100 kW or more. It has been taken into consideration that around 5% of the

buildings in the state have connected load of 100 kW or more. Considering this percentage, the Total Incremental Electrical Consumption contributing to buildings having load >100kW is estimated to be almost 225 GWh.

Based on the energy savings percentage from ECBC and ECBC+, the moderate and ambitious savings in the commercial building sector are found to be 56 **GWh** and **79 GWh** respectively.

An effective approach to reduce long-term unnecessary electricity usage in residential buildings is by making them more energy efficient. Implementing Energy-saving measures as per Eco Niwas Samhita (ENS) can be helpful in achieving this goal in the residential sector.

In the residential sector, by FY 2031, the electricity consumption is projected to be around 26,715 GWh. The overall incremental electrical consumption is estimated to be 10,211 GWh based on the anticipated household electricity demand between FY 2023 to FY 2031. In order to assess the savings that can be achieved from successful implementation of ENS, it is assumed that 4% of all the residential building stock would be ENS compliant by 2031. The strategy is expected to result in electricity savings of 54.5 GWh in the moderate scenario and that of 65.4 GWh in the ambitious scenario.

The cumulative energy savings expected from the enhanced implementation of ECBC and ENS in the state is shown below:

Table 5: Moderate and ambitious scenarios for effective implementation of ECBC and ENS

Particulars	Energy Savings in 2031 under moderate scenario (Mtoe)	Energy Savings in 2031 under ambitious scenario (Mtoe)
Energy Saving Potential (Mtoe) in ECBC	0.0048	0.0068
Energy Saving Potential (Mtoe) in ENS	0.0047	0.0056
Total	**0.0095**	**0.0124**

Implementing Agency: Bureau of Energy Efficiency, RRECL, Department of Housing and Urban Development

Actionable Items:

1. **Setting-up of effective enforcement plan with ULBs and SDA as monitoring agencies-** Effective implementation of ECBC and ENS depends on the effectiveness of rules & regulation adopted by the state. To ensure the same role & responsibility of all concerned departments, checkpoints, monitoring mechanism and penalties must be properly defined in ECBC and ENS rules & regulations. The building codes should be incorporated into the ULB Building Byelaws for the compliance of the ECBC and ENS. SDA being an extended arm of Bureau of Energy Efficiency shall monitor the process of ECBC and ENS compliance and record the data of total energy savings achieved through the implementation of ECBC and ENS.
2. **Development and Integration of ECBC and ENS (ECSBC[9]) compliance portal with ULB's building approval process, directory of energy efficient materials/technologies** – For effective and aggressive implementation, it is proposed that the state shall develop and integrate online portal with ULB's online building approval process to aid in quick ECBC & ENS approval and monitoring process online. The portal would ensure a faster process of compliance application, third party verification and certification. The portal may automatically fetch data from various ULB-level database to monitor compliance with building performance codes and make this information public via online dashboards. The portal may also contain educational resources, directory of materials and vendors and user-friendly guides for enhanced awareness and capacity building of developers and professionals. Investment would be needed in the development and integration of the portal for which RRECL and ULBs may jointly execute this action plan.

[9] *ECSBC will take precedence over ECBC/ENS, whenever it is notified.*

3. **Market Outreach for ECBC compliant Products, Radio Jingles, Social Media Awareness** – Market outreach for ECBC compliance products or products utilized in sustainable construction such as building materials used in passive building design would enable a conducive market for such materials which will promote construction practices necessary to comply with ECBC and ENS guidelines. The market outreach can take place through professional conventions and seminars, radio jingles and awareness campaigns on social media.
4. **Pilot projects for Super ECBC buildings as case studies (initial 20 Buildings):** It is proposed that the state government also undertake the development of Super-ECBC buildings in the state and publish its case studies for the understanding of stakeholders. Initially upcoming government building can be taken as a pilot project and best energy efficient technologies can be implemented to achieve the Super ECBC level. Case Study can be published in social media to encourage developers and other stakeholders to make Super ECBC compliant buildings.

ECBC compliance case studies in the state

Energy Conservation Building Code (ECBC) Building Cell of Rajasthan Renewable Energy Corporation Ltd has successfully completed building reports for ECBC Compliance. Details of the projects are given as follows:

Vidyut Bhawan, Janpath Jaipur, Rajasthan:

Vidyut Bhawan is an upcoming office building at Jaipur, Rajasthan. The proposed building has Basement 1 + Basement 2 + Ground +6 floors. The total built up area of the project is around 3,67,053.7 ft2 or 34112.8 m2. The project is now at design stage and the project will implement all the measures which make the building to comply with ECBC-2017 (SuperECBC).

Results and Conclusion:

a) The whole Building Simulation shows that the building project can achieve approximately 37% energy savings compared to standard ECBC model with an Energy Performance Index ratio of 0.64.

Estimated Cost of suggested Energy Conservation Measures (ECMs) only				
Sr. No.	**Category**	**Conventional Design**	**Suggested Design**	**Cost Difference**
1.	Wall	230 mm Brick Walls with 12 mm Cement Plaster on Both sides	2 mm Cement plaster + 150 mm AAC Block + 50 mm EPS insulation + 115 mm fly ash brick wall + 12 mm Cement plaster	+ 1,34,40,195/-
2.	Roof	20 mm Cement Plaster + 25 mm Cement Screed + 115mm R.C.C Slab + Plaster	10 mm High Solar Reflective Index heat resistant tiles + 25 mm Cement Screed + 20 mm Cement Plaster + 150 MM RCC SLAB + 75 mm Expanded polystyrene (EPS) Insulation + False Ceiling	+ 70,85,530/-
3.	Fenestration	Single Clear 6 mm thick glass With Low SHGC	Double Glazed Unit (6 mm Glass + 12 mm Airgap + 6 mm Glass) with High SHGC	+ 24,86,214.83/-
4.	Lighting	CFL Lights (11.2 W/m2) & 5 W/m2 for garage	LED- 4.95 W/m2 for Office & 1.61 W/m2 for parking garage	+ 5,91,600/-
5.	Meters	Water Meters	Energy meters, Water Pumps and Motors	+ 46,000/-
6.	Solar PV	Conventional	(Recommended Solar PV of 160 kWp)	+ 64,00,000/-
7.	HVAC	HVAC Type – Split Air Conditioners	HVAC Type – VRF	+ 78, 60,000/-
Estimated Cost*		4,24,49,522/-	8,03,59,062/-	3,79,09,539/-
Total Units of Electricity consumption (kWh)		3,063,400	1,524,300	-15,39,100
Cost Difference is approximately 3% of Total Project Cost				
Total Units of Electricity consumption (kWh)		3,063,400	1,524,300	-15,39,100
Energy Savings Compared to Conventional 15.39 Lac kWh per year				
Total Cost /Year for Electricity from GRID (Rs.8/unit)		2,45,07,200/-	1,21,94,400/-	- 1,23,12,800/-
Energy Cost Savings Compared to Conventional is 1,23,12,800/- per year				
Payback period will be less than 3 years approximately				

b) Difference in the Project Cost of Super ECBC Building (implementing Energy Conservation Measures) compared to Conventional Standard designed building will be approximately only 3% of the Total Project cost.

c) As per building simulation through eQuest Version 3-65, Proposed Super ECBC designed building will save approximately 15.39 Lakh kWh per year which results in approximate savings of Rs. 1,21,94,400 per year. (@Rs.8/- per unit).

d) As a result, payback period will be around 3 Years.

5. **Home Energy Auditor Training, compliance structure and incentive on energy savings for first few residential projects** – BEE has developed a Home Energy Auditing tool. SDA may run awareness and capacity development programs in the state of Rajasthan to train building professionals about the benefit of auditing and implementation of Energy Conservation Measures (ECMs) in residential houses. SDA may encourage RWAs by providing some incentive based on energy savings on implementation of ECMs in their societies. These action items will help in the promotion of ENS in the state and create technical capacity of the professionals.

6. **Periodic upgradation of PWD Schedule of Rates (SoR) to incorporate latest energy efficient materials and technologies**

   Regular upgradation of PWD Schedule of Rates (SoR) to incorporate latest energy efficient materials and technologies is required as technologies in the field of energy efficiency is developing on some very regular intervals. Adoption of new innovative technologies becomes easier if it is mentioned in PWD Schedule of Rates (SoR) document.

7. **Inclusion of curriculum on energy efficiency in buildings, in universities and Schools**

   Raising awareness about energy conservation among children is crucial. To instill a fundamental understanding of this concept and promote a behavioral shift in children, it is suggested that the curriculum on energy efficiency and

conservation be developed and integrated into schools and universities in the state of Rajasthan.

8. **Installation of Solar PV system on the buildings having connected load of 100 kW or above.**

   In light of Rajasthan's abundant solar radiation resources, the implementation of a solar PV systems on Renewable Energy Generation Zone (REGZ) within the framework of building code compliance (ECBC) emerges as a crucial strategic initiative. A pivotal component of this plan involves the mandatory installation of solar photovoltaic (PV) systems in commercial buildings with a connected load exceeding 100 kW.

   Rajasthan, renowned for its sun-drenched landscapes, is ideally situated to harness solar energy, making it imperative to capitalize on this sustainable energy source. The state's vast solar potential not only promises a reduction in carbon emissions but also offers a pathway to energy self-sufficiency, promoting environmental and economic benefits.

   Enforcing the installation of solar PV systems in commercial buildings aligns with Rajasthan's commitment to clean and renewable energy solutions. By incorporating this requirement into building regulations, the state can incentivize large-scale solar adoption, facilitating a transition towards cleaner, greener energy practices.

9. **Incentives on Green Building Certified and ECBC+/SuperECBC Buildings:**

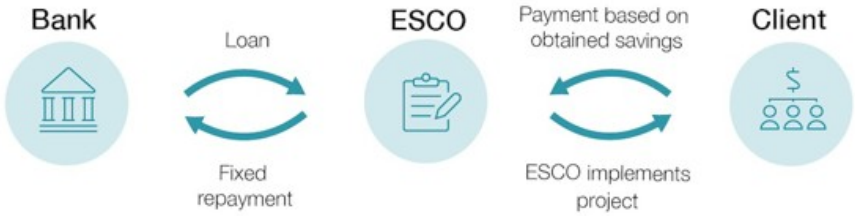
   Urban Development Department offers additional 0.075, 0.10 and 0.15 BAR free of charge for projects which are rated Silver, Gold and Platinum respectively by IGBC/LEED/GRIHA[10]. Additional rating systems should also be added such as GEM, EDGE, etc. for better transparency and inclusion of more organizations in the movement of sustainable buildings. The certified energy managers/auditors and accredited professionals should be empaneled to spread the mass awareness and adoption of green buildings. Incentives for ECBC+ and SuperECBC may be provided based on the per square footage of

[10] *https://igbc.in/assets/html_pdfs/5.%20Rajasthan%20UDD%20_%20Additional%20BAR%202019.pdf*

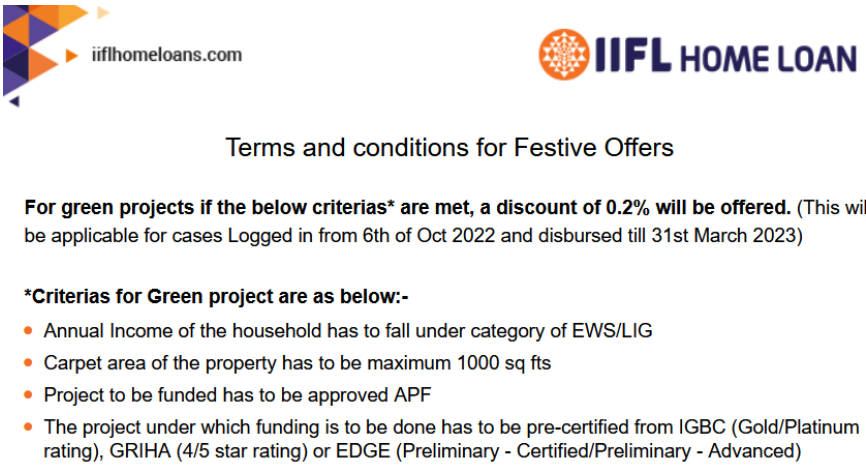
the building area or rebate in property tax may be offered to encourage the adoption of higher energy efficiency levels in the building design.

There are other programs which may be adopted for incentives:

- **Low-Interest Rate Loans:** Banks and Financial Institutes may provide loans at lower interest rates to the developer willing to develop ECBC+ and SuperECBC buildings in the state.



Example – A recent program successfully completed for green buildings. Similar programs may be introduced for ECBC+ and SuperECBC in association with financial institutions.



- **Grants and Rebates:** Financial incentives in the form of grants or rebates can be provided for energy-efficient retrofits, renewable energy installations, or green building certifications.
- **Utility Rebates or Lower Tariff:** DISCOM may provide electricity at lower rates on ECBC+ and Super ECBC Buildings for some time-period.

Strategy#2 Replacement program for inefficient (below than 3 Star Rated) appliances.

Implementation Timeline: Long Term (Till FY 2031)

The Standards & Labelling (S&L) Programme of Bureau of Energy Efficiency (BEE) has seen a successful implementation across the country, leading to significant savings in energy through mandatory and voluntary use of energy efficient electrical appliances by consumers in a wide range of applications. The S&L Programme encompasses appliances and equipment that have applications in multiple sectors, however the buildings sector is the most widely covered sector in terms of types and number of appliances. Currently, the S&L Programme encompasses a total of 38 appliances, of which 16 are subject to mandatory regulation while the other 22 are regulated on the voluntary basis. The following table provides a detailed list of appliances that fall under mandatory and voluntary regulation.

Table 6: List of mandatory and voluntary appliances under S&L Programme

Mandatory Appliances	Voluntary Appliances
1. Room Air Conditioners	1. General Purpose Induction Motors
2. Frost-free refrigerators	2. Agriculture Pump Sets
3. Tubular Florescent Lamps	3. LPG Stove
4. Distribution Transformer	4. Office Equipment's (Printers & Copier)
5. Room Air Conditioner (Cassette, Floor Standing)	5. Ballast
6. Direct Cool Refrigerator	6. Computers (Laptop/Notebooks)
7. Color TV	7. Diesel Engine driven mono set pumps
8. Electric Geysers	8. Solid State Inverter
9. Variable Capacity Inverter Air Conditioners	9. Microwave Oven
10. LED Lamps	10. Solar Water Heater
11. Ceiling Fans	11. Diesel Generator Set
12. Light commercial AC	12. Grid Connected solar Inverter
13. Deep Freezers	13. Commercial Beverage Coolers

14. Washing Machine 15. Chillers 16. UHD Color TV	14. Air Compressor 15. High Energy Li-Battery 16. Side by Side/Multi Door Refrigerator 17. Pedestal Fan 18. Induction Hob 19. Tires 20. Solar Photovoltaic 21. Table/Wall Fan 22. Packaged Boiler

The current strategy has been proposed for the complete buildings sector covering both Domestic and Commercial Buildings. However, a majority of the mandatory and voluntary appliances have a significantly higher penetration in the domestic buildings sector than in the commercial buildings sector.

The electricity consumption pattern varies greatly between urban and rural areas. This is due to the variation in type and number of appliances being used by urban and rural residents. This entails the inclusion of the number of urban and rural households in the savings calculation. Based on the estimated population of the state as per the report "Population Projections for India and States 2011 – 2036" and Household Size as per census, the number of households were estimated out for urban and rural regions. Different categories of appliances have different penetrations among the urban and rural households, based on the usage pattern. Some appliances viz. Fans, refrigerators, washing machines, LEDs, air-conditioners and microwaves have higher penetration as compared to other appliances. Taking into account the study given in the report "Impact Assessment of BEE's Standard & Labeling Program", penetration of different appliances among urban and rural areas was estimated. List of appliances considered in strategies is mentioned in the table below –

Table 7: Appliances taken into consideration for the strategy

Window AC	Color TV - LCD/Plasma/LED
Split AC	Washing Machines
Refrigerator-DC	TFL (Tubular Fluorescent Light)
Refrigerator-Frost Free	Electric Geysers
Ceiling Fans	LPG Stoves
Color TV CRT	Computer/Laptop/Notebooks

According to the study conducted by CLASP (Collaborative Labeling and Appliance Standards Program) to assess consumer awareness of energy labelling, 48% of consumers are aware of the scheme and 15% have some knowledge of it. Appropriate number of 3-Star rated appliances have been taken from the calculation of total number of appliances. Saving strategies in the moderate scenario include replacement of 3-star rated equipment to 5-star rated appliances, whereas in the ambitious scenario, replacement of non-star rated to 5-star rated equipment has been considered as a saving strategy. The percentage savings achieved upon transitioning from non-Star to 5-Star Labelled equipment's (efficiency) were taken into account for calculating savings in above mentioned scenarios.

The strategy is estimated to result in energy savings of 0.11 Mtoe in the moderate scenario and 0.14 Mtoe in the ambitious scenario till FY 2031.

Table 8: Moderate and ambitious scenarios for deepening of S&L Programme

Particulars	Energy Savings in 2031 under moderate scenario (Mtoe)	Energy Savings in 2031 under ambitious scenario (Mtoe)
Energy Saving Potential (Mtoe)	0.11	0.14

Implementing Agency- RRECL, DISCOMs, ESCOs

Actionable Items:

The action items to be carried out in order to implement the strategy at ground level mainly involve dissemination of the scheme's guidelines and specification amongst stakeholders such as manufacturers, retailers and consumers in a way

that can ensure meeting the implementation timeline proposed for the strategy. The following action items are suggested in order to ensure effective implementation:

1. **Development of state-specific implementation models and identification of relevant agencies-** A detailed phase-wise plan need to layout based on consumer's priority and reachability. It is important to develop a transparent model that can reach out to every household in the state. Financial implications will play a major role in replacement schemes so ESCOs and PPA models can be analyzed in detail. UJALA scheme is a successful case study in this area, can be referred for the development of state specific plan. Identification of implementing departments and agencies and listing of ESCOs in the state is required.
2. **Issuance of directive to government offices and buildings in the state to replace all existing inefficient appliances (lower than 3 Star Rated) with BEE 5-star rated appliances-** State Government shall issue directives to all government offices and buildings owned by state government to replace all appliances which are lower than 3 star-rated or purchased/installed before 2015 with BEE 5-Star rated appliances. Wherever possible inverter AC should be used to enhance efficiency due to its part load performance.

   Note: Inclusion of Energy Performance Contracts (EPCs) for private funding: Energy Performance Contracts (EPCs) serve as formal agreements between building owners and Energy Service Companies (ESCOs). Under these contracts, ESCOs assume responsibility for the design, retrofitting, financing, and execution of retrofit projects aimed at enhancing energy efficiency. In return, ESCOs are compensated through a portion of the energy cost savings realized over a specified contract period. This arrangement proves attractive to building owners, as it often eliminates the need for upfront capital investment.

   To facilitate the successful implementation of EPCs, it's crucial to establish a process of empanelment and accrediting ESCOs, as well as retrofitting existing buildings. This typically involves creating a framework that outlines the roles and responsibilities of all parties involved: the ESCO, building owner, and the

local electricity distribution company (DISCOM). State governments, in most cases DISCOM, can play a pivotal role in promoting EPCs by offering initial incentives to encourage building owners to adopt this financial mechanism.

Another avenue for promoting energy efficiency is to allow ESCOs to provide equipment on a lease basis, with the costs covered through regular EMIs. Importantly, the scope of ESCO services extends beyond large-scale equipment such as chillers and air handling units (AHUs). It also encompasses smaller, energy-efficient components like fans, elevators, air conditioners, motors, lighting fixtures, pumps, and more.

Key Highlights of The Agreement:

- Operation and Maintenance should be clearly in the scope of ESCOs instead of concerned department.
- Any additional increment in connected load maybe taken care in the EPC agreement.
- ESCOs shall install IoT based sensors and create analytical dashboards for monitoring of savings for all the stakeholders through web portals. This shall be integrated in the agreement.
- Pilot projects may be started in the semi-government buildings and PSUs.

Expanding the role of Energy Performance Contracts (EPCs) and encouraging collaboration among building owners, Energy Service Companies (ESCOs), and government bodies such as DISCOMs can establish a strong foundation for boosting energy efficiency in existing buildings. This initiative facilitates sustainable practices, lowers energy expenses, and introduces private investment. Moreover, it not only establishes a robust energy efficiency framework but also cultivates a pool of experts within the state, develops a sustainable business model, enhances skill development, creates job opportunities, and benefits the entire ecosystem.

3. **Cost of energy efficiency upgradation in yearly budgets by government department -** The government department should include the specific yearly budget which will focus on the energy audits and energy efficiency upgrades in the existing government buildings. This may be executed in phase wise in

which the existing building may be prioritized based on assessing current energy consumption, identifying potential upgrades, estimating costs, and prioritizing projects based on their impact and return on investment. The department should then allocate funds in their annual budgets for these initiatives, taking into account long-term savings, compliance requirements, and sustainability goals. Monitoring and reporting mechanisms should be established to track progress and ensure the effective implementation of energy efficiency measures and include IoT based monitoring wherever possible. This process helps align government operations with energy efficiency and sustainability objectives while promoting fiscal responsibility.

4. **Workshops & Campaigns on behavioral change interventions for energy conservation –** Capacity building of these stakeholders is key to develop a market environment for energy efficient appliances. State Government shall organize workshops at various levels to encourage people for behavioral change and run mass campaigns to reach out maximum people to increase awareness about benefits of behavioral changes and promote Lifestyle for Environment (LiFE). Workshops and campaigns shall be carried out to target maximum people by organizing through online platforms, print media, social media, nukkad nataks, and radio jingles etc.

Strategy #3 Promotion of BEE Star Rating and Shunya Rating of Buildings

Implementation period: Long Term (Till FY 2031)

The Star Rating and Shunya Rating of buildings is currently at a voluntary stage which is used as a benchmarking system for buildings in order to classify them in terms of 'Star-Rating' & 'Shunya Rating' on the basis of their energy performance. It is proposed that to promote Star Rating & Shunya Rating in all government & commercial buildings and conduct an assessment for their energy performance along with the ECBC Compliance process. Assessment of buildings on a scale of 1-5 stars or Shunya Rating will promote the development of energy efficient buildings in the state. Certification of Star Rating or Shunya Rating can be provided based on this assessment.

Implementing Agency: Bureau of Energy Efficiency; RRECL; Department of Housing & Urban Development.

Actionable Items:

1. **Issuance of directives to all government departments to conduct energy audits and target to achieve BEE Star Rating for their buildings**-

   State Government shall issue directives to all government departments and buildings owned by state government to conduct energy audit and implement energy conservations measures and target to achieve BEE Star Rating or Shunya Rating for their buildings. To catalyze private investments in the building sector's energy efficiency in Rajasthan, we propose the establishment of an Energy Service Company (ESCO) business model. This ESCO will serve as a specialized entity focused on implementing energy-efficient solutions in residential and commercial buildings across the state. Through partnerships with local governments, financial institutions, and technology providers, the ESCO will offer comprehensive energy audits, retrofitting services, and performance-based contracts to building owners. By aligning incentives with energy savings, this model encourages private investment, drives energy conservation, and contributes to the success of Rajasthan's energy efficiency action plan.

2. **Periodic energy audits for commercial buildings on load basis and incentives on achieving specific level of star rating for buildings**-

   A notification from State Government shall be issued for conducting mandatory energy audits of commercial buildings based on their connected load and incentives can be given on the achievement of star rated energy efficient buildings to encourage more building owners to reduce their EPI and save more energy.

3. **Capacity Building of Architects & Building Professionals and Developers**-

   Capacity building programs of Architects & Building Professionals and Developers will ensure to increase the technical capacity of and awareness about innovative technologies. Capacity building of these stakeholders is key to developing a market environment for energy efficient buildings. The

capacity building programs can be taken up periodically, preferably quarterly. Capacity building workshops may be carried out either district-wise or zone-wise and target maximum stakeholder to participant in these programs.

4. **Market Outreach for Star & Shunya Rating by Radio Jingles, Social Media Awareness-** Promotion of the Star & Shunya Rating is an important part of promoting energy efficiency in buildings. In order to increase awareness about this rating program, promotion campaigns shall be carried out to reach masses by advertising in print media, social media, conduct nukkad nataks, plays and run radio jingles etc.
5. **Mandatory minimum set point of 24 degrees for air conditioners in all government buildings –**

   The Bureau of Energy Efficiency has been raising awareness on the energy savings and cost benefit of lowering the operating set point of air conditioners and have advised consumers across the country to maintain set point on or above 24 degrees Celsius to ensure optimal temperature and energy consumption from the use of air conditioners. It is recommended that government departments take lead in the implementation of this practice across the state.
6. **Transformation of iconic government buildings to Net-Zero energy buildings -**Transforming government buildings to net zero will ensure maximum energy performance of these buildings. It will further boost the market and professional environment of sustainable construction products, energy efficient appliances, and energy audit and consulting services. The SOR of government construction projects can be regularly updated with energy efficient and climate responsible materials through the help of this strategy.

5.3. Energy Saving Targets & Monitoring Mechanism

The proposed strategies for the building sector, the total energy saving estimated is 0.12 Mtoe in the moderate scenario and 0.15 Mtoe in ambitious scenarios by FY 2031.

Table 9: Moderate and ambitious scenarios energy savings for building sector

Action Plan	Energy Savings in 2031 under moderate scenario (Mtoe)	Energy Savings in 2031 under ambitious scenario (Mtoe)
Effective implementation of ECBC and ENS (ECSBC)	0.0095	0.0124
Replacement program for inefficient appliances	0.1100	0.1400
BEE Star Rating and Shunya Rating of Buildings	0.0007	0.0010
Total	**0.1202**	**0.1534**

Implementation Agency: Bureau of Energy Efficiency, RRECL, Department of Housing and Urban Development

Monitoring Mechanism:

To effectively carry out the action plan, it is essential to establish a robust monitoring and verification system. While the SDA (State Designated Agency) holds the primary responsibility for overseeing progress, it is imperative for other stakeholders, including organizations engaged in building sector development and planning, to actively engage in diligent monitoring and reporting. The suggested monitoring framework, outlining the steps to track the scheme's progress, is presented in the table below:

Type of Monitoring	Frequency	Nodal Agencies	Responsible Agencies
Reporting, Monitoring and Review of the scheme advance and implementation status	Quarterly	State Designated Agencies	• Department of Housing and Urban Development
Review of the scheme advancement and course correction, if required.	Half-yearly	Department of Housing and Urban Development	• State Designated Agency • Department of Housing and Urban Development
Review of the scheme advancement and policy interventions required	Yearly	Department of Housing and Urban Development	• State Designated Agency
Progress reporting of scheme advancement	Monthly	State Designated Agency (through the ECSBC Cell)	• Bureau of Energy Efficiency

In conclusion, Monitoring mechanisms are essential for successful implementation of energy efficiency action plans, providing a way to track progress, identify areas for improvement, and evaluate energy efficiency measures. Moreover, monitoring mechanisms can also help to identify patterns and trends in energy consumption, allowing policymakers to develop effective energy efficiency strategies. Effective monitoring mechanisms are essential for achieving energy efficiency goals in the building sector, leading to cost savings, improved comfort, and environmental benefits.

TRANSPORT SECTOR

6. Focus Sector 3: Transport

6.1. Current Scenario

The Government of Rajasthan is committed to decarbonizing the transport sector and has introduced a number of initiatives towards this direction. The Govt. of Rajasthan has laid down various goals in the two cities i.e., Jaipur & Ajmer-Pushkar to ensure sustainable urban transportation under the JnNURM scheme of Government of India. The Rajasthan Electric Vehicle Policy 2022 proposes 8 model cities, namely Jaipur, Jodhpur, Kota, Udaipur, Bikaner, Ajmer, Bharatpur and Alwar for achieving EV transition and infrastructure goals.

The data for the number of vehicles has been sourced from the Vahan Dashboard. The number of registered vehicles in the state has increased from 11.8 million in 2017 to 16.9 million in 2021, with an Average Annual Growth Rate (AAGR) of 8.54%.

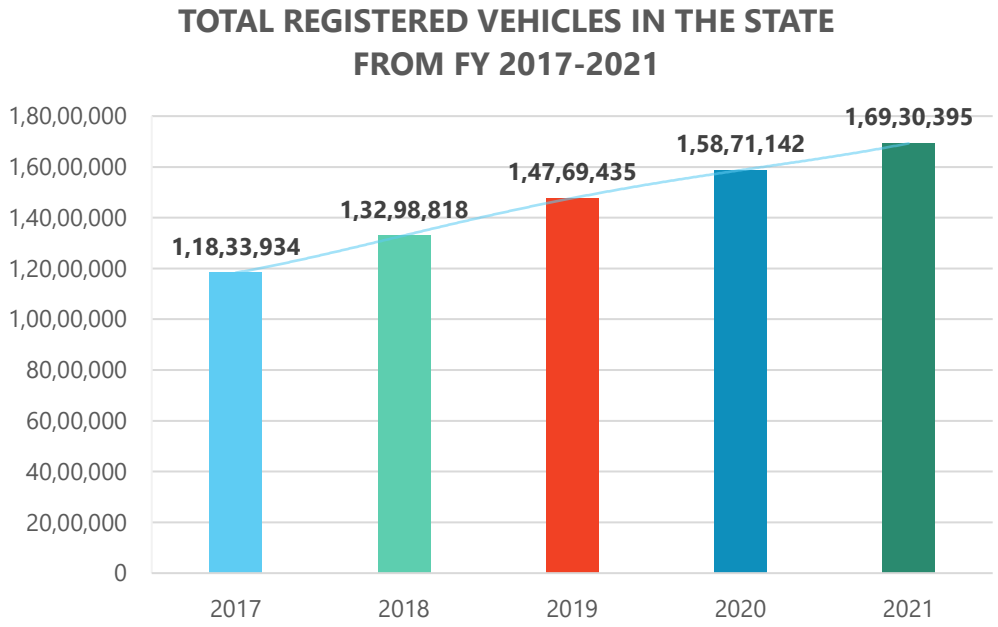


Figure 17: Total registered vehicles in the state of Rajasthan[11]

[11] *https://vahan.parivahan.gov.in/vahan4dashboard/*

This AAGR is further treated as CAGR to project the number of registered vehicles by the years 2026 and 2031, with base year as 2021.

The registered EVs as per the records of Transport Department, Rajasthan, below is the graph which shows exponential growth in last few years.[12]

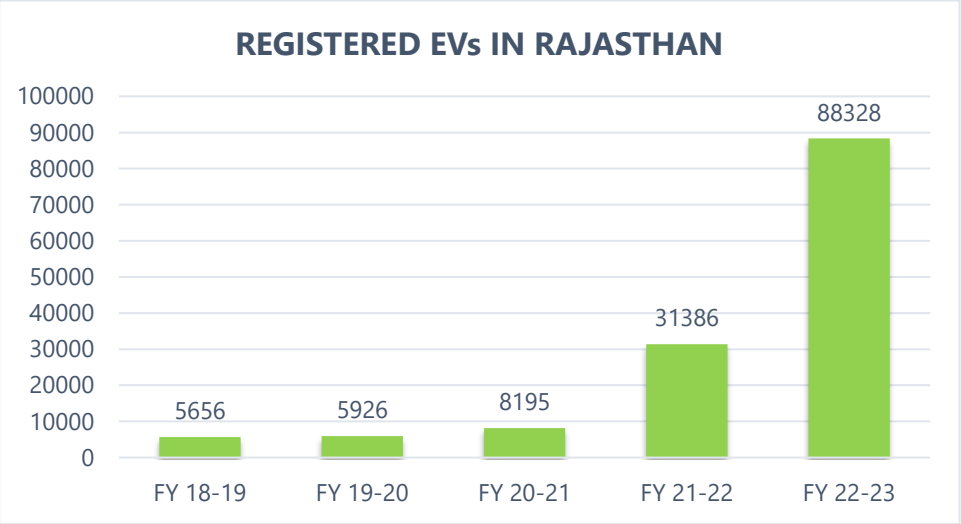


Figure 18 Registered EVs in Rajasthan

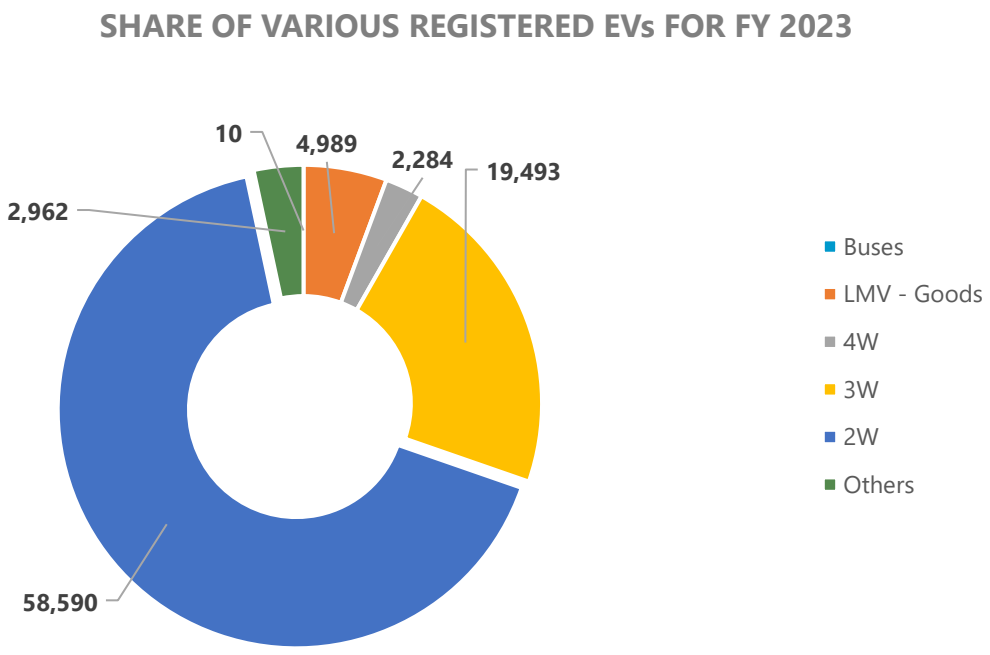


Figure 19 Share of various EVs registered in FY 2023

[12] *Transport Department, Rajasthan*

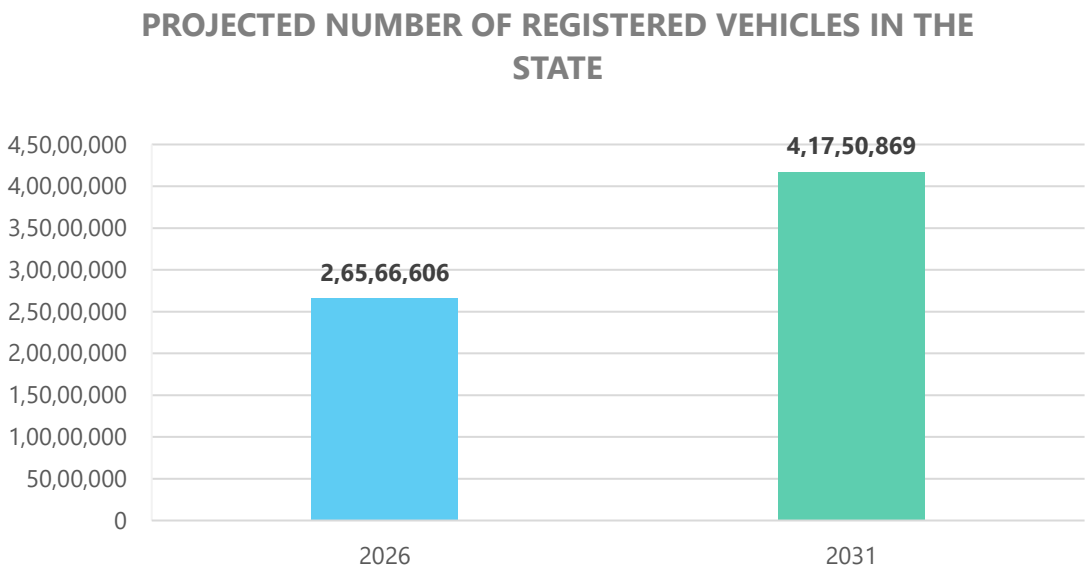


Figure 20: Projected number of registered vehicles

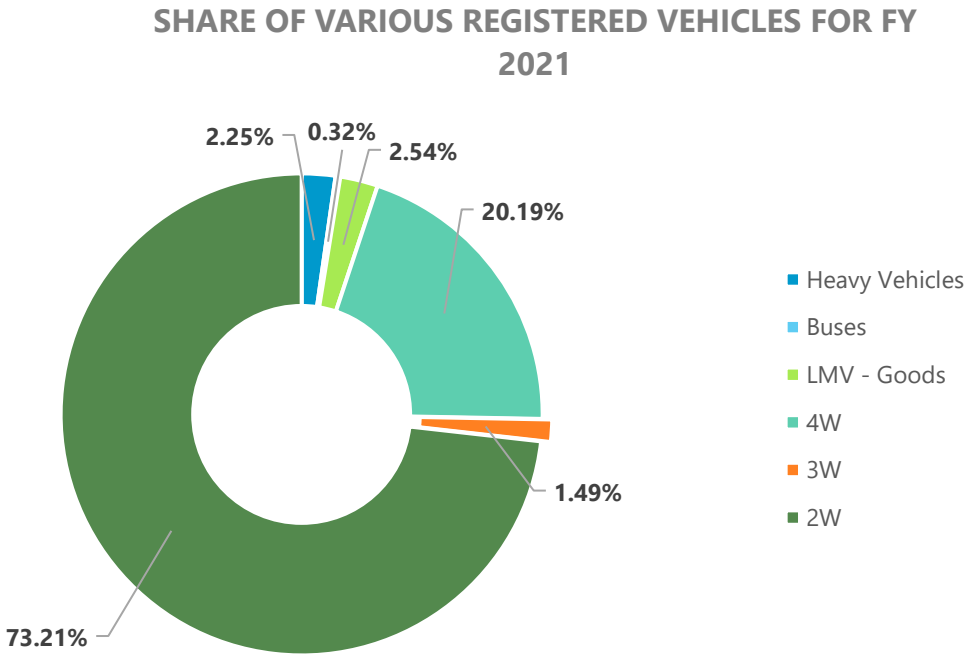


Figure 21: Share of vehicle types for no. of registered vehicles

It can be seen that 2-Wheleers (73%) make up the largest share in the vehicle category type. The next highest is 4-Wheelers at 20% share. Hence, targeting two-wheelers and four-wheelers for transition to electric vehicles can bring about significant reduction in primary energy consumption in the transport sector of Rajasthan.

Adding to that, the sectoral transport share of the state is led by 2W (2 Wheelers) which holds 73% of the total registered vehicles. Further, the four-wheeler sector also shows potential for transition when compared with market availability. The data for the number of vehicles has been sourced from the Vahan Dashboard. The number of registered vehicles in the state has increased from 1,18,33,934 in FY 2017 to 1,69,30,395 in FY 2021. In the study, tractors, ambulances, tankers and private trailers have been excluded which is negligible in the numbers as compared to the total registered vehicles.

The number of EV Chargers is forecasted based on current trend which is 76% increment value. Currently 330 number of EV chargers are installed and 250 number of chargers will be installed in the year FY 2023-24. The central government is installing 7000 EV chargers across the country and 200 number of EV chargers are expected to be allocated for Rajasthan.

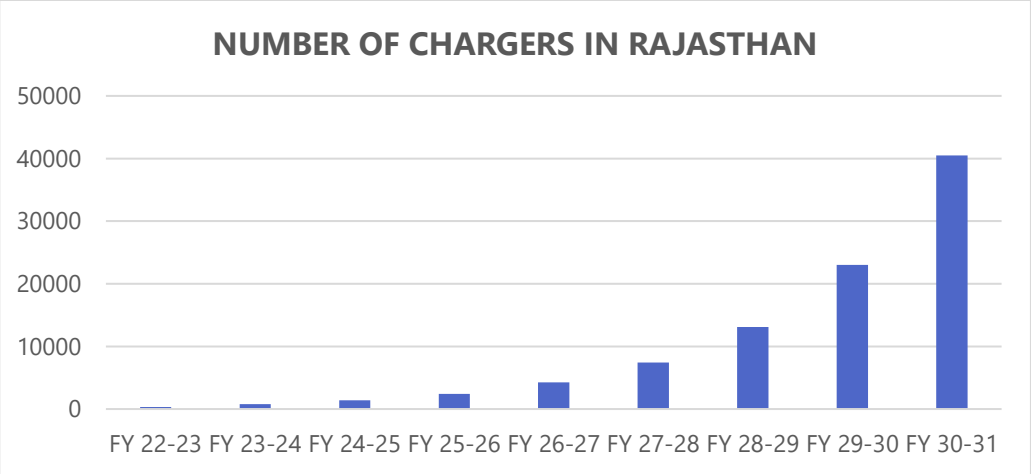


Figure 22 Number of EV chargers in Rajasthan

6.2. Strategies in the Transport Sector

As per the stakeholder consultation with relevant department, the long-term strategy for Electric Vehicle Transition has been under the design phase. The policy and the proposed strategy encompass a number of aspects of the transport sector ranging from incentives to consumers to undergo EV transition, converting state's bus fleet to electric, electric transition in logistics transport, and development of charging station across the state. Ethanol blending in petrol is proposed as another strategy to bring about emissions reduction in the transport

sector. The strategy has been proposed in line with the national policy on ethanol blending.

Strategy #1 Infrastructure Development for EV charging stations and Incentives to Consumers for quick transition to EVs

Implementation Period: Long Term (Till FY 2031)

The transition to Electric Vehicles (EVs) across all segments of vehicles will be instrumental in decarbonization of the sector and in bringing significant savings in fossil-fuel based energy consumption. In this strategy, it is proposed to convert new vehicles registered in the state till FY 2031 to electric vehicles along two different scenario trajectories, namely moderate scenario and ambitious scenario. The highest EV conversion rate is proposed for 2-wheelers because of it having the highest share in registered vehicles and taking into consideration the availability and affordability of 2-Wheeler electric vehicles. The EV conversion considerations for moderate and ambitious scenarios are given in below table:

Table 10: EV transition considerations for moderate and ambitious scenarios

Current EV Policy (REVP) 2022[13]	Moderate Scenario	Ambitious Scenario
• 15% of conventional 2-Wheelers convert to electric by 2027. • 5% of conventional 4-Wheelers convert to electric by 2027. • 30% of 3-Wheelers to convert to electric by 2027.	• 25% of conventional 2-Wheelers convert to electric by 2031. • 10% of conventional 4-Wheelers convert to electric by 2031. • 25% buses in the state to transition to electric buses by 2031. • 40% of 3-Wheelers to convert to electric by 2031. • 5% of heavy vehicles (trucks and lorries) to convert to electric by 2031	• 35% of conventional 2-Wheelers convert to electric by 2031. • 20% of conventional 4-Wheelers convert to electric by 2031. • 35% buses in the state to transition to electric buses by 2031. • 50% of 3-Wheelers to convert to electric by 2031. • 15% of heavy vehicles (trucks and lorries) to convert to electric by 2031

[13] *Final REVP 2022.pdf (rajasthan.gov.in)*

The EV transition strategy can result in potential energy savings of 0.55 Mtoe and 0.80 Mtoe in the moderate scenario and ambitious scenario respectively.

Table 11: Moderate and ambitious scenarios energy savings for Infrastructure Development for EV charging stations

Particulars	Energy Savings in 2031 under moderate scenario (Mtoe)	Energy Savings in 2031 under ambitious scenario (Mtoe)
Energy Saving Potential (Mtoe)	0.55	0.80

Implementation Agency: Department of Transport DISCOMs, PSUs and Private Sector

Actionable Items:

1. **Establishment of regulatory mechanism to develop EV charging Infrastructure**-

There are several regulatory mechanisms that can be put in place to develop EV charging infrastructure in Rajasthan. Some possible approaches are mentioned below:

- **Incentives for private companies to install charging infrastructure:** The government can provide incentives such as tax breaks or subsidies to private companies that install EV charging infrastructure in Rajasthan.
- **Public-private partnerships:** The government can enter into partnerships with private companies to develop and operate EV charging infrastructure. This can include agreements on revenue sharing, investment, and maintenance.
- **Zoning regulations:** The government can zone certain areas of the city for EV charging infrastructure, such as near highways or in commercial areas, to ensure that the infrastructure is developed where it is most needed.
- **Time-of-use pricing:** The government can introduce time-of-use pricing for EV charging to encourage drivers to charge their vehicles during off-peak hours when electricity is cheaper.

By implementing some or all of these regulatory mechanisms, the Rajasthan government can encourage the development of a robust EV charging

infrastructure that will help to support the transition to electric vehicles in the state.

2. Pilot projects on Battery Swapping stations

Establishment of a wide network of swappable battery station is a key of success for EV infrastructure in the state. Pilot projects on battery swapping stations can provide valuable information and insights into the feasibility and effectiveness of this technology.

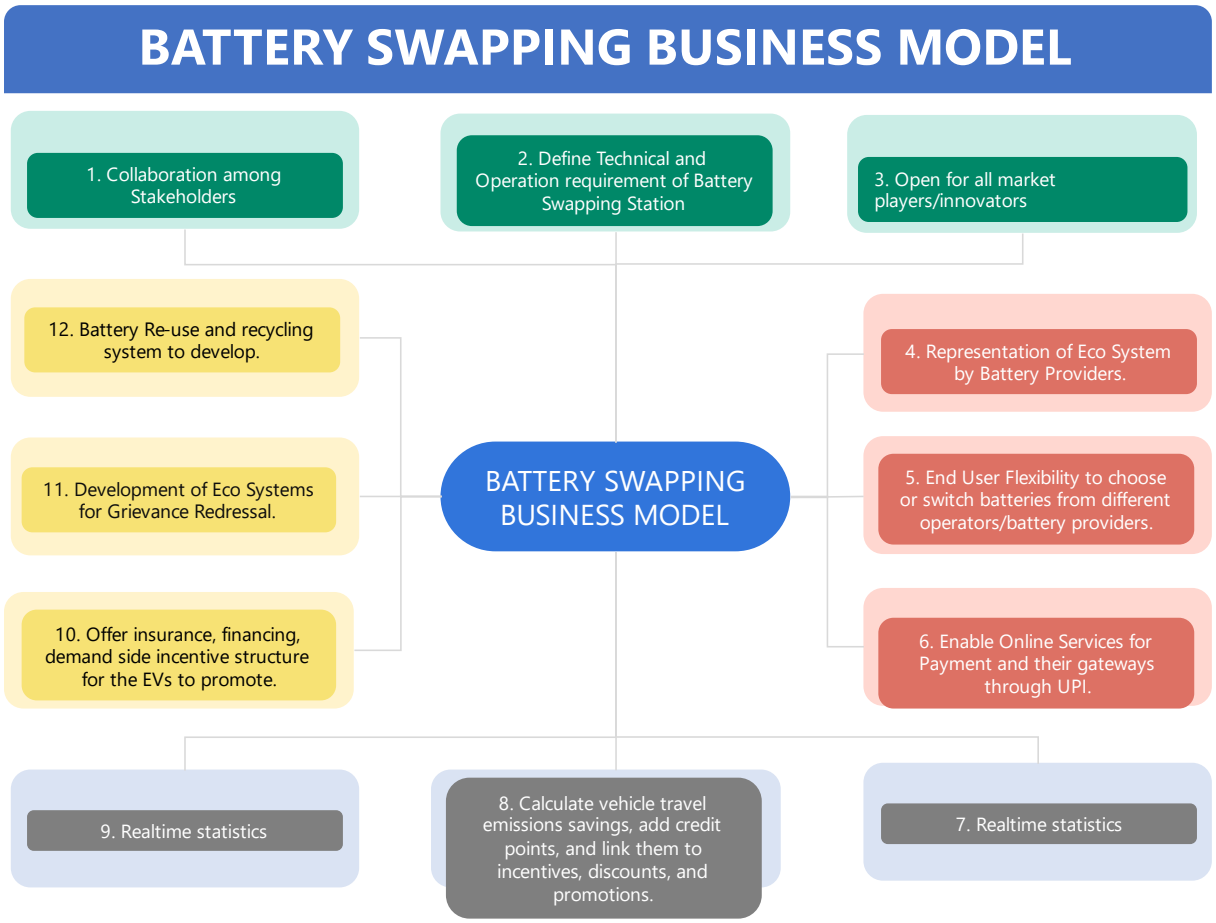


Figure 23 Preferred Business Model or Battery Swapping

Battery swapping pilots can be tried in key Government offices and through private, especially IT buildings, with large car ownership. As state has many highways, battery swapping stations could be setup along a major highway to demonstrate how this technology can enable long-distance electric vehicle travel. This pilot project can provide valuable data on how battery swapping affects driving patterns and charging behaviour.

These pilot projects can provide valuable information on the practicality, cost, and user acceptance of battery swapping stations, which can inform the development and implementation of future policy initiatives.

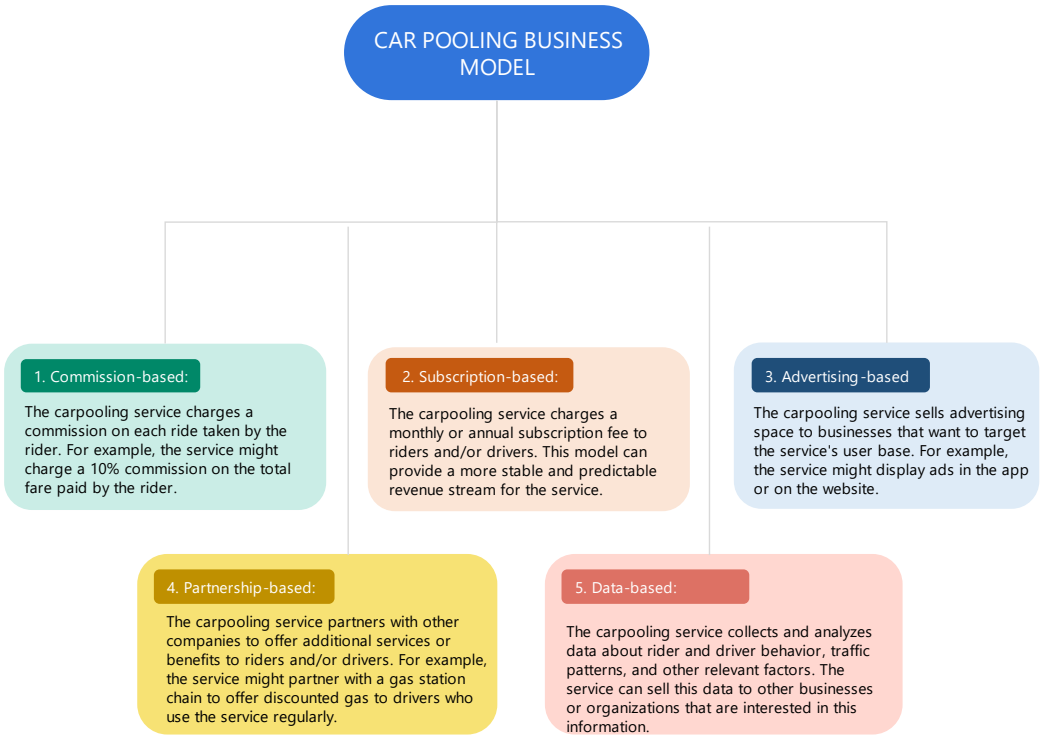


Figure 24. Preferred Business Model for Carpooling

3. **Pilot projects on Hydrogen Fuel Cell Vehicles (HCVs):** Pilot projects on hydrogen fuel cell vehicles (HCVs) can be an effective way to explore the potential of this technology and to identify any barriers or challenges to its widespread adoption. The results of the pilot project should be shared with stakeholders, including the public, to raise awareness of the potential of HCVs.
4. **Pilot projects on renewable based charging infrastructure:** Initiating pilot projects focused on charging infrastructure powered by renewable energy sources presents a promising opportunity to seamlessly integrate clean energy into electric vehicle charging networks. These endeavors will effectively showcase the viability of clean energy adoption in the realm of transportation, consequently mitigating carbon emissions and charting a course towards sustainable solutions. Through the amalgamation of intelligent grid systems, efficient battery storage solutions, and collaborative

efforts between public and private entities, these trial initiatives yield valuable insights for enhancing energy utilization, refining grid dynamics, and understanding user engagement patterns. Undoubtedly, these initiatives play a pivotal role in shaping the landscape of future transportation systems, characterized by their eco-friendliness and economic feasibility. It was suggested that central government should take initiative in installing renewable energy-based charging stations.

5. **Training of skill labored for maintenance of charging infrastructure:** Training skilled labor for the maintenance of charging infrastructure is a pivotal step in advancing the electric vehicle (EV) ecosystem. This training equips individuals with essential skills to ensure the reliability, safety, and efficiency of EV charging stations. The program encompasses diverse areas such as electrical systems, hardware maintenance, software troubleshooting, safety protocols, and customer service. Through hands-on experiences and theoretical knowledge, trainees become adept at identifying and rectifying issues that arise in charging stations. This training not only supports the seamless operation of EV infrastructure but also contributes to job creation and the sustainable growth of the EV industry.
6. **Incentives on the development of charging infrastructure by the private sectors in the state:** Incentivizing private sector involvement in the development of charging infrastructure is a strategic move to accelerate the adoption of electric vehicles (EVs) and foster sustainable mobility solutions within the state. By offering attractive incentives, the government encourages private companies to invest in charging infrastructure, thereby expanding the charging network and addressing range anxiety for EV owners. These incentives can take various forms, such as tax benefits, subsidies, grants, and streamlined regulatory processes. By partnering with the private sector, the state not only facilitates the transition to cleaner transportation but also stimulates economic growth, job creation, and technological innovation. This collaboration between public and private entities serves as a cornerstone for a greener, more accessible transportation future.

The government of Rajasthan offers a variety of tax reliefs to encourage investment and employment generation. These reliefs include:

- Investment subsidy of 75% of state tax due and deposited, for seven years.
- Employment generation subsidy in the form of reimbursement of 50% of employer's contribution towards employees EPF and ESI, for seven years.
- Exemption from payment of 100% of electricity duty for seven years.
- Exemption from payment of 100% of land tax for seven years.
- Exemption from payment of 100% of market fee (mandi fee) for seven years.
- Exemption from payment of 100% of stamp duty.
- Exemption from payment of 100% of conversion charges payable for change of land use and conversion of land.
- The urban development and housing (UDH) department will allot government land at concessional rates. As per the order dated September 28, land will be allotted at 50% concession for the first 500 renewable energy-based EV charging stations installed within five years.

7. **Disposal of electric vehicle batteries:** EV Battery Disposal: The responsible disposal of electric vehicle (EV) batteries is crucial for environmental sustainability. Lithium-ion batteries, commonly used in EVs, contain valuable and potentially hazardous materials. Proper recycling processes involve dismantling, recovering valuable metals like lithium, cobalt, and nickel, and managing harmful components. This reduces resource depletion and minimizes environmental impact. Innovations in recycling methods aim to improve efficiency and decrease costs. Governments and industries are collaborating to establish regulations and infrastructure for safe and eco-friendly EV battery disposal, promoting a cleaner energy future.
8. **Scrapping Model and Tax exemption on motor vehicles:** The Rajasthan Government and the Department of Transport have released a circular notification concerning the proper disposal of vehicles with registrations older than 15 years. Additionally, a notification has been issued by the government to grant tax concessions for both transport and non-transport vehicles, applicable during their initial registration. There is a recommendation for both the central and state governments to offer

incentives or subsidies for retiring these vehicles or transitioning to electric vehicles.

Strategy #2 Ethanol Blending Program

Implementation Period: Long Term (Till FY 2031)

The Ethanol Blending Program is proposed to ensure mixing of ethanol in motor spirit (petrol) in a fixed ratio to offset a part of the energy consumed by petrol and bring about reduction in emissions. In the proposed strategy and in line with the country's target of 20% blending of ethanol blending in petrol by 2031. As 10% blending target is already achieved in year 2022. Further, 20% is suggested in the moderate scenario and a 30% blending target is suggested in the ambitious scenario.

The ethanol blending can lead to potential fossil fuel energy savings of 1.02 Mtoe and 1.53 Mtoe in the moderate and ambitious scenarios respectively.

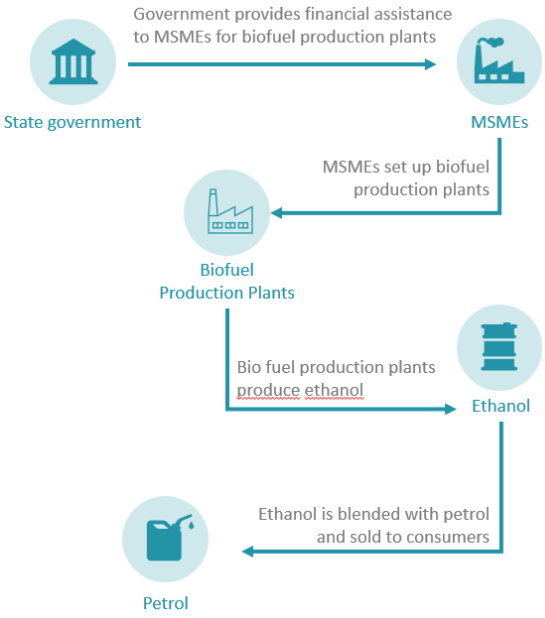
Table 12: Moderate and ambitious scenarios for Ethanol blending

Particulars	Energy Savings in 2031 under moderate scenario (Mtoe)	Energy Savings in 2031 under ambitious scenario (Mtoe)
Energy Saving Potential (Mtoe)	1.02	1.53

Implementing Agency: Biofuel Authority of the State.

Actionable Items:

1. **Financial Assistance on Biofuel production plants (Capital Subsidy for MSMEs):** To ensure a steady supply of ethanol for blending with petrol, it is recommended to offer financial assistance for the installation of biofuel production plants. Micro, small, and medium-sized enterprises (MSMEs) interested in setting up these plants could receive capital subsidies. The aim is to establish a strong supply chain for feedstock to meet production targets and create a supportive environment for ethanol blending in fuel. By promoting the growth of biofuel industries, new technologies can be introduced, and the market can be strengthened.



2. **Capacity Building for the investors:** Capacity building for investors in ethanol blending program aims to empower them with essential skills and insights to engage effectively in the ethanol industry. This initiative provides knowledge about regulatory aspects, market trends, technological advancements, and sustainability practices. By enhancing investors' understanding, the program encourages increased investment in renewable energy, supporting energy diversification and environmental goals.
3. **Monitoring mechanism for the supply of feedstock and production of ethanol:** The monitoring mechanism for feedstock supply and ethanol production establishes a robust system to oversee and manage these essential elements. This mechanism employs real-time tracking, data analysis, and reporting to ensure a steady supply of raw materials, prevent disruptions, and maintain efficient production processes. By keeping a vigilant eye on these aspects, the monitoring mechanism guarantees the smooth functioning of the ethanol production cycle, contributing to sustainability and resource optimization.

4. **Support for the research and development programs:** Support for research and development (R&D) programs in ethanol blending is a strategic investment that fuels innovation in the renewable energy sector. By allocating resources to R&D initiatives, governments and organizations encourage the exploration of advanced blending techniques, sustainable feedstock options, and efficiency improvements. These programs drive the evolution of ethanol blending technology, making it more cost-effective and environmentally friendly. Ultimately, R&D support enhances the growth of ethanol blending programs, aligning with energy diversification goals, and fostering a greener energy landscape.

Strategy #3 Promotion of Standard and Labelling program of Tyres for Fuel Efficiency in Vehicles

The Bureau of Energy Efficiency (BEE) in India has implemented a standard and labeling program for tyres to promote fuel efficiency in vehicles. The promotion of a standard and labeling program for tyres with regard to fuel efficiency in vehicles can be an effective way to encourage the adoption of more fuel-efficient tyres by consumers.

Actionable Items:

1. **Awareness campaigns:** The first step is to create awareness among consumers about the importance of fuel-efficient tyres and the benefits of using them. This can be done through advertising campaigns, social media, and other public outreach efforts. The government can provide education to consumers on how to maintain their tyres for optimal fuel efficiency. This can include tips on proper inflation, regular rotation, and alignment.
2. **Capacity Building of Tyre Manufacturer and Vehicle OEMs-** Capacity building workshops shall be organized in the state to enhance the knowledge of Tyre Manufacturers and Vehicle OEMs about Star Rating of Tyre and its benefits and compliance methodology to encourage them to produce or use star rated tyres. By promoting a standard and labeling program for tyres with regard to fuel efficiency, consumers can make informed decisions about which tyres to purchase, and manufacturers can be encouraged to develop

more fuel-efficient tyre technology. This can result in significant reductions in fuel consumption and greenhouse gas emissions, contributing to a more sustainable future.

6.3. Energy Saving Targets & Monitoring Mechanism

On the basis of the proposed strategies for the transport sector, the total energy saving estimated is 1.57 Mtoe in the moderate scenario and 2.33 Mtoe in ambitious scenarios. The potential savings under moderate and ambitious scenarios is the overall estimated savings from individual strategies under the respective scenarios and can be considered as the energy saving targets for FY 2031 for the Transport Sector.

Table 13 Moderate and ambitious scenarios energy savings for Transport sector

Strategies	Energy Savings in 2031 under moderate scenario (Mtoe)	Energy Savings in 2031 under ambitious scenario (Mtoe)
Transition to electric vehicles	0.55	0.80
Ethanol blending	1.02	1.53
Total	**1.57**	**2.33**

Monitoring Mechanism:

To effectively carry out the action plan, it is essential to establish a robust monitoring and verification system. While the Rajasthan Transport Department holds the primary responsibility for overseeing progress, it is imperative for other stakeholders, including organizations engaged in building sector development and planning, to actively engage in diligent monitoring and reporting. The suggested monitoring framework, outlining the steps to track the scheme's progress, is presented in the table below:

Type of Monitoring	Frequency	Nodal Agencies	Responsible Agencies
Reporting, Monitoring and Review of the scheme advance and implementation status	Quarterly	Department of Transport	• Rajasthan Transport Department
Review of the scheme advancement and course correction, if required.	Half-yearly	Department of Transport	• State Designated Agency • Rajasthan Transport Department
Review of the scheme advancement and policy interventions required	Yearly	Department of Transport	• Rajasthan Transport Department • State Designated Agency • Bureau of Energy Efficiency
Progress reporting of scheme advancement	Monthly	Department of Transport	• Rajasthan Transport Department • State Designated Agency

In conclusion, Monitoring mechanisms are essential for successful implementation of energy efficiency action plans, providing a way to track progress, identify areas for improvement, and evaluate energy efficiency measures. Moreover, monitoring mechanisms can also help to identify patterns and trends in energy consumption, allowing policymakers to develop effective energy efficiency strategies. Effective monitoring mechanisms are essential for achieving energy efficiency goals in the transport sector, leading to cost savings, improved comfort, and environmental benefits.

AGRICULTURE SECTOR

7. Focus Sector 4: Agriculture

7.1. Current Scenario

Rajasthan's economy is predominantly considered as an agricultural economy since agriculture is the primary source of employment & livelihood of the people of Rajasthan. Being an agricultural state with a significant focus on crop production. Major crops grown in Rajasthan include wheat, barley, maize, oilseeds, pulses, cotton, and sugarcane. Due to the arid and semi-arid climate, farmers in Rajasthan often practice rain-fed agriculture, relying heavily on monsoon rains for crop production. However, there has been an increasing adoption of modern agricultural practices such as drip irrigation, greenhouse cultivation, and use of high-yielding crop varieties. According to the Economic Survey of Rajasthan 2020-21, published by the Directorate of Economics and Statistics, Government of Rajasthan, the share of agriculture and allied sectors in the Gross State Domestic Product (GSDP) of Rajasthan for the financial year 2019-2020 was estimated at 20.96%.

Table 14: Land use statistics of Rajasthan (FY 2018-19)[14]

Land Use	Area (in Lakh Hectare)	Percentage
Net area sown	177.78	51.85
Area under forests	27.60	8.05
Non-Agriculture Uses	19.93	5.81
Permanent pastures and other grazing lands	16.68	4.86
Land under misc. tree crops and groves	0.26	0.08
Cultivable wasteland	37.84	11.04
Fallow lands other than current fallows	21.06	6.14
Current fallows	17.89	5.22
Barren & Cultivable Land	23.83	6.95
Reporting Area for Land Utilization	342.87	

[14] *Agriculture Statistics, Rajasthan*

Statistics:

According to a report by the Ministry of New and Renewable Energy (MNRE) in 2021, Rajasthan has the highest solar potential in India, with an average solar insolation of over 5.5 kWh/sq.meter/day.

Approximately 60,000 standalone solar pumps have been installed by the Government of Rajasthan as on FY 2022-23. The state also aims to install a total of 1.40 lakh solar pumps in upcoming years by year 2025. Further, as per the Rajasthan Agricultural Statistical at a Glance for the year 2021-22, the total number of electrical and diesel pumps in the state are 18,87,746 in which electrical pumps have a share of about 75% and the remaining 25% are diesel pumps.

The installation of solar water pumps in Rajasthan has resulted in an estimated cost savings of INR 400 crores for farmers, reducing their operating expenses and reliance on grid electricity.

The adoption of solar water pumps in Rajasthan has led to energy savings of over 800 million kWh per year, contributing to a greener and more sustainable energy mix.

7.2. Energy Efficiency Strategies in the Agriculture Sector:

This section presents the proposed strategies in the agriculture sector along with their impact in terms of energy saving potential. The following strategies are proposed as part of the State Energy Efficiency Action Plan:

Strategy #1 Transition of conventional diesel pumps to Solar powered pumps

Current Status:

Rajasthan, known for its arid climate and limited water resources, faces numerous challenges in the agriculture sector and power distribution. To address these issues, the adoption of solar water pumps offers significant benefits, including reduced dependency on the grid, lower operating costs, improved efficiency, and environmental sustainability. Further, decentralized solar PV power projects in

Rajasthan offer a range of benefits for both farmers and DISCOMs. These projects, developed in vacant or unused lands near or within DISCOM substations, provide quality and reliable daytime electricity to farmers, while also offering cost-saving advantages and reducing losses. Below are the specific issues faced by DISCOMs in agriculture electricity supply, the advantages of decentralized solar PV power projects, and relevant statistics for the state of Rajasthan.

Losses and Misuse Catered by DISCOM in Agriculture Electricity Supply:

1. Electricity Theft: Electricity theft is a significant issue in the agriculture sector, leading to substantial losses for DISCOMs. According to a report by the Central Electricity Authority (CEA) in 2019, Rajasthan witnessed a loss of 32.3% due to electricity theft in the agricultural segment.
2. Unmetered Connections: Unmetered connections provided to farmers result in inaccurate measurement of electricity consumption, leading to losses for DISCOMs. This also contributes to overconsumption and wastage of electricity. The exact statistics for unmetered connections in Rajasthan are not readily available.
3. High Transmission and Distribution (T&D) Losses: Rural areas, where the agriculture sector is often located, face infrastructure challenges and outdated equipment, resulting in high T&D losses. As per the CEA report, Rajasthan's T&D losses stood at 22.38% in 2019.
4. Subsidized Tariffs: Subsidized tariffs offered to agricultural consumers can lead to revenue loss for DISCOMs. Additionally, some farmers may abuse the subsidy by using electricity for non-agricultural purposes, further impacting DISCOM finances. The exact figures for subsidized tariffs and revenue loss in Rajasthan are not provided in the available data.

The advantages of solar water pumps in Rajasthan, highlighting cost and energy savings while addressing the challenges faced by DISCOMs:

1. **Reduced Dependency on Grid Electricity:** Solar water pumps provide farmers with a reliable and self-sufficient energy source, reducing their dependency on grid electricity. By harnessing the abundant solar resources

in Rajasthan, farmers can operate their irrigation systems without relying on the fluctuating availability of grid power. This reduces the burden on DISCOMs and prevents instances of electricity and transformer theft.

2. **Lower Operating Costs:** Compared to conventional diesel or electric pumps, solar water pumps offer lower operating costs. With solar energy being a free and renewable resource, farmers can significantly reduce their expenditure on fuel or electricity bills. This, in turn, reduces the need for government subsidies, leading to cost savings for both farmers and DISCOMs.
3. **Improved Efficiency:** Solar water pumps operate at maximum capacity during daylight hours, aligning with the natural irrigation needs of crops. This high efficiency minimizes transmission and distribution losses, which can be costly for DISCOMs. By using solar pumps, farmers can optimize water usage and improve crop yields, leading to enhanced agricultural productivity.
4. **No Need for Metering:** As solar water pumps are self-sufficient and do not rely on the grid, there is no need for metering. This eliminates the cost of meter installation and maintenance, reducing expenses for DISCOMs. Furthermore, it mitigates the risk of meter tampering or theft, ensuring fair and accurate electricity consumption measurement.
5. **Environmentally Friendly:** Solar water pumps utilize clean and renewable energy, contributing to a greener and more sustainable agricultural sector. By reducing reliance on diesel pumps, which emit greenhouse gases and contribute to air pollution, solar pumps help improve air quality in rural areas. Additionally, the use of solar energy helps combat climate change by reducing carbon emissions.
6. **No Dual Connections:** By providing solar pumps and eliminating the need for dual connections (grid electricity and separate pump connections), DISCOMs can reduce infrastructure costs and complexity. Dual connections can lead to operational inefficiencies and increased maintenance requirements for DISCOMs. Eliminating dual connections streamlines the power distribution system and reduces administrative burdens.
7. **Improved Load Management:** Metering enables DISCOMs to monitor and manage electricity loads more effectively. By having accurate data on

electricity usage patterns, DISCOMs can balance power supply and demand more efficiently. This improved load management enhances the stability and reliability of the grid, reducing instances of power outages or voltage fluctuations.

Scenario:

The first scenario is the moderate scenario, which aims to transition 75% of diesel-powered pumps to solar pumps by 2031. This scenario aims to achieve a significant reduction in the energy consumption of pumps used in irrigation, leading to significant energy savings.

The second scenario is the ambitious scenario, which aims to transition 95-100% of diesel-powered pumps to solar pumps by 2031. This scenario is the ideal goal and aims to achieve maximum energy savings in the agriculture sector by eliminating the use of diesel-powered pumps.

This scenario will not only lead to energy savings but will also contribute to reducing carbon emissions, improving air quality and environmental sustainability.

It is also essential to note that the transition to solar-powered pumps will reduce the operational and maintenance costs as solar pumps do not require regular fuel refilling and have fewer moving parts, resulting in less wear and tear. Moreover, the installation of solar pumps will also provide an additional source of income for farmers, as they can sell excess electricity generated by the solar panels back to the grid.

In addition to the benefits mentioned above, the transition to solar-powered pumps will also lead to increased reliability and stability of power supply, as solar energy is available throughout the day and is not subject to disruptions in fuel supply.

Overall, the transition from conventional diesel pumps to solar-powered pumps will lead to a total savings of 0.11 Mtoe in moderate scenario and 0.14 Mtoe in ambitious scenario.

Table 15. Savings Potential in Transition of Conventional Diesel Pumps to Solar Pumps

Strategy	Energy Savings in 2031 under moderate scenario (Mtoe)	Energy Savings in 2031 under ambitious scenario (Mtoe)
Transition of conventional diesel pumps to Solar powered pumps	0.11	0.14

Implementation Agency: Department of Horticulture

Actionable items:

1. **Modification in financial incentive model of PM-KUSUM:** In the current context, the PM-KUSUM scheme extends financial support from governmental entities, covering 60% of the total expenses for pumps. This contribution is divided equally between the central government (30%) and the respective state government (30%). The beneficiaries are responsible for the remaining portion of the costs.

   After extensive consultations with various departments and a comprehensive assessment of the challenges encountered during the implementation, it is strongly recommended that the subsidy percentage be revised to 90% (with a 60/40 distribution ratio between central and state governments) from the existing 60% (with a 50/50 distribution ratio).

   Furthermore, in instances where additional solar photovoltaic (PV) systems are integrated, a 50% subsidy should be granted, with the central government covering 60% of the cost and the state government covering the remaining 40%. This arrangement would greatly benefit from the integration of net metering systems, enhancing the overall effectiveness and sustainability of the initiative.

2. **Promotion of suitable capacity solar based Ag-pumps in the Rajasthan State specially in desert districts:** There are specific regions characterized by extensive desert landscapes, heavily reliant on groundwater for sustaining irrigation activities. In this context, approximately 70% of the irrigation processes are heavily contingent upon groundwater resources. However, the

on-farm irrigation efficiency remains modest, hovering around 27%[15]. This is particularly concerning due to the state's predicament of over-allocated surface water availability within its various river basins.

Further exacerbating the issue is the prevalent practice of over-extracting groundwater, resulting in both ecological strain and considerable energy consumption. Notably, the region boasts a substantial fleet of electric and diesel-driven agricultural pumps, which regrettably contribute significantly to greenhouse gas emissions.

To counter this predicament, solar-powered water pumps have emerged as an ecologically sound and renewable alternative, showing promise in mitigating greenhouse gas emissions. The installation of solar pumps has seen a positive trajectory, with around 60,000 units already established, and this number continues to rise. The focus areas for this initiative primarily encompass desert districts such as Barmer, Jaisalmer, Jodhpur, Nagaur, and Sirohi. It is noteworthy that these Rajasthan has the potential to accommodate an estimated 400,000 solar pumps, 50,000 solar dryers, 2,000 solar cold storage units, 7,000 versatile food-processing machines, 50,000 grain-milling apparatuses, 20,000 bulk milk-chilling facilities, 80,000 solar refrigeration systems, and up to 400,000 vertical fodder cultivation setups. This underscores the considerable latent capacity that remains untapped[16].

Several key technologies necessitate strategic promotion:

a. Implementation of Variable Speed Drives (VSDs) on high-capacity electric pumps.
b. Integration of Solar Tracking Systems to optimize solar generation efficiency.
c. Adoption of Micro Irrigation practices to optimize water consumption and consequent pumping requirements.
d. Establishment of decentralized power generation networks through the deployment of solar electric pumps.

[15] Department of Water Resources. Water resources vision 2045. Government of Rajasthan; NA. Available from: https://water.rajasthan.gov.in/content/water/en/waterresourcesdepartment/rulespoliciesandacts/vision2045.html.
[16] Council on Energy, Environment and Water (CEEW)

e. Embrace of initiatives such as crop diversification schemes, mulching, precision farming, and natural farming practices.

A pivotal objective of the long-term plan, set to be realized by 2030, is the augmentation of current irrigation efficiency from 27% to a target of 40%.

3. **Greater outreach to relevant stakeholders:** It is crucial to engage and inform all relevant stakeholders, including farmers, Panchayat officials, and other key players in the agriculture sector, about the benefits of the PM KUSUM Yojana. This can be done through awareness campaigns, workshops, and meetings at the local level. This will help ensure that everyone is aware of the program and its benefits and can work together to implement it effectively.
4. **Capacity building of Panchayat/Block level officials:** It is important to provide training and capacity building programs to Panchayat and Block level officials to ensure effective implementation of the program. This can include training on the technical aspects as well as on the administrative aspects of the program. This will enable officials to provide the necessary support and guidance to farmers and other stakeholders in their respective areas and ensure the successful implementation of the program.

Implementation Period: Till FY 2031

7.3. Energy Saving Targets & Monitoring Mechanism

On the basis of the strategy proposed for the agriculture sector, the total energy saving estimated is 0.11 Mtoe in the moderate scenario and 0.14 Mtoe in ambitious scenarios. The potential savings under moderate and ambitious scenarios is the overall estimated savings from individual strategy under the respective scenarios and can be considered as the energy saving targets for FY 2031 for the Agriculture Sector.

Monitoring Mechanism:

To effectively carry out the action plan, it is essential to establish a robust monitoring and verification system. While the Rajasthan Horticulture Department

holds the primary responsibility for overseeing progress, it is imperative for other stakeholders, including organizations engaged in building sector development and planning, to actively engage in diligent monitoring and reporting. The suggested monitoring framework, outlining the steps to track the scheme's progress, is presented in the table below:

Type of Monitoring	Frequency	Nodal Agencies	Responsible Agencies
Reporting, Monitoring and Review of the scheme advance and implementation status	Quarterly	Department of Horticulture	• Department of Horticulture
Review of the scheme advancement and course correction, if required.	Half-yearly	Department of Horticulture	• State Designated Agency • Department of Horticulture • Department of Agriculture
Review of the scheme advancement and policy interventions required	Yearly	Department of Horticulture	• Department of Horticulture • State Designated Agency • Bureau of Energy Efficiency
Progress reporting of scheme advancement	Monthly	Department of Horticulture	• Department of Horticulture • State Designated Agency

In conclusion, Monitoring mechanisms are essential for successful implementation of energy efficiency action plans, providing a way to track progress, identify areas for improvement, and evaluate energy efficiency measures. Moreover, monitoring mechanisms can also help to identify patterns and trends in energy consumption, allowing policymakers to develop effective energy efficiency strategies. Effective monitoring mechanisms are essential for achieving energy efficiency goals in the agriculture sector, leading to cost savings, improved comfort, and environmental benefits.

8. Market Potential in Focus Sectors

The energy saved as a result of the proposed strategies in all sectors will lead to avoided generation of equivalent amount. In order to implement the suggested strategies, there will be a need for investments in energy efficiency projects, development of new policies, and modification of existing policies. In order to estimate the investment potential generated from the suggested strategies in the focus sectors, the equivalent cost of the saved energy in terms of metric tonnes of oil equivalent has been calculated. The Ministry of Power, Government of India, in consultation with the Bureau of Energy Efficiency (BEE) has notified the price of per metric tonne of oil equivalent as INR 18,402 only for the year 2018-19. The same amount has been applied to energy savings under ambitious scenarios for the estimation of maximum investment potential. Total energy saving potential by implementing various strategies in Rajasthan is shown in the graph below:

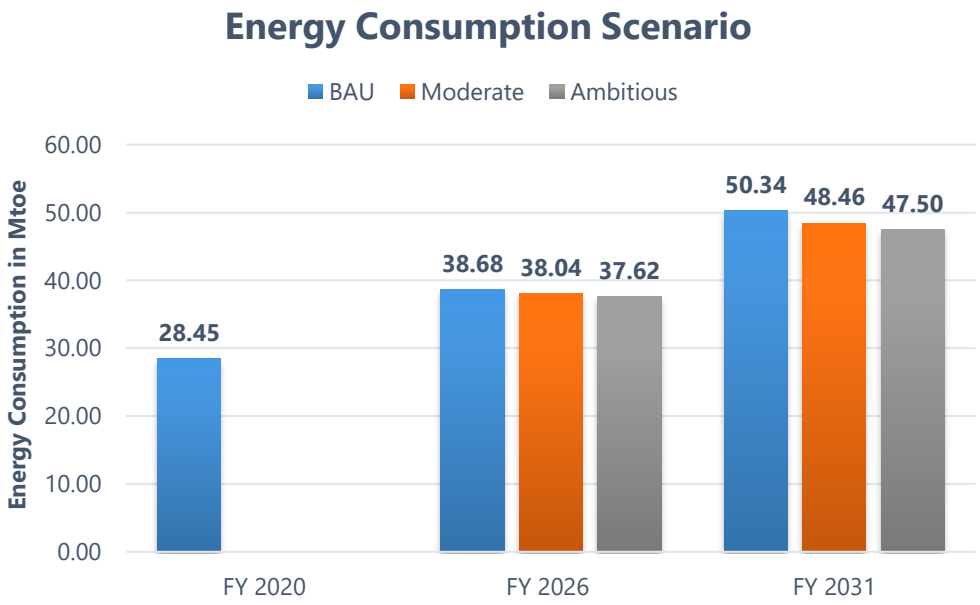


Figure 25: Energy Consumption Scenario (Mtoe)

It is estimated that with the implementation of various proposed strategies of Buildings, Transport, Agriculture and Industry Sectors, energy saving of 1.89 Mtoe in moderate scenario and 2.84 Mtoe in ambitious scenario can be achieved.

Table 16 Moderate and Ambitious Energy Saving Scenario for Focused Sectors

Sectors	Energy Consumption & Emission Reduction - FY2031				
	Moderate	**Ambitious**	**Moderate**	**Ambitious**	**Market Potential (INR Crores)**
	Mtoe Reduction	Mtoe Reduction	$MtCO_2$ Reduction	$MtCO_2$ Reduction	
Industry	0.09	0.22	0.27	0.68	401
Buildings	0.12	0.15	0.38	0.48	282
Transport	1.57	2.33	4.92	7.29	4,284
Agriculture	0.11	0.14	0.34	0.45	266
Total	**1.89**	**2.84**	**5.91**	**8.90**	**5,233**

9. The Way Forward

The state energy efficiency action plan, through research and interaction with various stakeholders, identifies the need, opportunity, and the potential of energy efficiency in the state of Rajasthan. While addressing the key focus sectors – Industry, Buildings, Transport and Agriculture, the action plan envisages analyzing consumption pattern, growth rates in alignment with GDP growth rate of the state and potential strategies for achieving savings.

The action plan lays out a plan for the state to implement the strategies, while at the same time being able to monitor implementation. It is imperative that implementation is carried out in the state through various stakeholders.

A market-based mechanism is anticipated to be developed through the implementation of the action plan which drives energy efficiency through better availability of energy efficiency products, financial instruments for improving the product reach and a wider adoption of energy efficiency schemes and policies curated by both state and central governments.

A collaborative approach, on the part of the government, industry and academia is the ideal way forward to implement the vision and targets of this action plan and continue to put the country on a high pedestal of energy efficiency achievements at the global platform.

10. Bibliography

1. Bureau of Energy Efficiency (BEE). (2019). *Unlocking National Energy Efficiency Potential (UNNATEE)*
2. Bureau of Energy Efficiency (BEE). (2019). *Roadmap of Sustainable and Holistic Approach to National Energy Efficiency (ROSHANEE)*
3. Reserve Bank of India (RBI). (2021). *Handbook of Statistics on Indian Economy 2020-21*
4. MSME Energy Map, SAMEEKSHA
5. Vahan Parivahan – VAHAN Dashboard
6. Annual Survey of Industries 2018-19
7. Directorate of Economics & Statistics, Rajasthan, Digest of *Statistics– 2021*
8. Census of India 2011
9. NITI Aayog: India Energy Dashboards