Bureau of Energy Efficiency
Government of India, Ministry of Power

STATE ENERGY EFFICIENCY ACTION PLAN

PUDUCHERRY

Prepared by
Confederation of Indian Industry

Supported by
Renewable Energy Agency Puducherry(REAP)

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सत्यमेव जयते

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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PREFACE

The Bureau of Energy Efficiency (BEE) has been involved in numerous efforts aimed at developing and implementing energy efficiency programmes. As part of this initiative, BEE has proposed the above assignment, which aims to provide technical assistance for the identification of focus sectors for the "State Energy Efficiency Action Plan" in various states/UTs, to ensure that resources are allocated in accordance with state/UT requirements, and to estimate the potential of energy conservation in sectors that are prevalent in the region. The "State Energy Efficiency Action Plan" is sought in two parts: a 5-year short-term strategy and a long-term plan aimed at high-impact energy efficiency by FY 2030.

All states/UTs are grouped into six zones for this assignment: North-East, East, North-1, North-2, West, and South. In this context, the Bureau of Energy Efficiency (BEE), with the assistance of the Confederation of Indian Industry (CII), was involved in identifying major energy guzzling sectors in the West and South Zones, as well as reviewing all existing policies related to energy conservation, which will be presented in the form of this report "State Energy Efficiency Action Plan."

Policymakers, planners, domain consultants, and other important stakeholders would benefit from the State Energy Efficiency Action Plan. The report will also allow knowledge exchange among stakeholders and, in the long run, will help to scale up energy-efficiency programmes in their respective states.

ACKNOWLEDGEMENT

The Confederation of Indian Industry (CII) extends its heartfelt appreciation to Dr. A. Muthamma (IAS), Secretary (Power)/Vice Chairman Renewable Energy Agency Puducherry (REAP), and Shri Yasam Lakshmi Narayana Reddy, Managing Director REAP, Renewable Energy Agency Puducherry (REAP), for their unwavering support and encouragement throughout the development of the State Energy Efficiency Action Plan.

We extend our sincere gratitude to the Bureau of Energy Efficiency (BEE), Ministry of Power, Govt. of India, for their invaluable guidance and leadership in steering this significant undertaking, the "State Energy Efficiency Action Plan" for Puducherry. CII is indebted to Shri Srikant Nagulapalli, Director General BEE, and Shri Milind Deore, Secretary, BEE, for their overarching guidance and unwavering support, which were instrumental in the successful completion of this project. We would also like to express our appreciation to Shri Abhishek Sharma, Joint Director and Shri Vikash Kumar Jha, Project Engineer, who provided regular consultations, assistance, feedback, and invaluable insights throughout the project.

CII expresses its deep gratitude for the consistent guidance and valuable suggestions provided by Shri Loganathan, Technical Assistant, REAP and the entire REAP team. Their efforts and significant contributions have played a pivotal role in the development of this report.

We are also profoundly thankful to all the stakeholder departments, department heads of Puducherry, and the various nominated officers for their pivotal roles in the assessment of policy frameworks and data for their collaborative efforts have greatly enriched the content of this report.

EXECUTIVE SUMMARY

India's rapid economic expansion and urbanization have paved the way for a huge increase in energy demand. As the nation continues to evolve and urban areas expand, the need for energy to power industries, transportation, and households has grown steadily. This burgeoning demand poses a complex challenge, as it requires a delicate balance between providing access to affordable and reliable energy for all while addressing environmental sustainability and energy security. In response to these challenges, India, in its updated Nationally Determined Contribution submitted during the 26th session of the Conference of the Parties (COP26) to the United Nations Framework Convention on Climate Change (UNFCCC) in Glasgow, United Kingdom in 2021, unveiled a strategic framework for climate action. This framework, symbolized by the "Panchamrit" (five nectar) elements, signifies India's resolute commitment to achieve net-zero emissions by 2070 and secure 50% of its energy from renewable sources by 2030.

It is imperative to recognize the pivotal role that States and Union Territories (UTs) play in effecting a transition to low-carbon development pathways. To facilitate this vital transition, the Bureau of Energy Efficiency, operating under the aegis of the Ministry of Power, Government of India, has embarked on the development of State Energy Efficiency Action Plan (SEEAP). These plans are tailored to meet the distinctive requirements of each state, ensuring that resource allocation aligns with the state's sustainable development objectives. The SEEAP project aims to contribute to India's national targets and provide a comprehensive roadmap for enhancing energy efficiency across the state and the country.

For Puducherry, SEEAP was developed by the Confederation of Indian Industry (CII), under the guidelines of Bureau of Energy Efficiency, Ministry of Power, GOI, in consultation with the State Designated Agency viz. Renewable Energy Agency Puducherry (REAP) with inputs & suggestions from various government departments and sector experts. The primary objective of the State Energy Efficiency Action Plan for Puducherry is to formulate sector-specific strategies in short-term 2025 and long-term 2030 goals for enhancing energy efficiency in the U.T.

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GLOSSARY

AgDSM	Agriculture Demand side management
ATF	Aviation Turbine Fuel
BEE	Bureau of energy efficiency
BPL	Below Poverty Line
CAGR	Compound annual growth rate
CEA	Central Electricity Authority
DDUGJY	Deendayal Upadhyaya Gram Jyoti Yojana
DISCOM	Distribution company
DSM	Demand side management
ECBC	Energy Conservation Building Codes
EE	Energy Efficiency
ESCO	Energy Service Company
FAME	Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India
FEEED	Framework for Energy Efficient Economic Development
FO	Furnace Oil
GHG	Green House Gases
HHS	Hot Heavy Stock
KMT	Kilo Metric Tonnes
KUSUM	Kisan Urja Suraksha Evam Utthaan Mahabhiyaan
LDO	Light Diesel Oil
LPG	Liquefied Natural Gas
LSHS	Low Sulphur Heavy Stock
MNRE	Ministry of New and Renewable Energy
MoP	Ministry of Power
MoPNG	Ministry of Petroleum and Natural Gas
MoU	Memorandum of Understanding
MSME	Micro, Small and Medium Enterprises
MTOE	Million tonnes of Oil Equivalent
MWh	Megawatt Hour
MW	Mega Watt
NITI Aayog	National Institution for Transforming India
NMEEE	National Mission on Enhanced Energy Efficiency
PAT	Perform, Achieve and Trade
PAF	Plant availability factor
SDA	State designated agencies
SKO	Superior Kerosene Oil

TFEC	Total Final Energy Consumption
ULB	Urban Local Bodies

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1. INTRODUCTION

1.1 Background

India is a diverse country with diverse energy consumption patterns in different states/UTs. Broadly, the energy consumption is divided in six major sectors i.e., **Buildings, Transportation, Municipalities, DISCOMs, Agriculture and Industries**. A need for a focussed sector-based energy efficiency approach by states/UTs has been felt. For instance, there may be states with lesser urbanised areas and therefore lesser number of high energy consumption buildings. Such a state may need more focus on energy efficiency in sectors such as Transportation, Agriculture, or others.

Similarly, Industry sector has 53% of total primary energy demand in India, and more than 30% in most States, however, the level of energy efficiency initiatives and programmes is not commensurate with the energy consumption in this sector. Most states are yet to set energy saving targets for industry, apart from targets set for the PAT programme. Most states focus primarily on energy conservation for PAT Designated Consumers (DC) and monitor DCs for energy audits and compliance with specific energy consumption (SEC) targets. Only a few states have mandated energy audits for specific categories of industry other than PAT DCs and provision to provide financial incentives for implementing energy efficiency in industrial units.

In the transport sector, there is a need to include and promote energy efficient public transport besides policy level intervention for efficient or clean fuel vehicles. Several states have come forward with a state level incentivisation for Electric Vehicles. Policy and framework for electric vehicles at the state level needs further focus. Though energy efficiency is a multi-dimensional subject, defining key focus areas to bridge gaps is the need of the hour. While some states may have the potential to improve efficiency in a particular sector, there may be gaps in terms of identification of these sectors.

If, for instance, a state with many MSME industrial units, may focus on energy efficiency in the industrial sector alone, a large potential of achieving energy efficiency may be unearthed. This may involve activities and resource mobilization to create awareness in industry, replacement of appliances and machinery with the help of ESCOs, setting up and utilization of Revolving Investment Fund, besides others.

In context of above, Puducherry has realized importance of energy efficiency and adopted various measures which align with India's nationally determined contribution of mitigating the climate change and the Energy Conservation Act 2001. As Energy Conservation and Energy Efficiency is the fastest, cleanest, and cheapest option than Generation and its easy way to meet energy needs. One unit of energy saved is equivalent to two units of energy generated, the State could save each year by greatly improving Energy Conservation and Energy Efficiency in all the sectors. The sectoral efficiency achieved will contribute effectively for the progressive economy of the nation, which shall meet the international best practices.

Therefore, the scope of this assignment shall cover identification of stakeholders from various sectors, identification of focus sector in a state, identification of gaps in the sector, providing best practices and identification of designated agency to carry out efficiency activities in the sector in consultation with state for preparation of a 5-year State Energy Efficiency Action Plan with defined targets in these sectors. The scope shall also include highlighting the benefits derived from these initiatives to the state.

1.2 India's Nationally Determined Contributions (NDCs) (Include LiFE)

India submitted its Intended Nationally Determined Contribution (NDC) to the United Nations Framework Convention on Climate Change (UNFCCC) on 2nd October 2015.

India hereby communicates an update to its first NDC submitted earlier on October 2, 2015, for the period up to 2030, as under:

1. To put forward and further propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation, including through a mass movement for 'LIFE'– 'Lifestyle for Environment' as a key to combating climate change.
2. To adopt a climate friendly and a cleaner path than the one followed hitherto by others at corresponding level of economic development.
3. To reduce Emissions Intensity of its GDP by 45 percent by 2030, from 2005 level.
4. To achieve about 50 percent cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030, with the help of transfer of technology and low-cost international finance including from Green Climate Fund (GCF)
5. To create an additional carbon sink of 2.5 to 3 billion tonnes of CO2 equivalent through additional forest and tree cover by 2030.
6. To better adapt to climate change by enhancing investments in development programmes in sectors vulnerable to climate change, particularly agriculture, water resources, Himalayan region, coastal regions, health, and disaster management.
7. To mobilize domestic and new & additional funds from developed countries to implement the above mitigation and adaptation actions in view of the resource required and the resource gap.
8. To build capacities, create domestic framework and international architecture for quick diffusion of cutting-edge climate technology in India and for joint collaborative R&D for such future technologies.

India's NDC is ambitious, and it is a significant contribution towards achieving the goals of the Paris Agreement. Environmentally sustainable, low carbon initiatives are underpinning all key sectors of the Indian economy. [1]

India reaffirms its commitment to the UNFCCC and the Paris Agreement on Climate Change.

India's NDC is a step forward towards our long-term goal of reaching net-zero by 2070.

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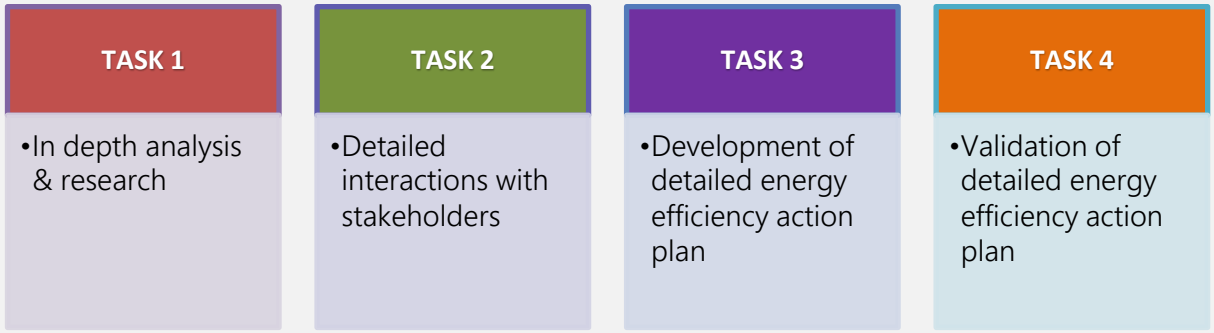
1 https://unfccc.int/sites/default/files/NDC/202208/India%20Updated%20First%20Nationally%20Determined%20Contrib.pdf

1.3 About State Energy Efficiency Action Plan

This assignment aims to provide technical assistance for the identification of focus sectors for the **State Energy Efficiency Action Plan for Puducherry** U.T. to ensure that the allocation of resources is as per the requirement of U.T. and estimate the potential of energy conservation in sectors which are predominant in the region. The State Energy Efficiency Action Plan is sought 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.

The above said objective will be achieved by completion of four tasks as given below.

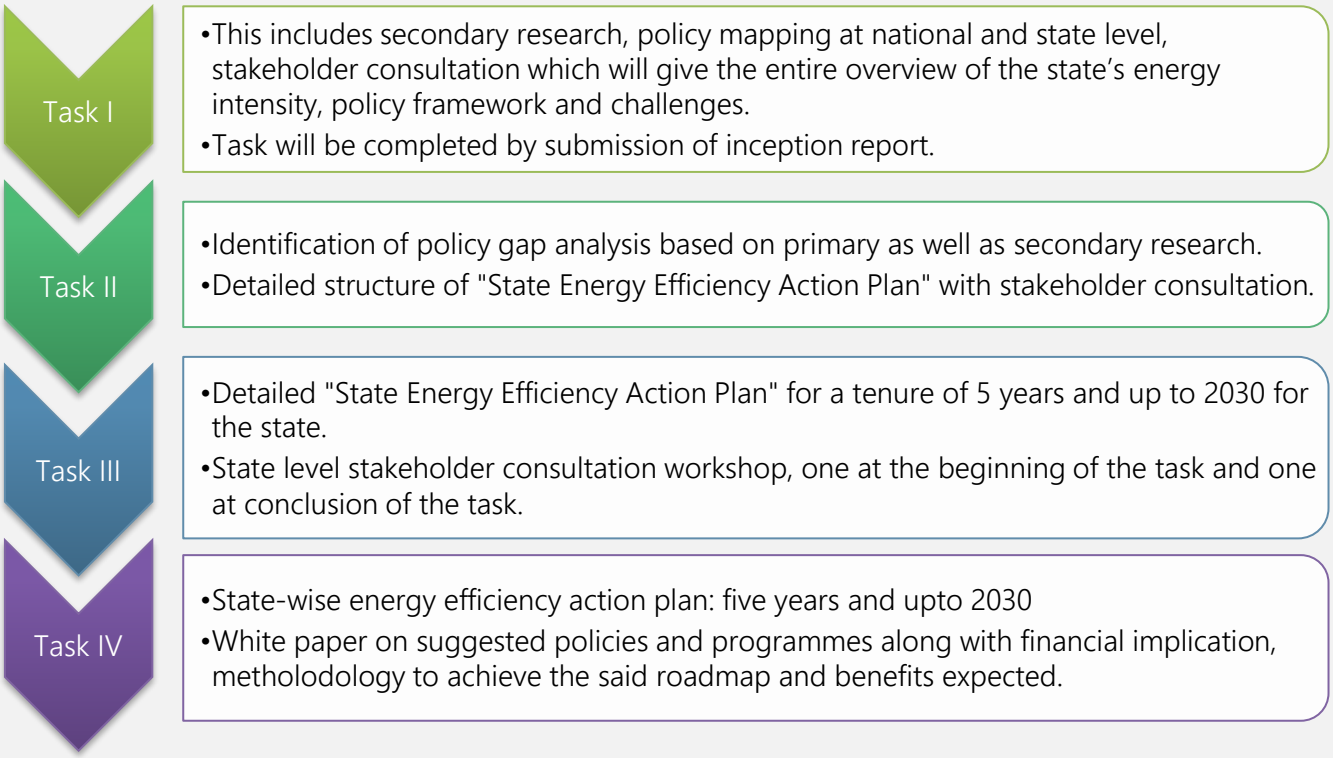
Figure 1 Key tasks in state energy action plan



Outcome

Task wise outcome of the study is as detailed in Figure 2.

Figure 2 Task wise expected outcome of the study



Energy efficiency drivers for state

Puducherry has scored 23.5 points in SEEI 2020 released by the Union Ministry of Power and is one of the best performing states in energy conservation, which is a clear indication of the state's determination and the actions taken to improve the energy efficiency. The key drivers of energy efficiency in the State are shown below.

Limited Self Generation of Power

Puducherry has only one gas based generating plant of 32.5 MW capacity at Karaikal and meets the most of the demand through allocation from Central Generating Stations. The present peak demand of the state is 470 MW.

High electricity cost

In Puducherry, the domestic and commercial consumers have telescopic tariff rate for electricity consumption, with rates at upper slabs is Rs 6.45 / kwh and Rs 7.50 /kwh. So, in order to limit the electricity consumption in lower slabs, people's interest in energy efficient appliances is increasing.

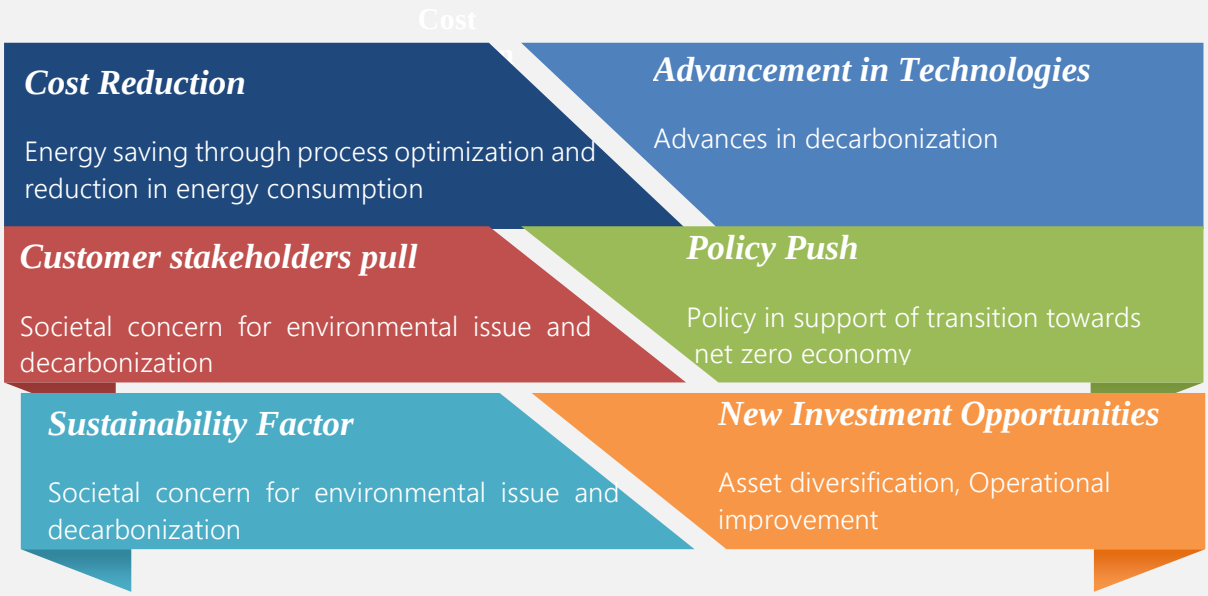
State's interest to reduce emissions

Puducherry government is trying to reduce the carbon emissions of the state and energy efficiency has a prominent role in reducing emissions. Puducherry Climate Change Action Plan was formulated with an objective of identifying and prioritizing strategies that simultaneously advance the UT's developmental goals while yielding co-benefits of climate change mitigation and adaptation effectively. Several missions has been adopted by the UT for mitigation like solar mission, mission for enhanced energy efficiency, mission for a green Puducherry and sustainable agriculture.

Increasing awareness on energy efficiency

A number of awareness programs by various agencies has been influencing the mindset of people towards energy efficiency.

Figure 3 Energy efficiency drivers of the U.T.



1.4 Puducherry U.T. Profile

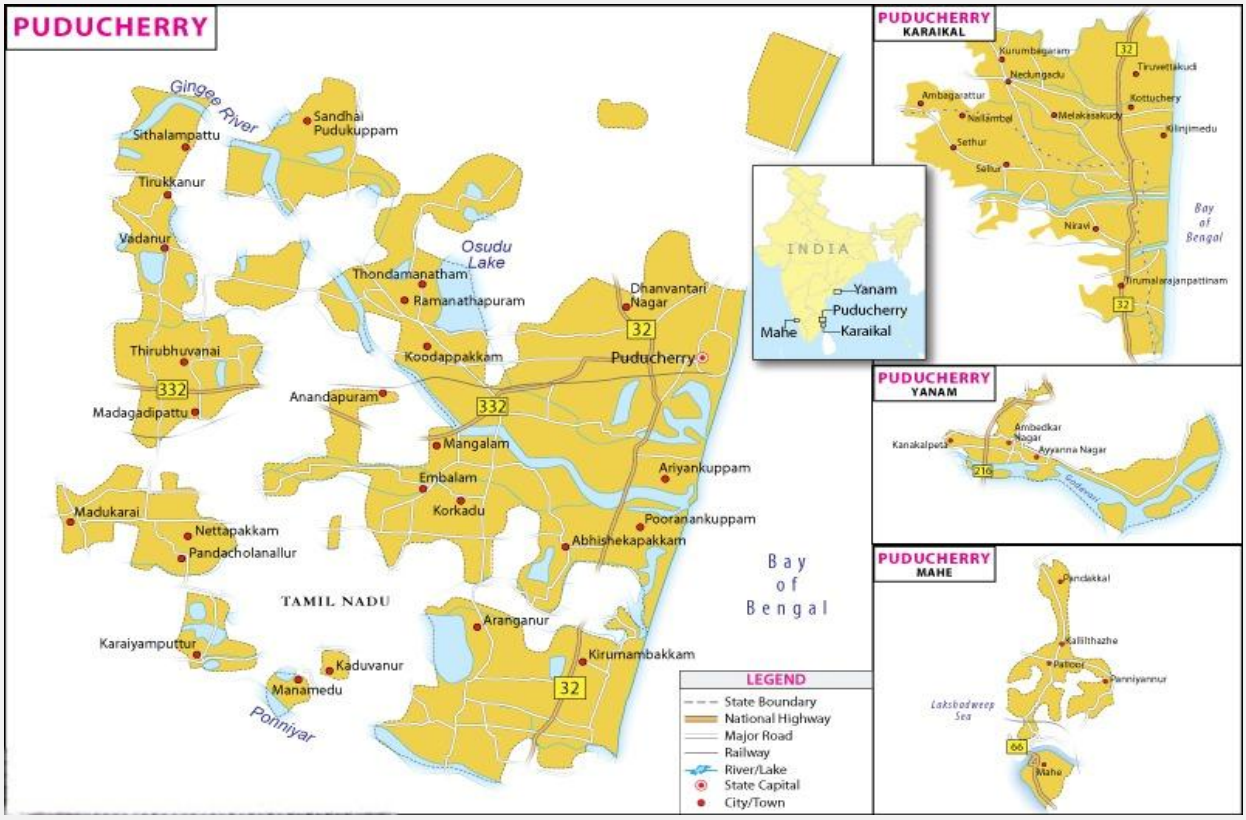


Figure 4 Puducherry Profile

Puducherry also known as Pondicherry, is a union territory of India, consisting of four small geographically unconnected districts. It was formed out of four territories of former French India, namely Pondicherry (Pondicherry; now Puducherry), Karaikal (Karaikal), Mahi and Yanaon (Yanam), excluding Chandan Nagar. Historically known as Pondicherry, the territory changed its official name to Puducherry on 20 September 2006.

The Union Territory of Puducherry lies in the southern part of the Indian Peninsula. The areas of Puducherry district and Karaikal district are bound by the state of Tamil Nadu, while Yanam district and Mahi district are enclosed by the states of Andhra Pradesh and Kerala, respectively. Puducherry is the 29th most populous of the 30 states and union territories of India, and the third most densely populated union territory. It has a gross domestic product (GDP) of ₹210 billion (US$2.8 billion) and ranks 25th in India.

Table 1 Shows the top 5 sectors of Pondicherry in terms of GVA

	Sub Sector	Sector	GVA (Rs. in Lakh)	% Share
1	Manufacturing	Secondary	992,585	28.56
2	Construction	Secondary	512,723	14.75
3	Real estate, ownership of dwelling & professional services	Tertiary	441,540	12.70
4	Trade & repair services	Tertiary	311,249	8.95
5	Agriculture, forestry & fishing	Primary	145,777	4.19

Pondicherry is one of the best performing states in the State Energy Efficiency Index (SEEI) of 2019 as well as 2020. SEEI assess the performance of states in energy efficiency through 68 indicators across six sectors: Buildings, Industry, Municipalities, Transport, Agriculture and distribution companies (DISCOMs), and Cross Sector initiatives. The indicators cut across Policy and Regulation, Financing Mechanisms, Institutional Capacity, Adoption of Energy Efficiency Measures, and Energy Savings. The consistency of Pondicherry in SEEI scores shows the efforts taken by the state to improve the energy efficiency.

1.5 Current Energy Scenario of Puducherry

The Total Final Energy Consumption (TFEC) of Puducherry in Million TOE (MTOE) is 0.808. It accounts for the total energy consumed from electricity and fuels. The sector wise TFEC of Puducherry in MTOE for the FY 2019-20 is given in Figure 5.

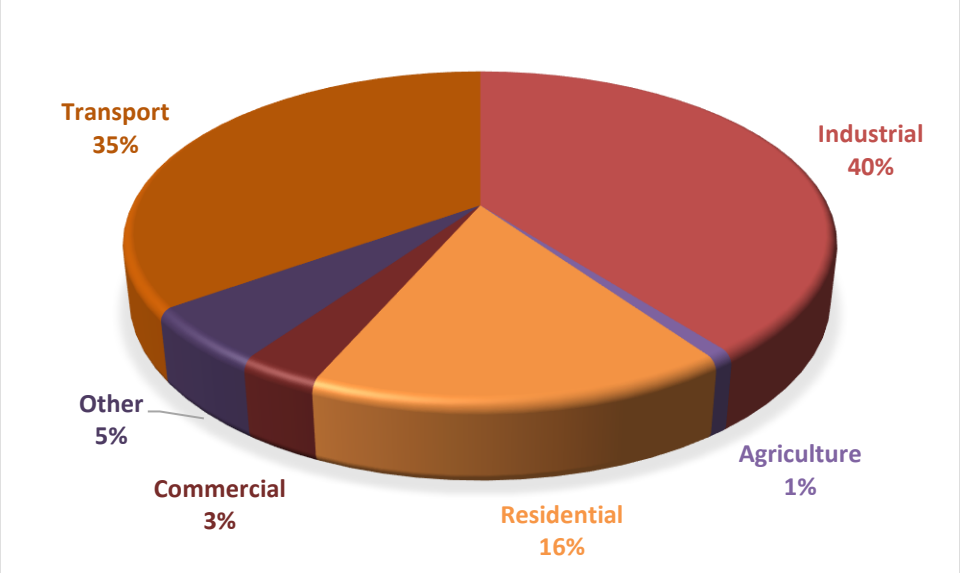


Figure 5: Sector wise TFEC of Puducherry

The Industrial sector accounts for 39.49% of the TFEC of the U.T. and consumes 0.32 MTOE. Diesel and furnace oil are the major fuels used in the U.T.

The Transport sector accounts for energy consumer in the state, contributing to 34.91% of TFEC of the U.T., equivalent to about 0.28 MTOE of energy; the main fuels consumed are petrol and diesel.

Buildings comprised of residential and commercial, are the third largest energy consumer and account for 0.16 MTOE, which is nearly 19.38% of the total energy consumption. (i.e Residential 16.23% & Commercial 3.16%). The energy consumed by both electricity and fuels are almost equally distributed in the building sector.

The agricultural sector consumes 0.01 MTOE of energy, which is merely 0.81% of TFEC, and the major contribution is from the usage of diesel used for agri implements, tractors and pumps.

Other sectors include fisheries, municipalities and cross-sectors consume 0.04 MTOE of energy, which is merely 5.41% of the total energy consumption.

The sector wise energy bifurcation from electricity and fuels is shown in Figure 6.

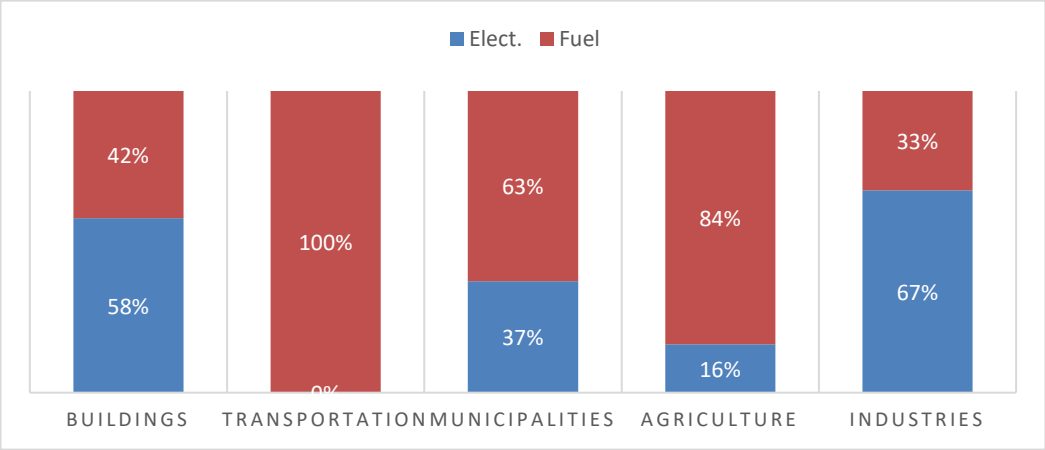


Figure 6: Puducherry Energy Bifurcation sector wise

1.5.1 Primary Energy Supply

The Figure 7 shows the energy supplied by primary fuels from FY 2020 in Puducherry.

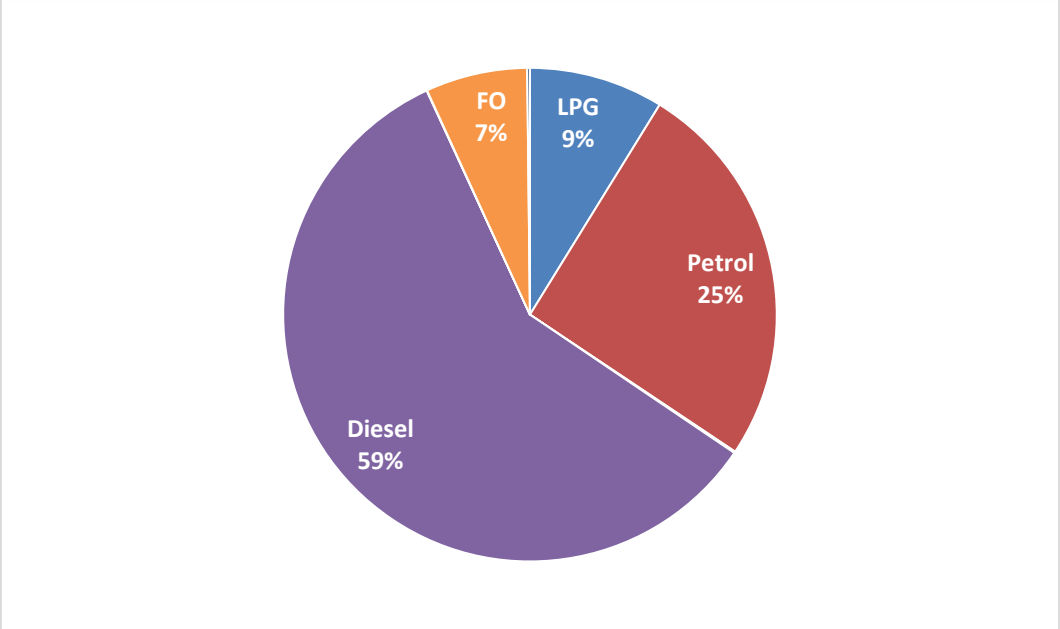


Figure 7: Primary energy supply trend of Puducherry

The energy supplied from Diesel; the most consuming fuel is 0.34 MTOE. Petrol accounts for 0.15 MTOE & comes second in consumption, followed by LPG & FO. The energy supplied by LPG & FO is 0.05 MTOE and 0.04 MTOE respectively.

1.5.2 Primary Energy Consumption by Economic Sub - Sectors

The sector wise primary energy consumption profile of Puducherry for FY 2020 is shown in Figure 8.

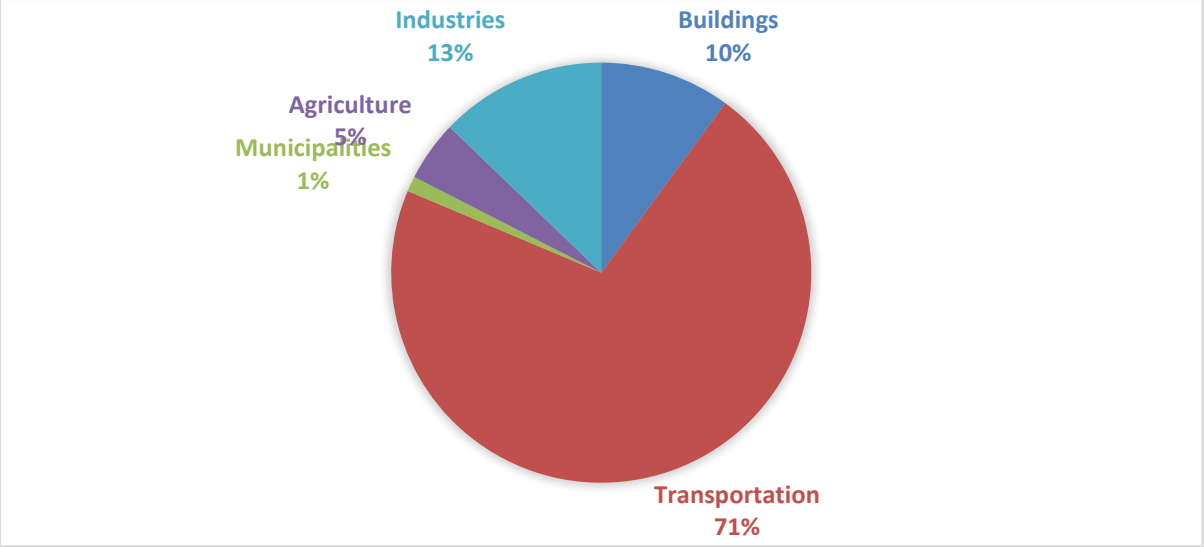


Figure 8: Sector wise primary energy consumption profile of Puducherry

The Transport sector, the most dominant sector in primary energy consumption, consumes 0.42 MTOE of Energy and accounts for 71% of energy consumption. In the Transport sector the major fuels consumed are Petrol and Diesel.

The Industrial sector consumes 0.07 MTOE of energy, which is 13% of the total primary energy supply. FO and Diesel are the major fuels used in Industries. FO is mainly used in boilers and Diesel in DGs.

The building sector accounts for 10% of primary energy and consumes 0.06 MTOE of energy. The fuels consumed in the building sector are LPG, Diesel, and SKO (Kerosene). Major consumption of LPG and Kerosene is in the Domestic/ Residential sector, while Diesel is in the commercial sector (used by DGs).

The Agricultural Sector accounts for 5% of the primary energy supply and consumes 0.03 MTOE of energy. As mentioned before, diesel consumed by Agri Pump sets, Implements and Tractors constitute the major portion of the energy consumption by this sector.

1.5.3 Electricity Sub-sector

The Electricity Department under the Government of Puducherry is in charge of electricity maintenance in the union territory. Approximately 90% of the power requirement is met through grid. With a view to reduce the dependency to other state, a separate Gas Power Plant has been set up at T.R. Pattinam with a capacity of 32.5 MW in the name of Pondicherry Power Corporation Limited.

The electricity consumption in MU by the major sectors of Pondicherry for FY 2020 is given in Figure 9.[2]

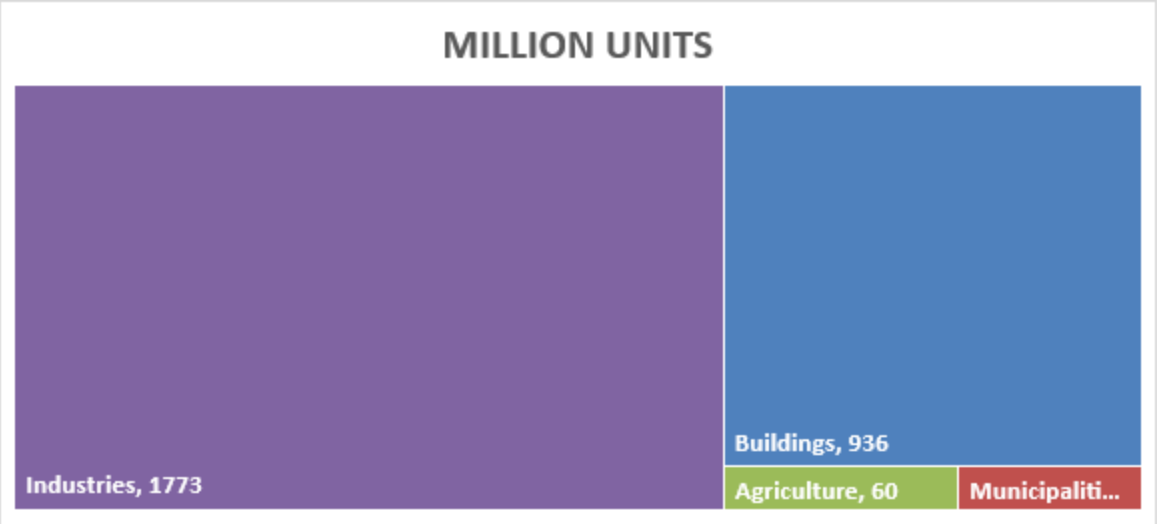


Figure 9: Sector wise Electricity Consumption of Puducherry

The Industrial sector of Puducherry comes first in electricity consumption and accounts for 63% of the total electricity consumption. As of 2014-15, there are 8,699 small-scale industries, 190 medium scale industries and 77 large-scale industries. There are also 2 sugar factories and 8 textile mills in Puducherry.[3]

The building sector is the second significant consumer of electricity and consumes about 33% of total electricity. In buildings, both residential and commercial consumers are considered. Out of the total electricity consumed by the building sector, 77% is accounted for by the domestic sector.

The Municipality sector consumes 2% of electricity, while the Agricultural sector consumes 2%. In Municipality, streetlight and water pumps are major consumer. Pumps are the major electricity consumer in the agricultural sector.

1.5.4 Renewable Energy Scenario

The renewable power generating sources of Puducherry is Solar which accounts to 9.33 MW[4].

Out of the total capacity installed, 1.9% is renewable power sources. In Puducherry, the land is not available in comparison to other states like Gujarat, Rajasthan, Maharashtra, Tamil Nadu, and Karnataka as a result of which, the large-installation model followed by these states has a limited reach here.

To overcome the limitation caused by land unavailability, Puducherry is now focussing more on solar rooftop projects in households and other buildings.

The Solar Mission in Puducherry is strategized in line with the National Solar Mission with objectives to meet the country's development goals and energy security of the nation while simultaneously yielding co-benefits for addressing climate change effects.

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[2] CEA Reports

[3] https://www.ibef.org/download/Puducherry-September-2021.pdf)

[4] https://www.ibef.org/download/Puducherry-September-2021.pdf

The Key actions proposed under solar mission are:

1. Promotion of grid interactive solar power generation in PPP/IPP mode through policy measures and facilitating setting up of 20MW rooftop and small solar powerplants of up to 2MW capacity
2. Promotion of solar application in public building for lighting and hot water generation through demonstration project of 50 kW solar power and 1,000 LPD SWH installation in two govt. buildings
3. Promotion of Solar water heating system application in health sectors
4. Strengthening technical competency of various stakeholders of RE technology including O&M service providers, technicians, installers, manufacturer & others
5. Promotion and facilitation of Renewable energy application in Govt. schools & central kitchens of UT.

1.5.5 Overview of the institutional framework – Energy

The Electricity Department of Government of Puducherry is a deemed licensee under Section 14 of Electricity Act, 2003 and is carrying on the business of Transmission, Distribution and retail supply of Electricity in Puducherry, Karaikal, Yanam, and Mahe Regions of the Union Territory of Puducherry. With all the Towns and villages electrified in as early as 1972, the Union Territory is 100% fully electrified. The business of generation of Electricity in the Union Territory of Puducherry is being carried out by the Puducherry Power Corporation Limited, an undertaking wholly owned by the Government of Puducherry.

Renewable Energy Agency Puducherry (REAP) is the Designated Government agency viz. State Designated Agency (SDA) to co-ordinate, regulate and enforce the provisions of the Energy Conservation Act 2001 (Central Act 52 of 2001). Renewable Energy Agency Puducherry aiming primarily to remould and instrumentalise the energy sector as a catalyst in promoting a development process that is economically and ecologically sustainable.

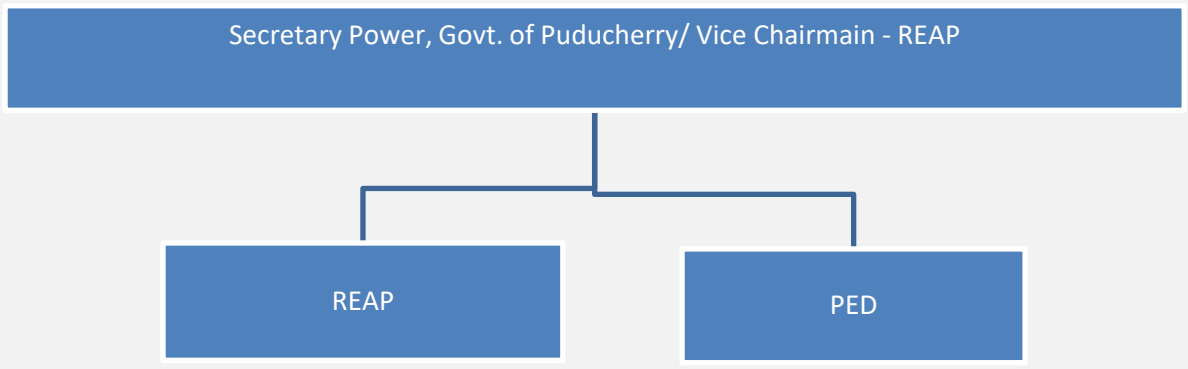


Figure 10 Institutional Framework of Puducherry

2. IDENTIFICATION OF FOCUS SECTORS

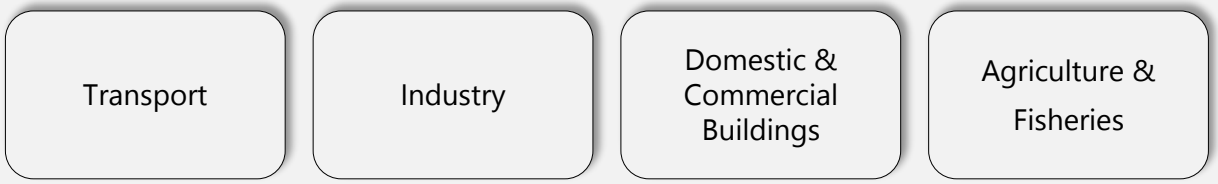
2.1 Methodology of Focus Sector Identification

Based on the secondary research, will identify the focus sectors where the energy intensive sectors are more, based on the energy consumption in various sectors.

2.2 Identified Focus Sectors

Energy consumption indicators and situation assessment are used to define target focus sectors and specific industries.

The following sectors should be focused for the development of "State Energy Efficiency Action Plan" for Puducherry.



Energy efficiency measures are thus becoming increasingly significant in these sectors, based not just on overall energy use but also on the potential for cost-effective improvements. For setting priorities, account has to be taken of the measures applicable in a given sector (including cost implications) and on the means of promoting energy efficiency action.

3. PROJECTIONS AND FORCASTING

The TFEC (total final energy consumption) projected for FY 2030 is 1.337 for the U.T. of Puducherry from the actual TFEC of 0.802 MTOE in FY2015. The methodology for forecasting involved analysing the trends in energy consumption and energy intensity for FY 2015-2020.

These trends were then used to estimate the energy consumption for the year 2030 based on the energy intensity from 2015 till 2020 based on time-series models which is a popular method for forecasting.

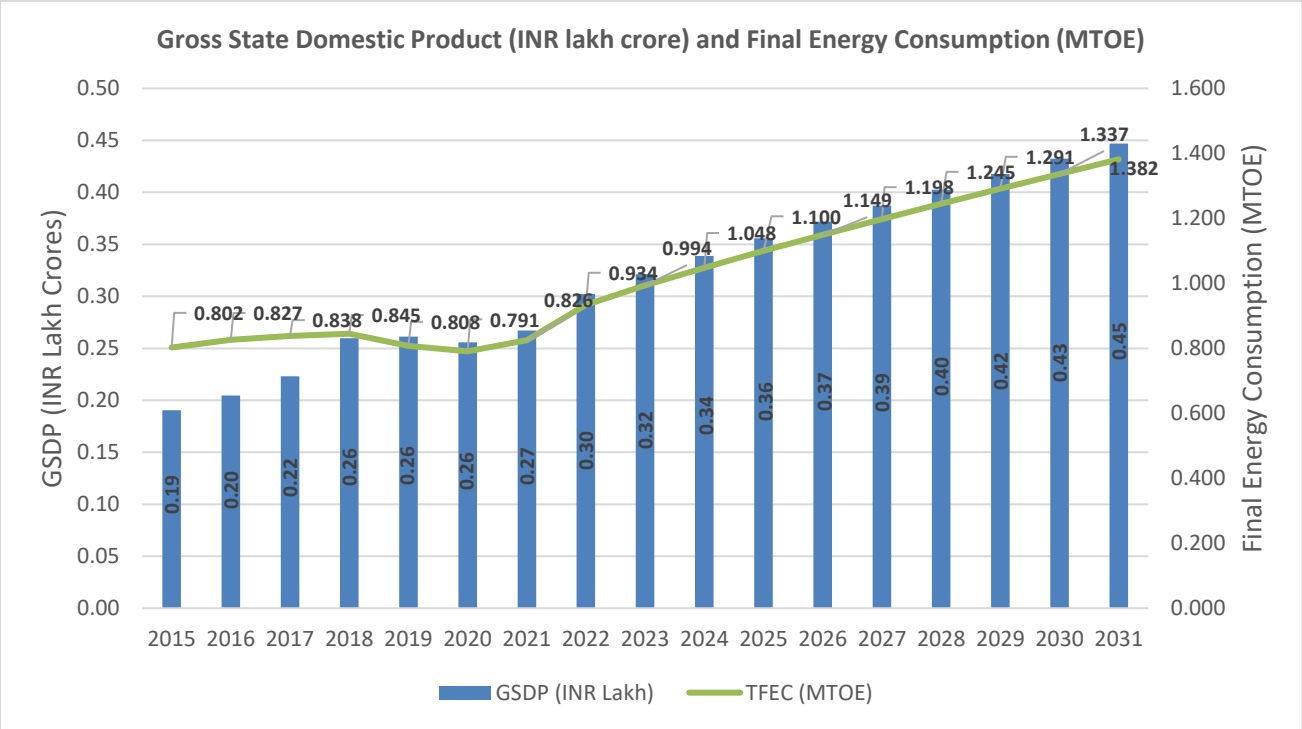


Figure 11 Gross State Domestic Product and Final Energy Consumption (MTOE)

4. FOCUS SECTOR – 1 INDUSTRY

4.1 Overview

Puducherry is one of the UTs in India with a diverse industrial sector. The UTs industrial sector includes various industries such as chemical, pharmaceuticals, automobile, paper, rubber, plastics industries, and more. Industry sector in Puducherry is one of the major energy sectors. It accounts to 39.49% of the total TFEC of the UT which is nearly 0.32 MTOE[5].

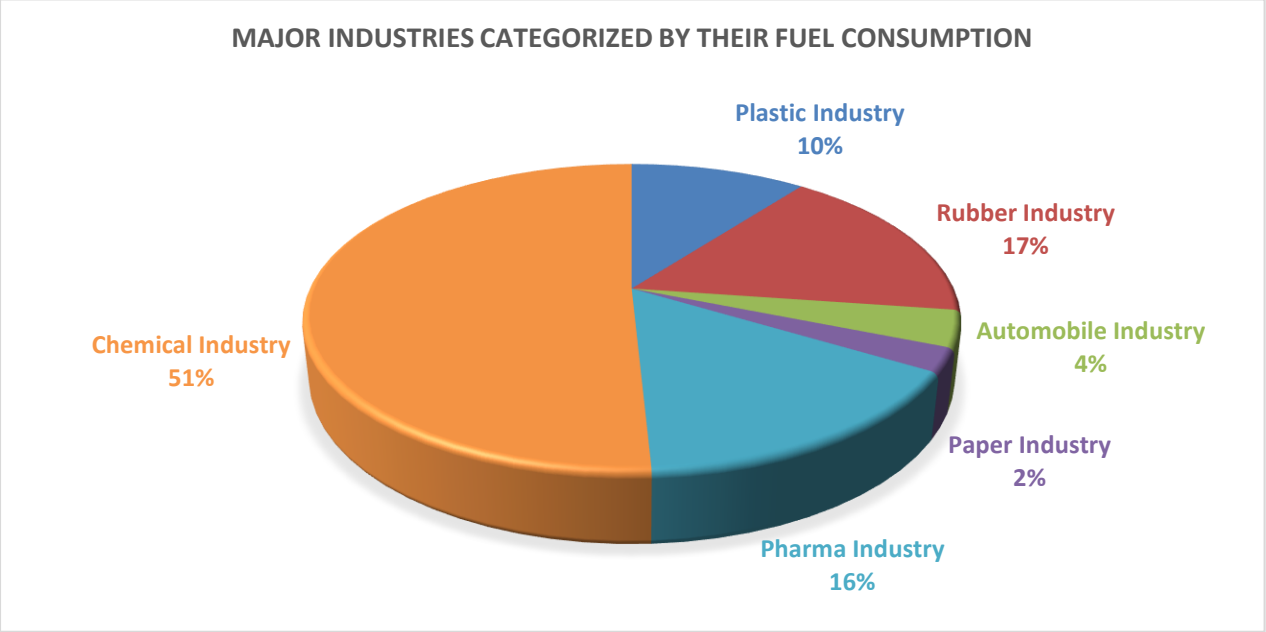


Figure 12 Major industries categorized by their fuel consumption[6]

4.2 Energy Efficiency Strategies in the Industry Sector

Strategy: Deepening of PAT Scheme

The Perform, Achieve and Trade (PAT) scheme, launched by the Bureau of Energy Efficiency (BEE) in 2012, is aimed at improving energy efficiency and reducing greenhouse gas emissions in energy-intensive industries. Puducherry, being one of the leading industrialized UTs in India, can benefit significantly from the deepening of the PAT scheme.[7]

The deepening of the PAT scheme can help Puducherry achieve its energy efficiency and emission reduction targets by incentivizing industries to adopt energy-efficient practices and technologies.

By increasing the coverage of industries under the PAT scheme, Puducherry can further unlock its potential for energy savings and emission reductions. This can not only contribute to meeting the UTs climate change goals but also lead to cost savings for the industries.

[5] CEA Report
[6] Annual Survey of Industries 2019-20
[7] BEE – PAT Cycle data

involved. Therefore, the deepening of the PAT scheme can be an effective tool for sustainable industrial development in Puducherry.

Scope Boundary

•Units in new sectors under PAT

Implementing Agency

•Bureau of Energy Efficiency(BEE) and SDA of Puducherry (REAP).

Current Policy In Place

• Perform, Achieve & Trade (PAT) Scheme

Saving Potential

Energy saving potential is estimated by calculating SEC for moderate and ambitious scenarios.

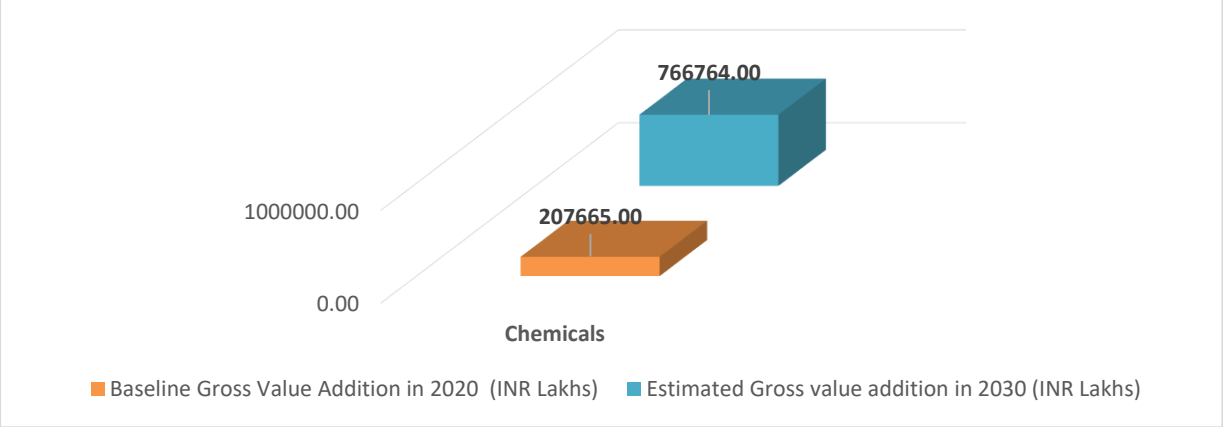


Figure 13 Production of PAT Industries 2020 vs Projected Production for FY 2030

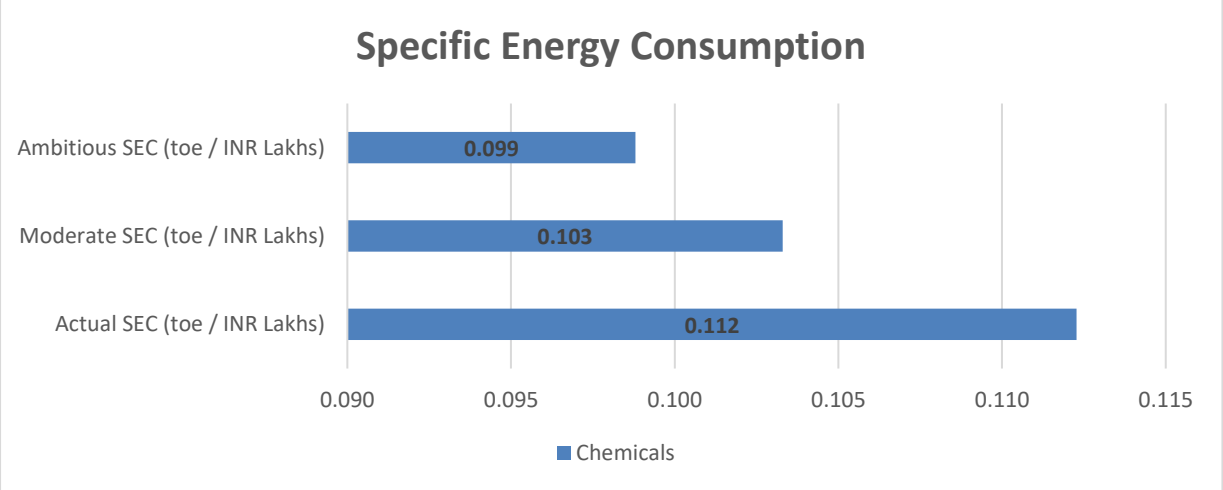


Figure 14 Specific Energy Consumption – Industry Sector

Action Plans

This section describes several action plans that can be implemented across the industry sector for this strategy. For each of the strategies, a short, medium and long-term period has been taken into consideration for actionable instruments.

S. No	Action Plan	Timeline	Estimated Investment (in lakhs)
1	Identification of new DCs in existing sectors	Long Term	36
2	Study to check possibility to reduce existing sectoral threshold energy consumption.	Long Term	15
3	Sectoral Energy Profiling of industrial sector at UT level	Long Term	12
	Total		63

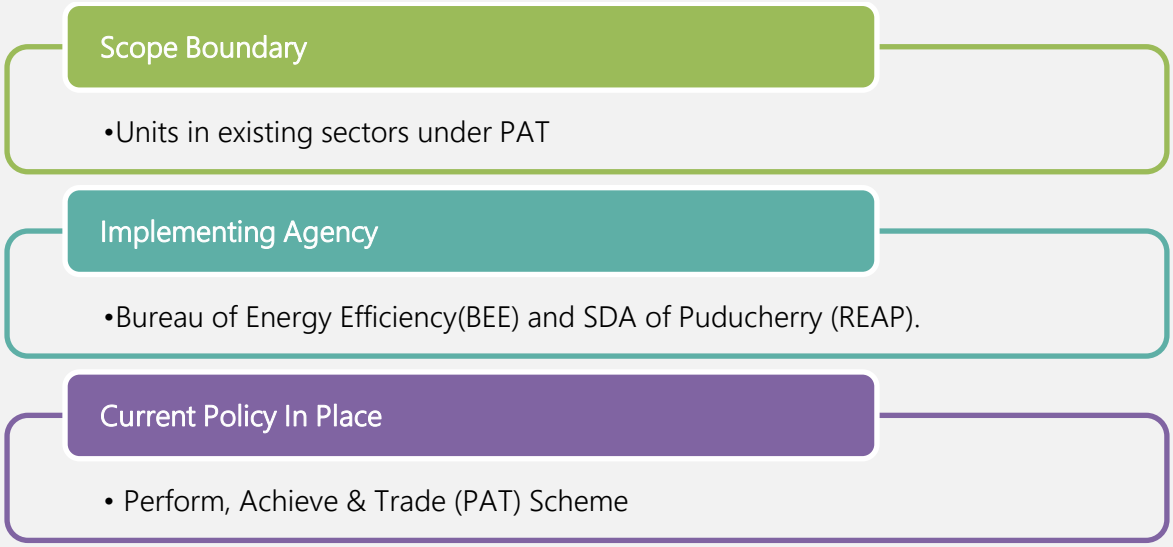
Strategy: Widening of Non - PAT Scheme

Widening of these industries aiming to improving energy efficiency and reducing greenhouse gas emissions in energy-intensive industries. Puducherry, being one of the leading industrialized UTs in India, can benefit significantly from the widening of the PAT scheme.[8]

The widening of these industries can help Puducherry achieve its energy efficiency and emission reduction targets by incentivizing industries to adopt energy-efficient practices and technologies.

By increasing the coverage of industries, Puducherry can further unlock its potential for energy savings and emission reductions. This can not only contribute to meeting the UTs climate change goals but also lead to cost savings for the industries.

involved. Therefore, the widening of the industries can be an effective tool for sustainable industrial development in Puducherry.[9]



[8] BEE – PAT Cycle data
[9] Annual Survey of Industries 2019-20

Saving Potential

Energy saving potential is estimated by calculating SEC for moderate and ambitious scenarios.

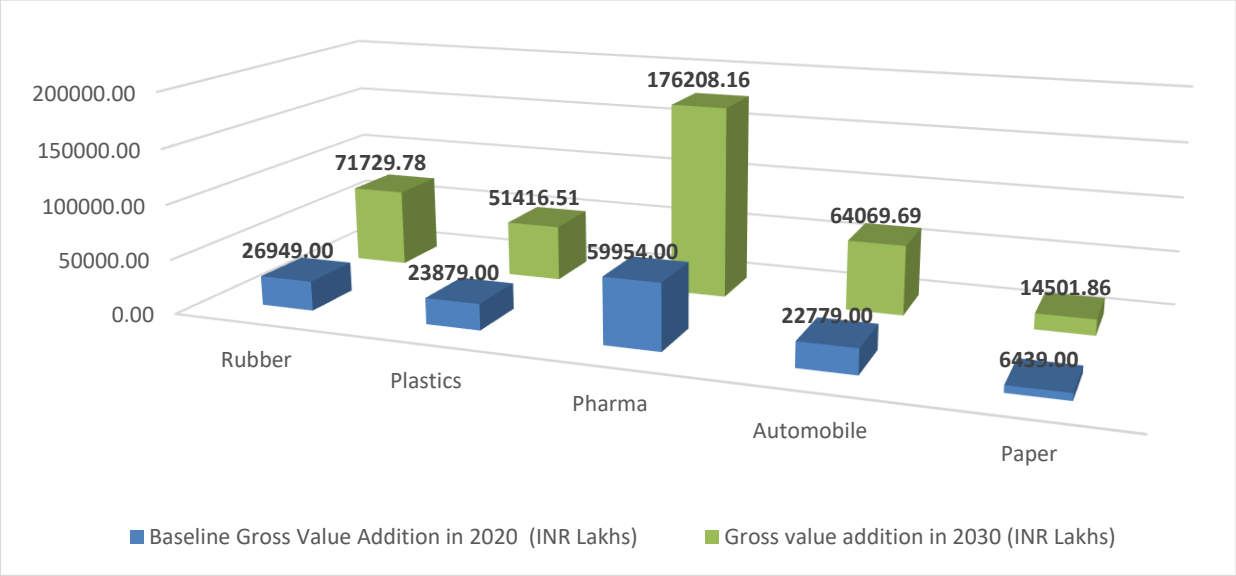


Figure 15 Production of Non-PAT Industries 2020 vs Projected Production for FY 2030

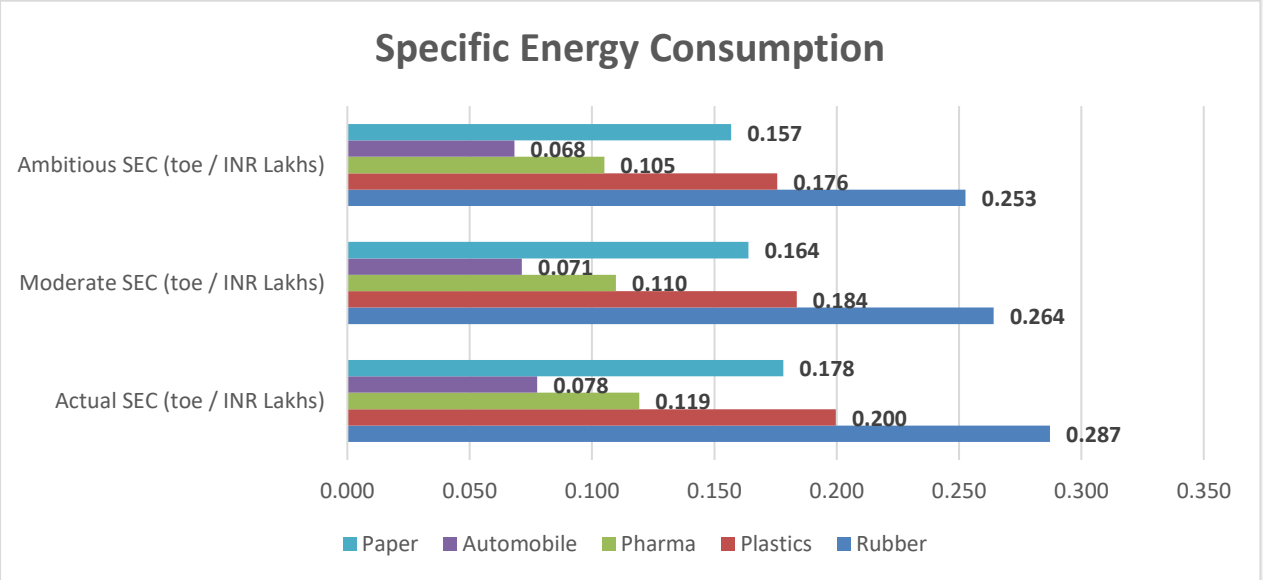


Figure 16 Specific Energy Consumption – Industry Sector

Action Plans

This section describes several action plans that can be implemented across the industry sector for this strategy. For each of the strategies, a short, medium, and long-term period has been taken into consideration for actionable instruments.

S. No	Action Plan	Timeline	Estimated Investment (in lakhs)
1.	Feasibility Study of new probable sectors (Rubber, Plastics, Pharma, Automobile, Pulp and Paper) to be included in PAT scheme	Short Term	15

S. No	Action Plan	Timeline	Estimated Investment (in lakhs)
2	Capacity Building of Energy managers and Energy Auditors in PAT DCs and new probable sectors for compliance with scheme and new technologies.	Short Term	12
3.	Sectoral Energy Profiling of industrial sector at UT level	Long Term	-
	Total		27

Strategy: Promotion of Green Rating of Industries

Through promoting the use of green rating practices by additional industries. By utilizing and implementing green grading in the industries, it will aid in the alignment of those sectors with environmental norms and standards.

Scope Boundary

- Sectors are Large, Small and Medium Industries like pharmaceutical, food and fisheries, ceramics, foundry, etc are considered based on energy consumption patterns of the industries, their contribution to the UT's economy, and their potential for energy efficiency improvements.

Implementing Agency

- Bureau of Energy Efficiency(BEE), Dept. of Science, Technology & Environment and Industries department and SDA of Puducherry (REAP).

Policy - Green rating is to be notified

- Incentive scheme for Green rating industries

Saving Potential

Energy saving potential is estimated by calculating SEC for moderate and ambitious scenarios.

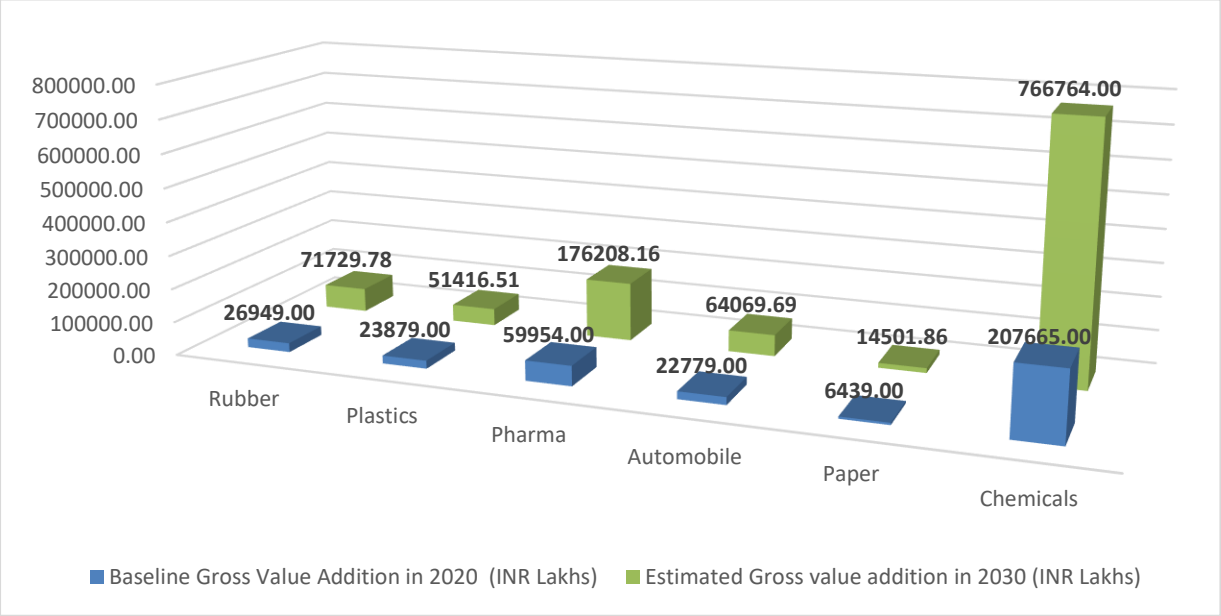


Figure 17 Production of Non-PAT Industries 2020 vs Projected Production for FY 2030

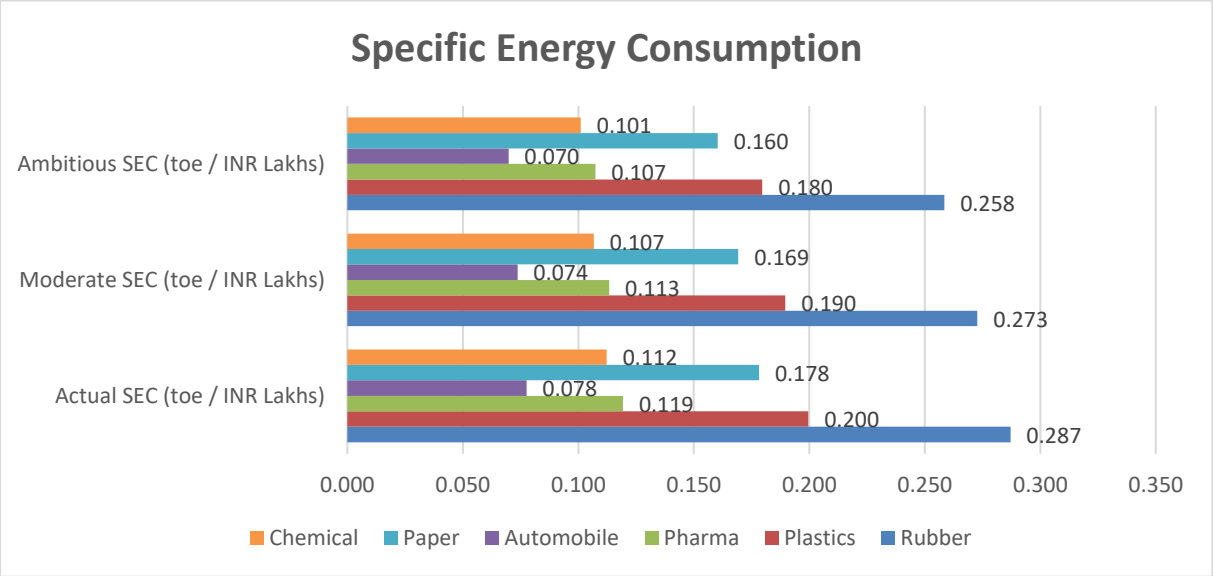


Figure 18 Specific Energy Consumption – Green rating industries

Action Plans

This section describes several action plans that can be implemented across the industry sector for this strategy. For each of the strategies, a short, medium, and long-term period has been taken into consideration for actionable instruments.

S. No	Action Plan	Timeline	Estimated Investment (in lakhs)
1.	Policy for incentivizing green rating of industries to be notified	Short Term	62.5
2	Capacity Building of green rating assessors and govt. officials	Short Term	12

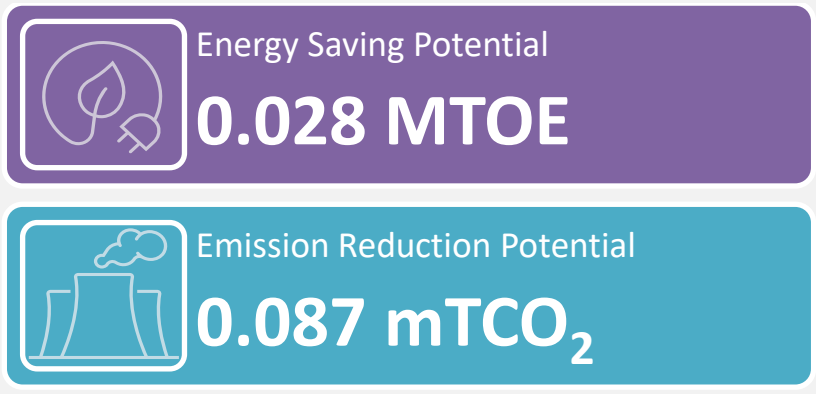
S. No	Action Plan	Timeline	Estimated Investment (in lakhs)
3.	Awareness and promotion of green company rating for industries	Short Term	18
	Total		92.5

4.3 Energy Saving Potential and Monitoring Mechanism

Energy saving target of the industry sector is 0.01694 MTOE and 0.02796 MTOE for moderate and ambitious scenarios FY2030 respectively as seen from Table 2.

Table 2 Summary of energy saving from the strategies.

Strategy	Energy Saving Potential (Moderate) in Mtoe	Energy Saving (Ambitious) in Mtoe
1. Deepening of PAT	0.00852	0.01278
2. Widening of PAT	0.00333	0.00499
3. Green rating of Industries	0.00509	0.01019



Following are the possible monitoring mechanisms for strategies in industry sector.

Table 3 Monitoring Mechanism - Industry

Policy Type	Monitoring Mechanism
Regulatory	The Electricity Department, Government of Puducherry is responsible for regulating the power sector in the U.T., including the implementation of energy policies for industries. It can monitor compliance with these policies through inspections, audits, and other enforcement measures.
Industry associations	Industry associations can play a key role in monitoring energy policies for their members.

SDA (State Designated Agency)	The REAP can monitor industry compliance with energy policies through data collection and analysis, as well as through partnerships with industry associations and other stakeholders.
Audits	Energy audits can be conducted by independent third-party providers to assess the energy consumption and efficiency of industrial facilities. These audits can help identify areas for improvement and track progress towards energy policy goals.
Reporting	Mandatory reporting requirements or through voluntary reporting programs that incentivize companies to disclose their energy use and emissions data.

CASE STUDY

INDUSTRY

Green rating industries

The case study depicts of one of the JK Tyre Industries rated as a green industry.

It shows the steps taken by the industry to become as green rated industry.

JK Tyre is seized of the need for sustainable growth and a dwindling stock of natural capital. In view of this, the company is committed to the following ten-natural capital commandments:

01

Reduce specific consumption of energy and water by 2-5% every year over the next ten years.

02

Reduce specific generation of waste and reduce the quantum of waste being directed to landfills by 2-5%every year over the next ten years.

03

Increase the use of renewables, including renewable energy, by 2-5% every year in place of non-renewable resources over the next ten years. The Company already generates about 39% of its total requirement of power through renewable resources.

04

Reduce specific greenhouse gas emissions and other process emissions by 2-5% every year over the next ten years and explore opportunities through Clean Development Mechanism (CDM) and other Carbon Exchange Programs.

06

Increase the share of harvested rainwater in the overall annual use of water by 2-5% every year over the next ten years.

07

Incorporate a comprehensive and holistic life cycle assessment criterion for evaluating new and alternativetechnologies and products.

08

Strive to adopt a green purchase policy; incorporate the latest clean technologies.

09

Take the lead in promoting and managing a product stewardship program by forging partnerships with businesses and communities.

05

Increase the use of recyclables and enhance the proportion of recyclable resources embedded in the product by 2-5% every year over the next ten years.

10

Reduce the depletion of natural capital, which is directly attributable to the Company's activities, products, and services by 2-5% every year over the next ten years. We also commit to attain these commandments in our pursuit to certifications like TS16949, ISO 9001, ISO 14001, OHSAS 18001, SA-8000, ISO- 50001, ISO-27001, Green Buildings,

Eco Labels Sustainability reporting and the like.

Source: Sustainability Report 2018-19, JK Tyre[10]

Incentives schemes by KSPCB

Implementation of the GreenCo rating will facilitate industries to achieve multiple benefits in saving natural resources, reduce pollution and achieve cost benefits. It will also provide industries a credible recognition for enhanced green performance.

KSPCB, in the process of encouraging the industries participating in the GreenCo rating system and will provide incentive and recognition to the GreenCo rated industries.[11]

One time Incentive as per the Table below will be given to the GreenCo certified industries.

Size / Rating	Micro, Small & Medium	Large CI-10 to 50 Cr	Large CI-50 to 100 Cr	Large CI-100 to 250 Cr	Large CI-250 to 1000 Cr	Large CI > 1000 Cr
Platinum	Rs.50,000	3,00,000	4,00,000	5,00,000	7,50,000	10,00,000
Gold		2,00,000	2,50,000	3,00,000	5,00,000	7,50,000
Silver		1,50,000	2,00,000	2,00,000	2,50,000	5,00,000
Bronze		75,000	1,00,000	1,00,000	1,50,000	2,50,000

Note:

1. One time Incentive as per the Table below will be given to the GreenCo certified industries.
    a. Capital Investment (CI) shall be as defined in Rule 32 of Karnataka Water Rules and Size of the industry shall be as per KSPCB norms.
    b. The GreenCo rating incentive scheme is operational from the financial year 2023-24.
    c. The procedure and guidelines for availing the incentives will be published by the Board separately.

2. Annual recognition for best 3 units in each category as above will be given annual awards at State Level function to be organized by the State Board and State Government.

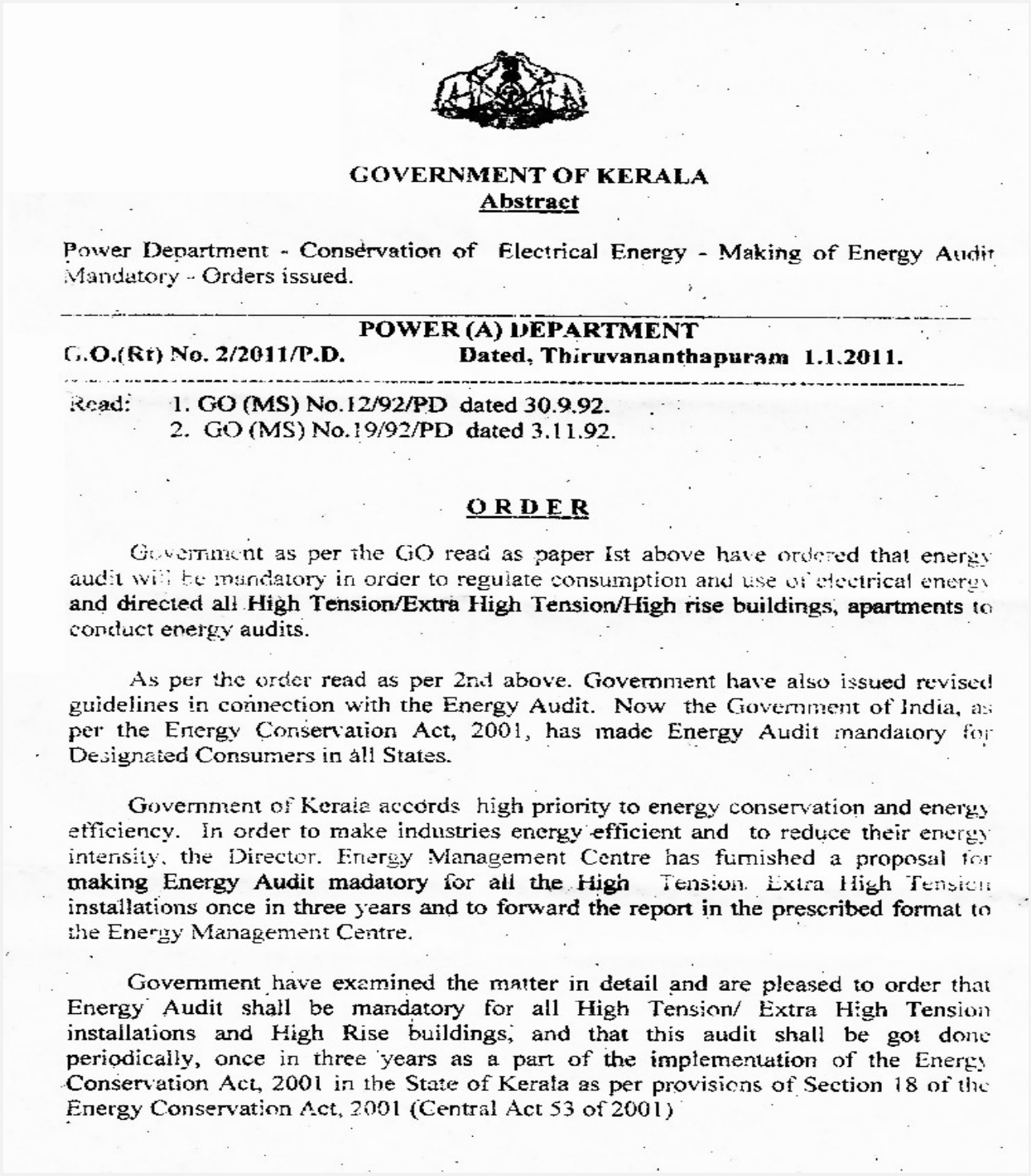
3. Exclusive mention of GreenCo rated companies in the website of KSPCB: The Board will prominently feature all the GreenCo rated companies in the State with their unique features in the KSPCB website to provide them publicity and recognition.

[10] Source: Sustainability Reports: https://jktyre.com/JK%20Tyre%20Sustainable%20190320.pdf
[11] Source: KSPCB – Green rating of Industries in Karnataka

Mandatory Energy Audit

As per order issued by Government of Kerala, Kerala State Electricity Board (KSEB), notified the policy, Mandatory Energy Audit shall be conducted for the reduction of energy consumption for HT/EHT consumers in the state.[12]

Thus, the same can be replicated in the U.T. of Puducherry



GOVERNMENT OF KERALA
Abstract

Power Department - Conservation of Electrical Energy - Making of Energy Audit Mandatory - Orders issued.

POWER (A) DEPARTMENT

G.O.(Rt) No. 2/2011/P.D. Dated, Thiruvananthapuram 1.1.2011.

Read: 1. GO (MS) No.12/92/PD dated 30.9.92.
2. GO (MS) No.19/92/PD dated 3.11.92.

ORDER

Government as per the GO read as paper Ist above have ordered that energy audit will be mandatory in order to regulate consumption and use of electrical energy and directed all High Tension/Extra High Tension/High rise buildings, apartments to conduct energy audits.

As per the order read as per 2nd above. Government have also issued revised guidelines in connection with the Energy Audit. Now the Government of India, as per the Energy Conservation Act, 2001, has made Energy Audit mandatory for Designated Consumers in all States.

Government of Kerala accords high priority to energy conservation and energy efficiency. In order to make industries energy efficient and to reduce their energy intensity, the Director, Energy Management Centre has furnished a proposal for making Energy Audit madatory for all the High Tension, Extra High Tension installations once in three years and to forward the report in the prescribed format to the Energy Management Centre.

Government have examined the matter in detail and are pleased to order that Energy Audit shall be mandatory for all High Tension/ Extra High Tension installations and High Rise buildings, and that this audit shall be got done periodically, once in three years as a part of the implementation of the Energy Conservation Act, 2001 in the State of Kerala as per provisions of Section 18 of the Energy Conservation Act, 2001 (Central Act 53 of 2001)

[12] Source: Kerala – Gazette Notification, Govt. of Kerala
www.keralaenergy.gov.in/images/pdf/Gazette%20Notification%20-%20EC%20rules.PDF

The Energy Management Centre will implement the Energy Audit scheme as per the terms proposed by them.

By Order of the Governor,

Paul Antony
Principal Secretary to Government

To

The Director General, BEE, Ministry of Power, Government of India (with C/L)
The Director, Energy Management Centre, Thiruvananthapuram
The Secretary, Kerala State Electricity Board , Vydhuthi Bhavan, Pattom, Thiruvananthapuram
The Principal Accountant General (Audit)/ Kerala, Thiruvananthapuram.
The Accountant General(A&E) Kerala, Thiruvananthapuram
GA(SC) Department (vide No.5525 dated 29.12.2010)
Stock file/Office copy.

Forwarded/By Order

Section Officer

5. FOCUS SECTOR 2: TRANSPORT

5.1 Overview

Puducherry has a total area of 490 Sq. Kms. It is bounded on Tamil Nadu on it South, North, and West side and on the East by Bay of Bengal. It comprises of Pondicherry has 294 Sq. Kms of area, Karaikal has 157 Sq. Kms of area, Yanam has 30 Sq. Kms of area and Mahe has 9 Sq. Kms of area. [13]

In terms of vehicle categories, Puducherry has a significant number of two-wheelers, followed by cars and commercial vehicles. As per the latest statistics, the U.T. has over 13 lakhs registered vehicles, out of which 83% are two-wheelers, 1% are three-wheelers 14% are four-wheelers, and the remaining 3% are commercial vehicles.

The most commonly used fuel for vehicles in Puducherry is petrol, followed by diesel and LNG (Liquified natural gas). The U.T. also has a few electric vehicle charging stations in major cities.

However, In Puducherry, the number of registered vehicles has increased significantly over the past decade, with over 13 lakhs registered vehicles as of 2021. This increase in vehicles has led to a corresponding rise in air pollution, particularly in urban areas. By increasing the adoption of electric vehicles, Puducherry can reduce its carbon footprint and improve air quality. Additionally, the U.T. has set a target of achieving 100% electrification of the public transport system by 2030, and increasing the electrification of road transport will be crucial in achieving this goal.

5.2 Energy efficiency strategies in the transport sector

Strategy: Conversion of vehicle fleet into EVs by setting UT's more aggressive target

Electric vehicles are significantly more efficient than their petrol or diesel counterparts. While electric vehicles can convert around 60% of the electrical energy from the grid to power the wheels, petrol or diesel cars can only convert 17%-21% of the energy stored in the fuel to the wheels, resulting in a wastage of around 80%.

Thus, electrification of road transport is a good way to reduce energy consumption and emissions, particularly as the grid becomes greener with increased use of renewables.

[13] Puducherry at a glance 2022 - https://statistics.py.gov.in/puducherry-glance-2022

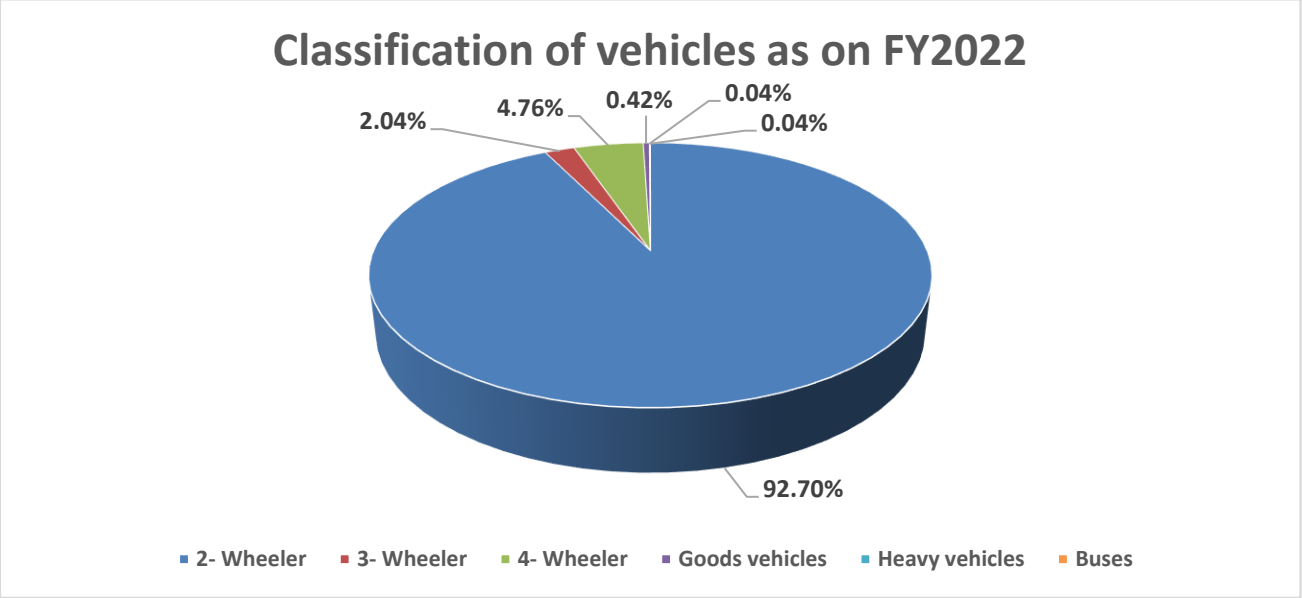


Figure 19 Classification of vehicles as on FY2022

Despite being one of the fastest growing electric vehicle markets in India with favourable demand-side incentives through their EV policy and an established charging infrastructure, Puducherry still has a long way to go to transition from ICE vehicles to electric vehicles, with only 0.10% of registered vehicles being electric.

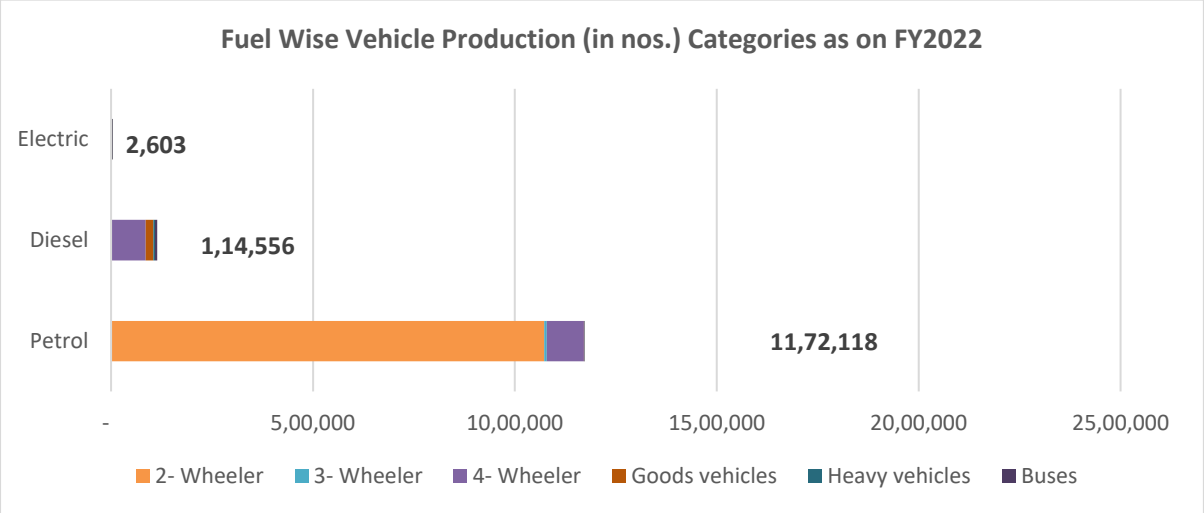


Figure 20 Fuel Wise Vehicle Categories as on FY2022

Projected number of vehicles for FY2030 is estimated by projecting electric vehicles currently.

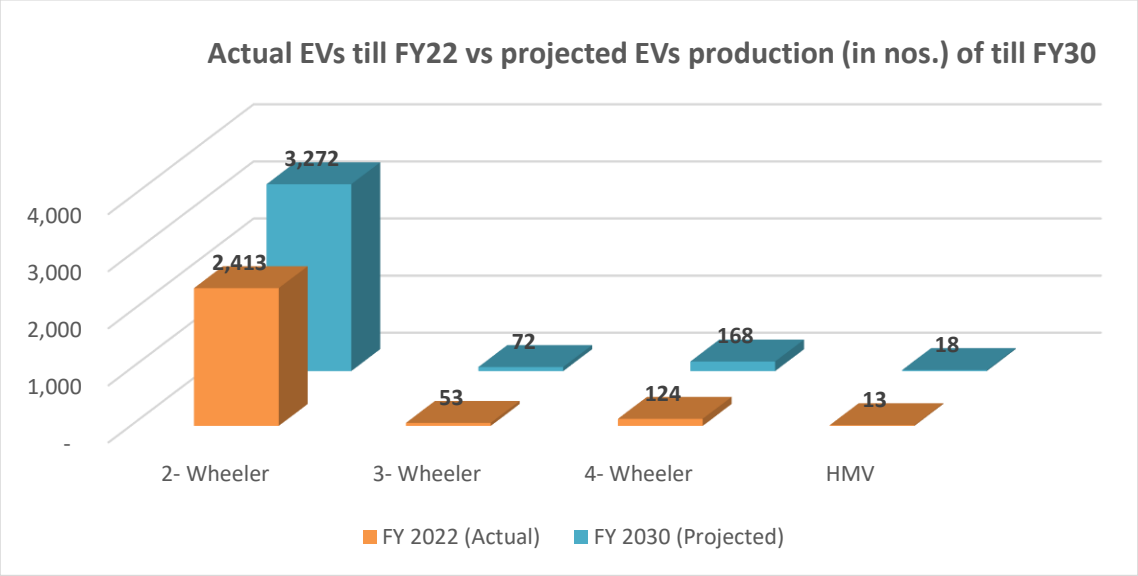


Figure 21 Actual EVs VS Projected EVs

The strategy and its implementation are explained below.

Scope Boundary

- Two-wheelers, three-wheelers, four-wheelers, buses and heavy vehicles.

Implementing Agency

- Transport Department, DISCOMs, PSUs and private sector, SDA - REAP

Current Policy In Place

- National Electric Mobility Mission Plan 2020 (NEMMP)

Saving Potential

By increasing the share of EVs in the vehicle stock of Puducherry with 1.76 lakh EVs in moderate scenario and 2.64 Lakh EVs in ambitious scenario by 2031, additionally 2500 charging stations and battery swapping infrastructure by 2026 and 5000 charging stations and battery swapping infrastructure by 2031, with Level-1, Level-2 and Level-3 (DC) chargers across all cities will result into energy saving of 1.08 MTOE by FY 2030.

Table 4: Energy Saving Potential - Transport

Particulars	Moderate Scenario for 2030	Ambitious Scenario for 2030
Energy Saving Potential (MTOE)	0.0313	0.0531

Particulars	Moderate Scenario for 2030	Ambitious Scenario for 2030
GHG Emission Reduction Potential ($MtCO_2$)	0.0979	0.1661

Action Plans

This section describes several action plans that can be implemented across the transport sector for this strategy. For each of the strategies, a short, medium, and long-term period has been taken into consideration for actionable instruments.

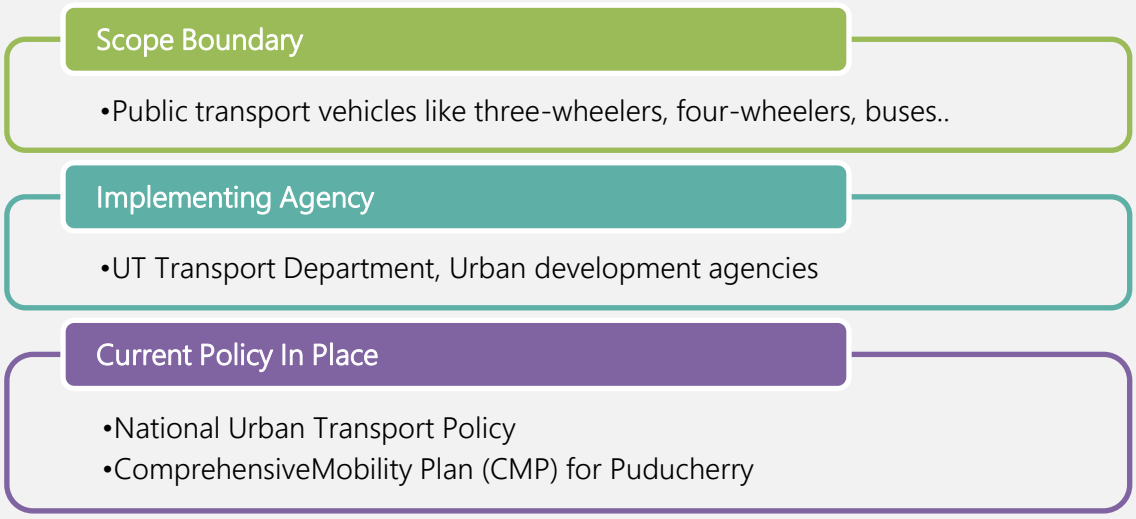
Policy Type	Action Plan	Timeline	Estimated Investment (in lakhs)
Awareness & Capacity Building	1. Awareness on Standard & Labelling Program for Tyres	Short Term	10
	2. Awareness on Energy Efficiency Program on High Energy Lithium-Ion Traction Battery Packs and Systems.	Short Term	-
Technological Intervention	1. Combined Charging Systems (CCS Standard)	Long Term	10
	2. Charging stations based on open access	Long Term	-
	3. Pilot projects on Hydrogen Fuel Cell Vehicles	Long Term	50
	4. Pilot projects on Battery Swapping stations in major cities	Long Term	-
	Total		70

Strategy: Facilitating adequate public transport infrastructure

Puducherry has an extensive public transportation system that includes buses, trains, and auto-rickshaws. The U.T. owned Puducherry Road Transport Corporation (PRTC) operates buses that connect various cities and towns within the UT, as well as neighbouring states. PRTC has a fleet of over 140 buses and operates over 55 routes across the state. PRTC carries around 2 lakh passengers per day.

Cars and two-wheelers are the major contributors to the total emissions produced by all vehicles in all cities. It is evident that more public transport vehicles would decrease the total emission produced on the road.

The strategy and its implementation are explained below.



Saving Potential

According to the Ministry of Urban Development report on Public Transit, cars and two-wheelers consume less than 50% of the total fuel consumption by all modes, however the total emission produced by these two modes is more than 60%. This is due to high level of congestion in the cities resulting in slow speeds and thus higher emissions. The public transport system is the most effective way to reduce the number of vehicles as well as the total emissions on the road. This is also the only way to a more equitable allocation of road space with people, rather than vehicles.
The energy saving potential is estimated by categorizing districts of the U.T. based on the population, thus arriving on total fuel consumption per day by vehicles with and without public transport per day.

Table 5 Savings potential adequate public transport

			Fuel consumption (kL/day)		Savings Potential	
Sr No.	Population	No. of Urban Agglomerations	Without Adequate PT	With Adequate PT	kL/day	MTOE/year
1.	<5 Lakhs	2	18	17	2	0.00
2.	5-10 Lakhs	1	559	502	57	0.02
3.	10-20 Lakhs		2617	2112	0	0.00
4.	20-40 Lakhs		2802	2099	0	0.00
5.	40-80 Lakhs		37164	38395	0	0.00
6.	>80 Lakhs		38395	37163	0	0.00
	TOTAL					0.02

0.0049 MTOE saving is estimated in moderate scenario and 0.0073 MTOE under ambitious scenario by considering 70% of the total saving potential and 100% saving potential respectively.

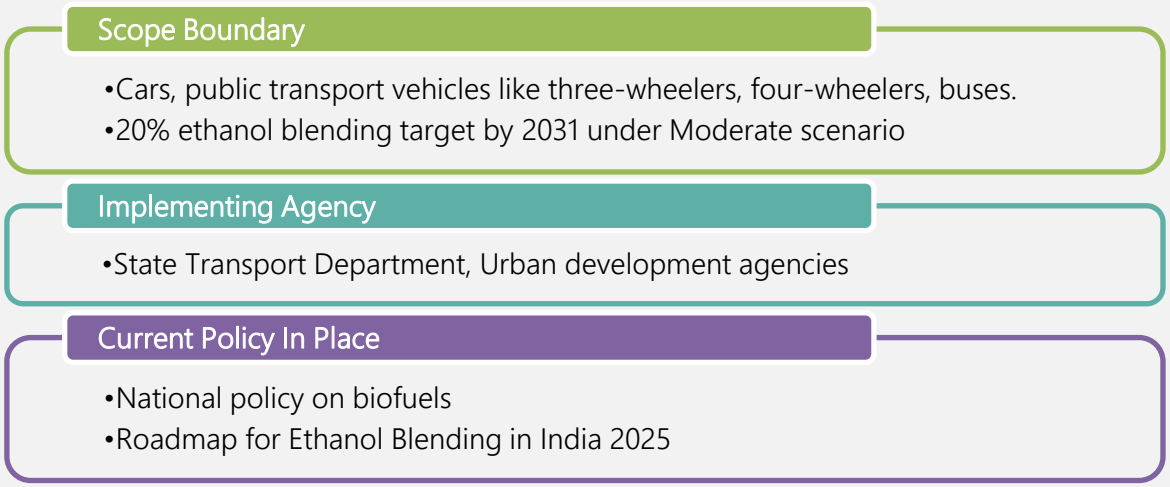
Table 6: Energy Saving Potential - Facilitating Public Transport

Particulars	Moderate Scenario for 2030	Ambitious Scenario for 2030
Energy Saving Potential (MTOE)	0.0049	0.0073
GHG Emission Reduction Potential ($MtCO_2$)	0.0153	0.0229

Strategy: Ethanol Blending Program

The ethanol blending policy of fuels can have a significant impact on the economy and environment of Puducherry. By blending ethanol with petrol and diesel, the U.T. can reduce its dependence on imported crude oil and promote the use of cleaner fuels. According to the Ministry of Petroleum and Natural Gas, India's ethanol blending program has resulted in a reduction of 7.9 million tonnes of CO2 emissions in 2020-21.

In fact, the central government has set a target of achieving 20% ethanol blending in petrol and 5% in diesel by 2025, which will create an additional demand of 1,000 crore litres of ethanol.



Saving Potential

The saving potential is estimated based on following assumptions.

Table 7 Saving Potential of Ethanol Blended Program

	FY2025		FY 2030	
Blending of fuel	Moderate	Ambitious	Moderate	Ambitious
Utilization of Vehicles	80%	80%	80%	80%
Fuel Blending %age	20%	30%	20%	30%
Already Blending in Fuel%	10%	10%	10%	10%
Incremental Fuel Blending	10%	20%	10%	20%
Amount of fuel blended (Mn Lit)	45	91	55	110

	FY2025		FY 2030	
Blending of fuel	Moderate	Ambitious	Moderate	Ambitious
GCV of Oil (Kcal/Kg)	10,350	10,350	10,350	10,350
Density (Kg/lit)	0.85	0.85	0.85	0.85
Energy Saved (MTOE)	0.04	0.08	0.05	0.10
Emission Factor for Oil (KgCO2/Kg)	3.13	3.13	3.13	3.13
Oil Requirement in Mn Kg	53.44	106.89	64.65	129.29
Emission Avoided (Mn TCO2)	0.17	0.33	0.20	0.40

Table 8: Energy Saving Potential – Ethanol Blending Program

Particulars	Moderate Scenario for 2030	Ambitious Scenario for 2030
Energy Saving Potential (MTOE)	0.0135	0.0193
GHG Emission Reduction Potential ($MtCO_2$)	0.0423	0.0604

Action Plans

This section describes several action plans that can be implemented across the transport sector for this strategy. For each of the strategies, a short-, medium-, and long-term period has been taken into consideration for actionable instruments.

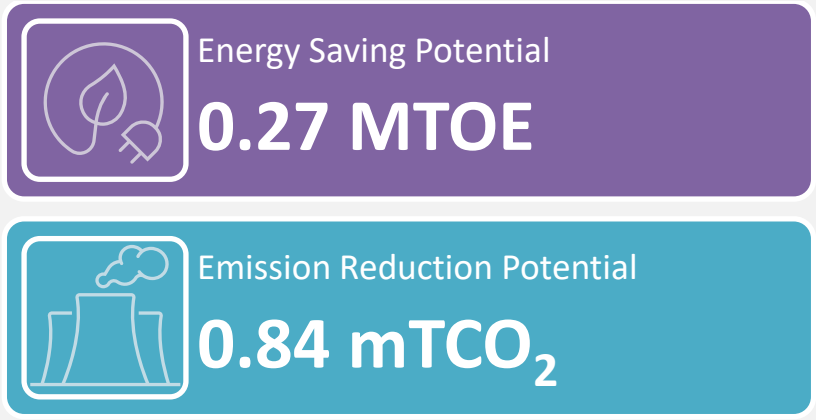
S. No	Action Plan	Timeline	Estimated Investment (in lakhs)
1	1. Support incentive on Biofuel production plants 25% subsidy for MSMEs (Cap of 5 Crore)	Long Term	10
	Total		10

5.3 Energy saving potential & monitoring mechanism.

Energy saving potential of the transport sector is 0.09 MTOE and 0.18 MTOE for moderate and ambitious scenarios FY2030 respectively.

Table 9 Summary of energy saving from the strategies - Transport

Strategy	Energy Saving Potential (Moderate)	Energy Saving (Ambitious)
1. Ethanol blending	0.09	0.18



Following are the monitoring mechanisms that could be implemented to track the progress and effectiveness of the policies in the transport sector in Puducherry:

Table 10 Monitoring Mechanism - Ethanol Blending

Aspects	Monitoring Mechanism
POLICY	• Promote quick transition to EVs • Incentive for consumers • Charging station infrastructure development in highways • Minimum RE integration for EV charging stations • Establish ecosystem to retrofit existing ICE vehicles to EVs • Mandatory EV purchase for Government use, while purchasing new vehicles • Adoption of E buses for city travel by the UT transport • Adoption of Battery Swapping for 2 and 3 wheelers • Bio diesel and CBG powered buses by UT transport. • Pilot projects on Hydrogen Fuel Cell Vehicles & filling stations
AWARENESS & CAPACITY BUILDING	•Awareness on EVs, its lower running costs •Awareness on Standard & Labelling Program for Tyres •Awareness on Energy Efficiency Program on High Energy Lithium-Ion Traction Battery Packs and Systems •Awareness on energy efficient driving and best O&M practices

TECHNOLOGY INTERVENTION	• Battery swapping • Charging stations based on open access • Hydrogen Fuel Cell Vehicles & Filling stations • Pantograph charging

CASE STUDY

TRANSPORT

Adoption of EVs in commercial vehicles

As EVs represent a significant addition to the load and energy demand at the distribution level compared to the transmission level, a case study is performed at DISCOM level. The case study intends to evaluate the impact of EV penetration at distribution companies (DISCOMs) in Delhi. Due to ease in data availability, the four major DISCOMs of Delhi has been considered i.e., BSES Yamuna Power Limited (BYPL), BSES Rajdhani Power Limited (BRPL), Tata Power Delhi Distribution Limited (TPDDL) and North Delhi Municipal Corporation (NDMC).

Data and Methodology

The electricity data is collated for the year 2018-19. Load curve data for DISCOMs are taken from State Load Despatch Centre Delhi. Other data is retrieved from 2018-19 tariff order of DISCOMs. The rated charger power and battery capacity are taken from Ministry of Power (MoP) and Faster Adoption and Manufacture of (Hybrid and) Electric Vehicles (FAME) guidelines. The excel based model is used to study the EV charging pattern and evaluate the impact on Energy Demand, Peak Power, and contribution to Actual Cost of Supply (ACoS)

Assumptions

The study has taken a baseline of 1100 EVs where 100 are electric buses to study the peak and energy demand. The remaining 1000 EVs is sub-divided into two-wheeler (2W), three-wheeler (3W) and four-wheeler (4W) category using the proportion in the Niti Aayog-RMI study. It is assumed that bus charging for intra-city transport will happen at the depot during night time. For other EV categories, both daytime and night time charging is accounted for. A certain percentage has been allocated between public charging during day and home charging at night maintaining the overall assumption that the bulk of charging would happen at home. It is assumed that the depth of discharge of the battery is only 70%, and corresponding charging energy demand is evaluated with an efficiency factor of 95%. The battery sizes and capacity of chargers are assumed according to market norms and government guidelines.

Electric Vehicle Charging Scenario

The charging pattern of the EV could vary according to the convenience of the EV user. Hence three EV charging scenarios have been considered to study the EV charging pattern, based on the most extreme, most probable, and average charging power requirement.

- Scenario I: If all vehicles are starting charging at the same time.
- Scenario II: If 50% of vehicles are starting charging at the same time.

- Scenario III: If 30% of vehicles are starting charging at the same time.

EV charging for 2W, 3W and 4W categories both at public charging stations as well as at residences in Scenario I, II and III. 4W charging takes more time in residences compared to 2W and 3W category due to the slow charging process of larger battery. In case of public charging stations, 4W contributes the maximum to power demand under all the three scenarios. Observably, the charging power and energy demand increase is highest at night in all three cases.[14]

Battery Swapping

Battery swapping has the potential to enhance the attractiveness of electric mobility by addressing both the early market purchase price disparities with conventionally powered vehicles and, importantly, the recharging time challenges associated with electric vehicles (EVs). For light-duty vehicles such as electric two-wheelers (E2Ws), a depleted battery can be swapped with a fully charged one at a swap station in just a few minutes.

E2Ws produce zero tailpipe emissions and make clear sense for the Indian market. Analysis in the working paper that follows shows that gasoline-powered two-wheelers are the costliest to own and operate in India in the long-term at every level of utilization even when the cost of gasoline is extremely low at INR 65 per litre. Additionally, because of the greater utilization of each battery in the swapping model, swappable batteries reach their end of life earlier than batteries used by a single EV owner, and this enhances the potential for faster rollout of more advanced battery technologies as they emerge.

The EV ecosystem in India is still at a nascent stage, and because EV technologies are rapidly evolving worldwide, many in the industry who might consider engaging with the potential of the battery-swapping business model are waiting for additional signals from the government. The International Council on Clean Transportation (ICCT), with support from NITI Aayog, explored the landscape of battery swapping for E2Ws in India and undertook quantitative analysis to ascertain the impact of various parameters on the total cost of ownership (TCO). The research suggests strategy frameworks to spur battery swapping in India.

Given that future reductions in battery price would undermine one of the major premises underlying the battery-swapping model—that it significantly defrays the upfront cost of purchasing the vehicle—early policy in India would do well to focus on the core benefits of battery swapping that are less likely to change in the near and medium term, and to prioritize standards setting and similar actions that are most effectively handled by government. We suggest an emphasis on (a) the time benefit of avoiding point charging and (b) how stakeholders, especially battery swapping operators (BSOs), could be supported in maintaining best practices for operational safety and end-of-life care.[15]

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[14] Journal – Alliance for Energy Efficient Economy
https://regridintegrationindia.org/wpcontent/uploads/sites/14/2019/11/10C_4_RE_India19_125_paper_Sasidharan_Chandana.pdf

[15] Niti Aayog – Battery Swapping for Electric Two Wheelers

6. FOCUS SECTOR 3: BUILDINGS

6.1 Overview

In Puducherry, the residential and commercial sector consumed 0.16 MTOE which accounted for 19.38% of total energy for FY 2020. The adoption of energy-efficient building practices is critical for reducing energy consumption and greenhouse gas emissions in Puducherry. Despite the slow adoption of ECBC standards in the U.T., there is a significant potential for energy savings through various strategies such as building envelope improvements, energy-efficient lighting systems, high-efficiency HVAC systems, and the use of renewable energy sources. The implementation of these strategies requires strong government support, stakeholder engagement, and effective policies to incentivize energy-efficient building practices.

6.2 Energy efficiency strategies in the buildings sector

Strategy: Mandatory Eco Niwas Samhita for Residential Buildings

Eco Niwas Samithi (ENS) is a program launched by the Ministry of Power to promote energy efficiency in residential buildings. The importance of ENS for energy efficiency lies in its potential to reduce energy consumption and greenhouse gas emissions, which are major contributors to climate change. By promoting energy-efficient practices in residential buildings, ENS can help reduce the demand for energy and promote the use of renewable energy sources. This, in turn, can help in achieving the country's goal of reducing its carbon footprint and mitigating the impact of climate change.

Scope Boundary

- ENS applies to "Residential buildings" with plot area ≥ 500m^2. The policy applies to new residential buildings, including single-family homes, multi-family buildings, and gated communities.
- The policy provides guidelines and specifications for energy-efficient building design, construction, and operation.
- The policy covers various aspects of building design and construction, such as orientation, insulation, lighting, ventilation, and renewable energy systems.

Implementing agency

- Renewable Energy Agency (REAP)

Current Policy In Place

- Lack of policy

Energy Saving Potential

The saving potential for FY2030 is 0.0075 MTOE which is estimated by calculating energy saving per household (kWh/household) which is then multiplied with the projected households for FY2030 for ambitious scenarios. Similarly, the GHG saving potential for this strategy is 0.0023 $MtCO_2$.

Table 11: Energy Saving Potential – Eco Niwas Samhita

Particulars	Moderate Scenario for 2030	Ambitious Scenario for 2030
Energy Saving Potential (MTOE)	0.0024	0.0075
GHG Emission Reduction Potential ($MtCO_2$)	0.0074	0.0023

Action Plans

This section describes several action plans that can be implemented across the residential sector for this strategy. For each of the strategies, a short-, medium-, and long-term period has been taken into consideration for actionable instruments.

S. No	Action Plans	Timeline	Estimated Investment (in lakhs)
1	Notification of ECBC & ENS in U.T. (Currently in draft phase and not yet notified)	Long Term	-
2	Development and maintenance of ECBC & ENS compliance portal	Short Term	5
3	Market Outreach for ECBC compliant Products, Radio Jingles, Social Media Awareness	Long Term	3
4	Pilot project investment for Super ECBC as case studies (initial 20 Buildings)	Short Term	100
5	Home Energy Auditor Training, compliance structure and rebates on energy savings for first few residential projects	Short Term	-
6	Capacity Building of Architects & Building Professionals	Long Term	8
	Total		116

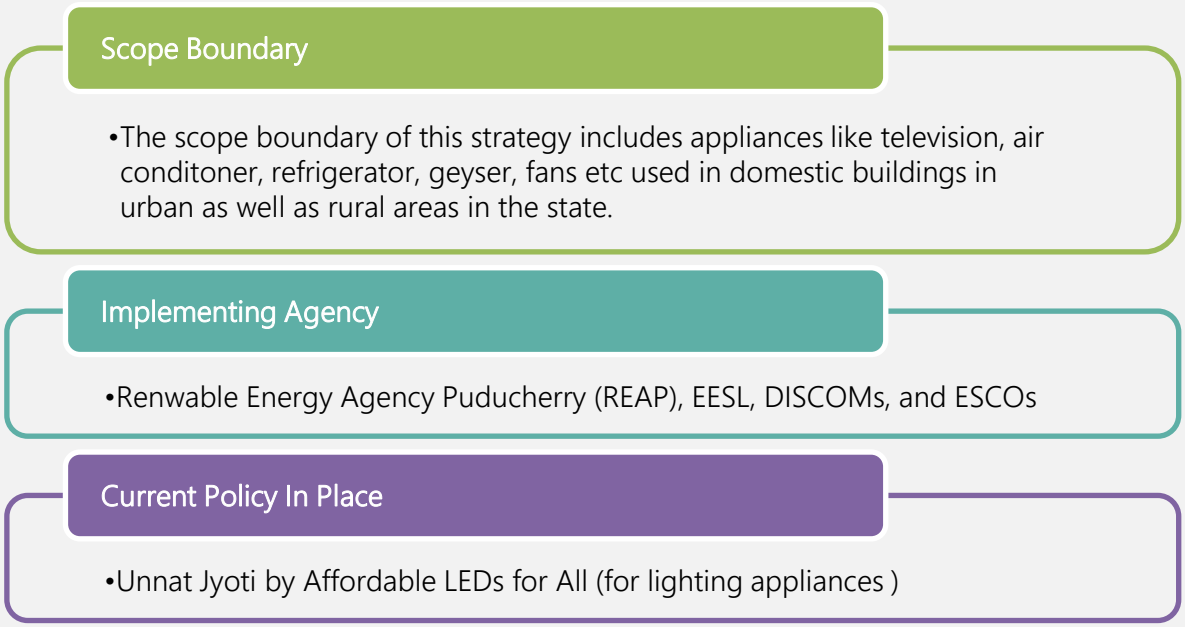
Strategy: Energy efficient lighting & appliances (including star labelled) programmes in residential & commercial buildings

The Bureau of Energy Efficiency (BEE) in India has implemented a standard and labelling program to promote the use of energy-efficient appliances. Under this program, old and inefficient appliances are encouraged to be replaced with new ones that meet the minimum energy performance standards (MEPS) set by the BEE.

The labels help consumers make informed choices, thereby reducing energy consumption and costs. In the context of domestic buildings, the S&L Programme can significantly reduce energy consumption by promoting the use of energy-efficient appliances, lighting, and building materials.

This, in turn, will help in mitigating greenhouse gas emissions, reducing energy bills for consumers, and promoting sustainable development.

The implementation of the strategy is explained below:



Saving Potential

The saving potential is estimated by assuming 30% of appliances will be replaced with efficient appliances in moderate scenario and 50% appliances will be replaced under ambitious scenario.

By considering replacement of appliances as shown in Fig. 7, 0.197 MTOE saving potential can

Table 12: Energy Saving Potential - Star labelled Program for buildings

Particulars	Moderate Scenario for 2030	Ambitious Scenario for 2030
Energy Saving Potential (MTOE)	0.0072	0.0168
GHG Emission Reduction Potential ($MtCO_2$)	0.0225	0.0526

Action Plans

This section describes several action plans that can be implemented across the residential sector for this strategy. For each of the strategies, a short-, medium-, and long-term period has been taken into consideration for actionable instruments.

Policy Type	Action Plan	Timeline	Estimated Investment (in lakhs)
Awareness & Capacity Building	1. Energy Efficient Technology Workshops for capacity building of Technology Suppliers and Professionals	Short Term	8
	2. Home Energy Auditor Training.	Short Term	-
Subsidy	3. DSM Schemes through DISCOM for energy efficient appliances such as BLDC fans, AC	Long Term	500
	Total		508

Strategy: Incentive for green rated buildings

Green buildings rating in India incorporates various features such as energy-efficient lighting, heating, ventilation, and air conditioning systems, and use renewable energy sources such as solar and wind power.

Scope Boundary

- Government and Commercial Buildings in the state, Residential and Commercial buildings as well as retrofitting of old buildings

Implementing Agency

- Renwable Energy Agency Puducherry (REAP),

Current Policy In Place

- Currently there is a lack of policy

Saving Potential

As per the housing census data, commercial buildings are further divided into offices, schools, hotels, lodges, factories, etc. The total number for each of the category in the U.T. is projected to FY2025 and FY 2030 and 1% penetration is assumed for moderate scenario and 2% for ambitious scenario for both FY2025 and FY2030

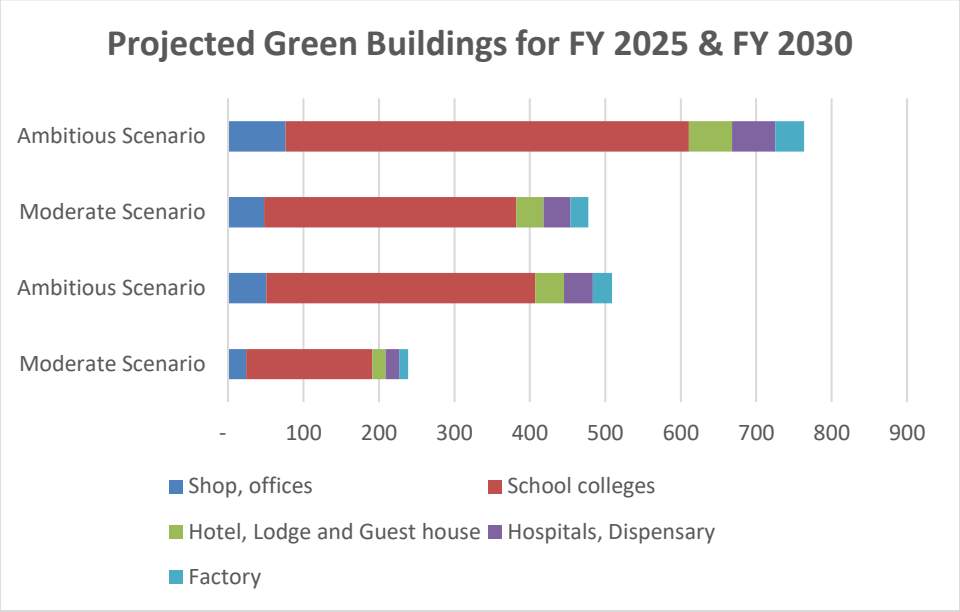


Figure 22 Projected Green Buildings

Table 13: Energy Saving Potential - Green rated buildings

Particulars	Moderate Scenario for 2030	Ambitious Scenario for 2030
Energy Saving Potential (MTOE)	0.0007	0.0017
GHG Emission Reduction Potential ($MtCO_2$)	0.0022	0.0052

Action Plans

This section describes several action plans that can be implemented across the commercial sector for this strategy. For each of the strategies, a short-, medium-, and long-term period has been taken into consideration for actionable instruments.

Policy Type	Action Plan	Timeline	Estimated Investment (in lakhs)
Awareness & Capacity Building	1. Encouraging Green Education	Short Term	5
Subsidy	1. Incentives (Rebate in property Tax Additional FAR, reduction in stamp duty and faster environmental clearance for upcoming, green-rated building projects) 2. Transformation of government buildings to Net-Zero 3. Incentive policy support to encourage net zero buildings	Long Term	505
	Total		510

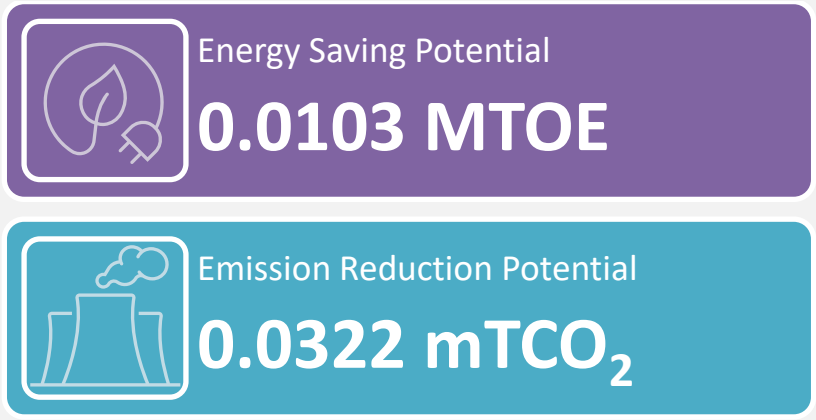
6.3 Energy saving potential & monitoring mechanism

Energy saving potential of the building sector is 0.0103 MTOE and 0.026 MTOE for moderate and ambitious scenarios FY2030 respectively as seen from Table 14

Table 14 Summary of energy saving from the strategies - Buildings

Strategy	Energy Saving Potential (Moderate)	Energy Saving (Ambitious)
1. Implementation of ENS-Residential buildings	0.0024	0.0075
2. Deepening of S&L in domestic buildings	0.0072	0.0168

Strategy	Energy Saving Potential (Moderate)	Energy Saving (Ambitious)
3. Green Rating	0.0007	0.0017



Following are the monitoring mechanisms that could be implemented to track the progress and effectiveness of the policies in the transport sector in Puducherry:

Table 15 Monitoring Mechanism - Buildings

Aspects	Monitoring Mechanism
POLICY	•Adoption of Eco Niwas Samhita (ENS) in Domestic and Aggressive implementation of ECBC in commercial •Incentives for Green Buildings and Net zero buildings •Demand Aggregation Model for Star rated Appliances in domestic •Mandatory use of 3 to 4 star rated appliances in commercial and government buildings •Promotion of Electric cooktops •Phasing out DGs by Solar PV with Battery Energy Storage System (BESS) in commercial
AWARENESS & CAPACITY BUILDING	•Capacity building programs for ECBC & ENS compliance checking professionals •Enhance awareness on ECBC, ENS and Green Buildings •Awareness programs on innovative and new technology. •Enhance awareness of minimum set point temperature of air conditioners to 24 degree Celsius.
TECHNOLOGY INTERVENTION	•Highly Efficient appliances •Electric cooktops

CASE STUDY

BUILDINGS

Green Building Rating System

Green building rating system like GRIHA, IGBC, LEED etc. developed for Indian construction sector. GRIHA is a rating system which assesses the environmental performance of buildings on scale of 0-104. On the basis of number of points scored, a building can be rated between 1 & 5 stars. GRIHA was developed by TERI and has now been adopted by the Ministry of New and Renewable Energy (MNRE) as the National Rating System for green buildings in India and to promote green buildings in India and to oversee the various activities associated with it, MNRE and TERI jointly established an independently registered society called ADARSH (Association for Development and Research of Sustainable Habitats

The CESE is a 5-star green rating building by GRIHA(India) and research facility at the IIT (Indian Institute of Technology), Kanpur on a plot area of 175, 000 square metre. It has been designed in an environment friendly manner and conceptualized and constructed as a "building in the garden" that is sustainable.

Key Sustainable Features:

- The building is fully compliant with the ECBC (Energy Conservation Building Code).
- Sustainable site planning has been integrated to maintain favourable microclimate.
- The architectural design has been optimized as per climate and sun path analysis.
- The building has energy-efficient artificial lighting design and daylight integration.
- Water body to cool the microclimate.
- Orientation of building: North – South.
- It also has energy-efficient air-conditioning design with controls integrated to reduce annual energy consumption.
- Passive strategies such as an earth air tunnel have been incorporated in the HVAC design to reduce the cooling load.
- Optimized window design by selection of Low E glass and external shading

Figure 23 Existing site features green building

Technical and Environmental Aspects

The focus of green building studies is placed on environmental aspect of sustainability. Taking the GBC, A Green Star Health care V1 as example, 87% of unweighted points are related to environmental sustainability. It is also evidenced in the extensive studies on environmental sustainability of buildings, e.g., energy efficiency, water efficiency, resource efficiency and greenhouse gas emission reduction. For instance, fly ashes could be used for structural components of green building design which helps to not only save the energy but also reduce the waste to the landfill. Similarly, the utilization of precast or prefabrication technologies helps to reduce the amount of construction and demolition waste to a large extent Indeed, utilizing precast slabs in temporary construction works have a number of benefits such as mitigation of obsolescence and cost savings.

Indoor Environmental Quality

One of most critical components of human benefits associated with green building is the indoor environmental quality (IEQ). The IEQ, including volatile organic compound emissions and other contaminants is another critical issue in buildings. Therefore, IEQ features in all leading green building assessment tools. Extensive studies have suggested that green building can achieve higher level of IEQ than conventional buildings, which helps to improve the health and productivity of occupants. As a result, the level of satisfaction of building users is enhanced. In fact, Leaman and Bordass's study found that users of green building tend to be more tolerant than those of conventional building in terms of indoor environmental quality.

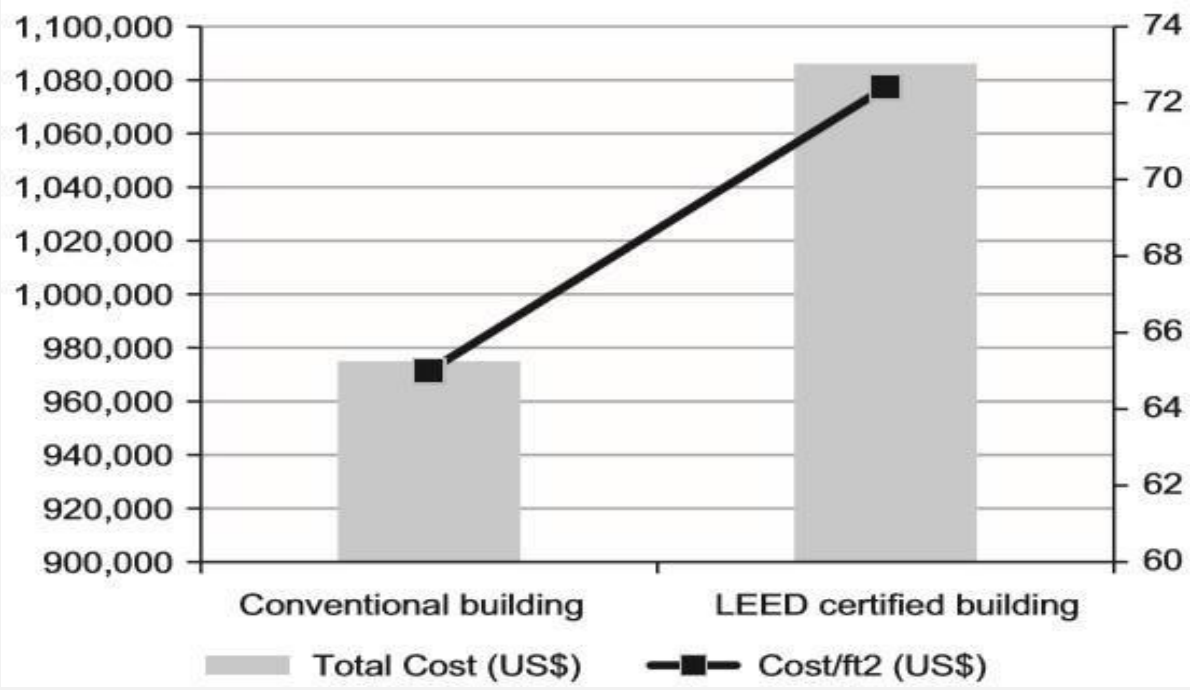


Figure 24 Total cost and cost per unit floor area, conventional buildings vs LEED certified

Conclusion

The conclusion for the studies can be classified into three different categories i.e., definitions and scope of green building, benefits and costs of green building and ways to achieve green building. It has been observed that in most of the literature reviews, the focuses are on environmental aspects of sustainability such as energy consumption, water efficiency and greenhouse gas emissions and also with their technical solutions. Also, the life cycle assessment approach, which is extensively applied in the environmental aspects of green building can be a useful tool for social sustainability.[16]

New rating tools are developing rapidly worldwide. But more studies in these fields are required to support these new rating tools and also help in assisting the decision-making for the investors and the developers. Also, awareness amongst the people should be spread about the green building concepts and its long-term profits. Current scenario is that people in countries like India are ignorant about this concept and also lack of awareness can be observed. Government initiative will help largely in spreading awareness. Also, provisions of educating and training people or the occupants will help to regulate their behaviour of using the green building which may affect the building performance significantly.

Also, the discussion on cost and benefits of the green building are quite noticeable. It is also worth noticing that all the leading green building assessment tools are designed according to their local climatic and geographic conditions. Thus, to set benchmarks for the world with references to green building, this point needs to be taken into considerations when comparing the effectiveness of these green building rating tools.

Mandatory Energy Audit for Commercial Buildings

The case study of an energy efficient day-use public office building in composite climate (Jaipur). The paper provides details about:

- Energy efficiency measures adopted in the building.
- Results of the building energy simulation during the building design.
- Methodology and results of the performance monitoring of the fully functional building for one-year period.
- Results of checking compliance with ECBC

Energy efficiency measures (EEMs) for this building includes use of insulation in external walls & roof, optimized window-to-wall ratio, efficient glazing, high efficiency water cooled chiller, T5 & LED lighting, and rooftop solar photovoltaic system. Since the building does not have an EIS, a monitoring methodology was developed. This consisted of

(i) two-weeks detailed energy monitoring twice a year, in winter and summer season

(ii) analysis of monthly energy bills for a year; and

(iii) a calibrated energy simulation model. Results show 53% of electricity is used for HVAC annually, while 31% of electricity is used for office equipment and 6% for artificial lighting. The difference in simulated performance (EPI: 53 kWh/m^2.y) and measured performance (EPI: 43 kWh/m^2.y) is explained.

[16] Source: Journal – International Journal of Advance Research in Science and Engineering http://www.ijarse.com/images/fullpdf/1538391836_PR19.pdf

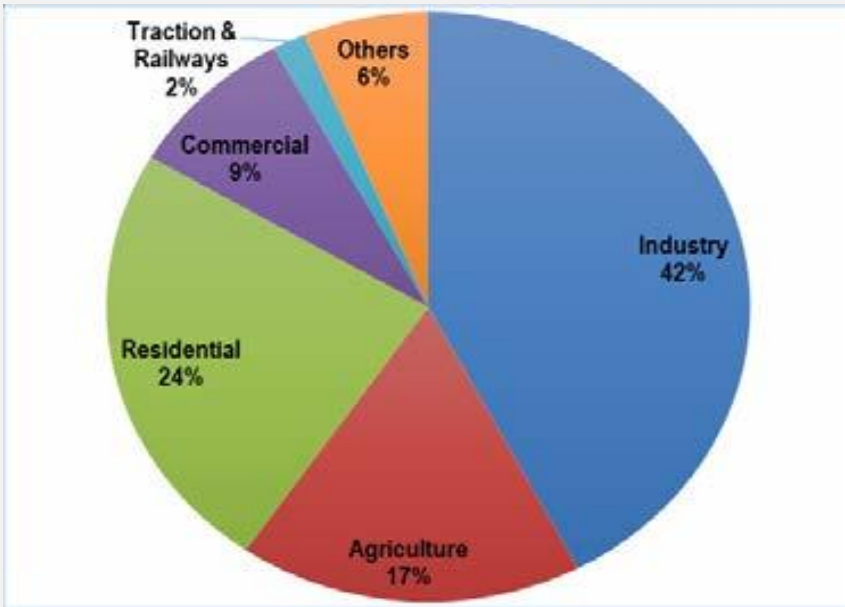


Figure 25 Electricity consumption in India sector-wise

Buildings are the second largest consumer of electricity in India after industries (Figure 1). Overall, buildings sector accounts for 33% (24% residential & 9% commercial) of the electricity consumption (Energy Statistics, 2017).

Mandatory building energy efficiency codes like ECBC are considered essential for mainstreaming building energy efficiency in new buildings in emerging economies. Further, it has been noted that world-wide the building energy efficiency codes have better acceptance in the cold climate regions as compared to warm climate regions (Liu et.al. 2010). There are several challenges in the implementation of building energy efficiency codes in the emerging economies and a multi-pronged approach is needed for successful implementation.

Most of the existing case studies on energy efficient commercial buildings in India are based on building energy simulation results and not on actual monitored energy performance of the building. Due to this reason, there is a lack of confidence and a certain degree of distrust amongst the builders/developers and building designers about the effectiveness of ECBC, building energy efficiency design measures and the results of building energy simulations.

This paper presents a case study of a commercial building. The paper provides details about:

- Energy efficiency measures adopted in the building.
- Results of the building energy simulation during the building design.
- Methodology and results of the performance monitoring of the fully functional building for one-year period.
- Results of checking compliance with ECBC

Energy Monitoring

Energy monitoring of the building was done to understand the actual energy performance of the building and to compare it with the estimated energy performance through energy simulation. As the building does not have an EIS, the methodology for energy monitoring involved.

Collection of Electricity Bill

Monthly electricity bills for a period of one year (May 2015 to April 2016) were collected. Using this data monthly and annual EPI of the building was calculated. The billing data was also cross-checked with the data from the logbook maintained by the building operation team on the hours of usage of HVAC system and periodic readings of the electricity meter.

Seasonal Energy Monitoring

The objective of the detailed seasonal energy monitoring was.

(i) To get break-up of energy consumption for different end-uses (e.g., HVAC, lighting, equipment, etc.),

(ii) To identify further energy saving opportunities by measuring theperformance of different systems (e.g., chillers, pumps, fans, lighting fixtures etc.).

Detailed energy monitoring for two weeks in winter and two weeks in summer was done. Winter monitoring was done for a duration of two weeks in January 2016. During this period, the HVAC system was not operational. Except HVAC system data, all measurements were done. In addition, data on building usage such as number of people, occupancy schedule, schedule of operation for lighting and other systems was gathered. Summer monitoring was for a duration of two weeks in May 2016. During summer, all the measurements were done as the HVAC system was fully operational.

Prior to actual energy monitoring, a detailed monitoring plan was prepared. Architectural drawings, HVAC schematic and electrical schematic was studied in detail to prepare a monitoring plan.

A visit to the building was done to exactly identify the different measurement points, instruments needed, measurement frequency and other details to be collected.

Monitoring plan for building included three levels of data monitoring and collection.

Level 1: Continuous data logging with an interval of 15 min. or less

Level 2: Spot measurement of parameters (2 times per day i.e 1100-1230 hrs, 1430-1630 hrs)

Level 3: Data collection (from hourly panel reading, through records or through interaction)

The objective of this model was:

1. To calculate the break-up of energy consumption for different end-uses round the year as the detailed monitoring was done only for a total of four weeks duration and

2. To calculate the energy saving through the additional measures identified during the monitoring period.

ECBC Compliance

'Whole building performance method' was followed for ECBC compliance check. This requires preparation of energy simulation model for two cases.

ECBC Prescriptive and as Designed. All the simulation inputs, (e.g., wall U-value, roof U-value, fenestration SHGC, VLT & U-value, lighting power density, HVAC system COP, etc.) for 'ECBC Prescriptive' case, were taken as defined in ECBC. For the 'As Designed' case, all the simulation inputs were taken as designed capacity and design specification. Inputs on building operation (e.g., thermostat setpoints, schedules, internal gains, occupant loads, etc.) were kept same for both cases. In addition, all the mandatory requirements were checked for ECBC compliance.

Actual energy performance of building may not match to the 'As Designed' case due difference in user behaviour and difference in actual performance of various systems.

Conclusion

Good quality case studies based on monitored energy performance are needed for mainstreaming ECBC in the country. The paper presents case study of an office building at Jaipur and cover.

I. Energy efficiency measures adopted in the building.
II. Results of the building energy simulation during the building design.
III. Methodology and results of the performance monitoring of the fully functional building for one-year period.
IV. Results of checking compliance with ECBC

Energy efficiency measures (EEMs) for this building includes use of insulation in external walls & roof, optimized window-to-wall ratio, efficient glazing, high efficiency water cooled screw chiller, T5 &LED lighting, and rooftop solar photovoltaic system. Since the building does not have an EIS, a monitoring methodology was developed.

This consisted of:

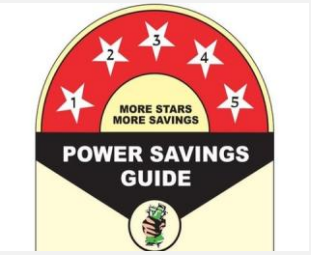
I. Two-weeks detailed energy monitoring twice a year, in winter and summer season.
II. Analysis of monthly energy bills for a year; and
III. A calibrated energy simulation model. Results show 53% of electricity is used for HVAC annually, while 31% of electricity is used for office equipment and 6% for artificial lighting. The difference in simulated performance (EPI: 53 kWh/m2.y) and measured performance (EPI: 43 kWh/m2.y) is explained.

The study shows that for building without an EIS, using a customised energy monitoring methodology, one can get quite good understanding of energy performance of building, break-up of energy for end- uses and performance of systems; also identify possibilities of further improvement in energy performance.

There is a need to have many such case studies. This would help in motivating builders / developers and other building sector professional to adopt energy efficiency measures in their projects, having more ECBC compliant buildings.[17]

Mandatory Star Rating, Fluorescent Tubes, Bureau of Energy Efficiency, India

India's energy labelling programme offers significant benefits to consumers, enabling them to reduce their energy bills by providing critical information on energy use at the time of purchase. The Bureau of Energy Efficiency (BEE), Government of India, is working to promote the efficient use of energy and its conservation across India. The number of stars can vary from 1 to 5, with more stars indicating higher energy efficiency and more savings for consumers. The illustration below is the BEE Star Rating Plan for Fluorescent Lamps. [18]



BEE STAR RATING PLAN					
STAR RATING	★	★★	★★★	★★★★	★★★★★
Lumens per Watt at 0100 hrs of use	<61	>=61 & <67	>=67 & <86	>=86 & <92	>=92
Lumens per Watt at 2000 hrs of use	<52	>=52 & <57	>=57 & <77	>=77 & <83	>=83
Lumens per Watt at 3500 hrs of use	<49	>=49 & <54	>=54 & <73	>=73 & <78	>=78

Figure 26 BEE-Star Rating

Energy Star, Department of Energy and Environmental Protection Agency, US Energy Star is a US

Voluntary labelling programmes engage product suppliers who label their energy-efficient lighting products to inform end users about product performance. Greater awareness of energy performance enables end users to make informed purchasing decisions and contribute to developing a stronger market for energy-efficient products.

Voluntary labelling is effective if combined with integrated awareness campaigns. Such campaigns demonstrate the benefits of energy-efficient lighting products to purchasers and manufacturers. Voluntary labels are implemented in countries as diverse as Brazil, India, Thailand, and the US Only highly efficient lamps are likely to be labelled because manufacturers and retailers have no incentive to label low-efficiency lamps. Voluntary labelling programmes can serve as an interim step toward mandatory programmes, particularly if a country is new to labelling or has limited resources.

Environmental Protection Agency (EPA) voluntary program helping businesses and individuals save money and protect the planet's climate by promoting highly energy-efficient products. ENERGY STAR was established in 1992, under the authority of the Clean Air Act Section 103(g), which directed the EPA "To develop, evaluate, and demonstrate nonregulatory strategies and technologies for reducing air pollution." The Energy Policy Act of 2005 amended the statute directing the Department of Energy and the EPA to manage a voluntary program to identify and promote energy efficient products and buildings in order to reduce energy consumption, improve energy security, and reduce pollution through voluntary

[17] Source: Journal - Building Energy Efficiency Project (BEEP), India https://www.beepindia.org/wp-content/uploads/2013/12/2-CASE-STUDY-OF-AN-ENERGY-EFFICIENT-COMMERCIAL-BUILDING.pdf

[18] UN Report of Accelerating the Global Adoption of Energy Efficient Lighting - https://wedocs.unep.org/bitstream/handle/20.500.11822/20406/Energy_efficient_lighting.pdf

labelling. Now in its 23rd year, the ENERGY STAR programme has boosted the adoption of energy-efficient products, practices, and services through valuable partnerships, objective measurement tools, and consumer education.

7. FOCUS SECTOR 4: FISHERIES

7.1 Overview

The fisheries sector is an important contributor to the economy of the U.T. of Puducherry, located on the south-eastern coast of India. The U.T. has a long coastline of around 30 kilometers, making it well-suited for fishery activities.

The fisheries sector in Puducherry comprises both inland and marine fisheries, including capture and culture fisheries. The marine fisheries are dominated by traditional, small-scale fishing operations using non-motorized boats, while the inland fisheries are largely based on freshwater aquaculture.

However, the fisheries sector in Puducherry faces several challenges, including overfishing, habitat destruction, and unsustainable fishing practices. In addition, the sector is also highly energy-intensive, with significant energy consumption involved in activities such as fishing, processing, transportation, and storage.

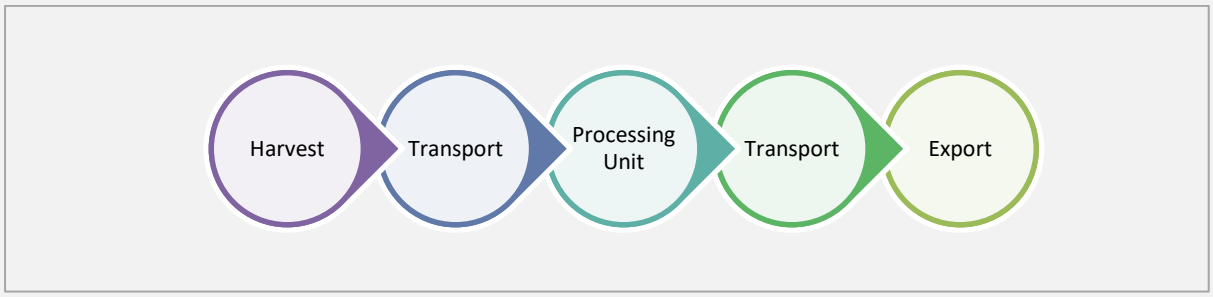
To address these challenges, there have been efforts to promote energy efficiency in the fisheries sector in Puducherry. These include the adoption of energy-efficient fishing techniques, such as the use of more fuel-efficient boats and gears, as well as the promotion of renewable energy sources such as solar power for onshore activities.

7.2 Energy efficiency strategies in the fisheries sector

Strategy: Energy efficiency across value chain of fisheries

According to Handbook on Fisheries Statistics 2020 by Department of Fisheries, Puducherry produced 0.07 lakh inland fishes and 0.44 lakh marine fishes.

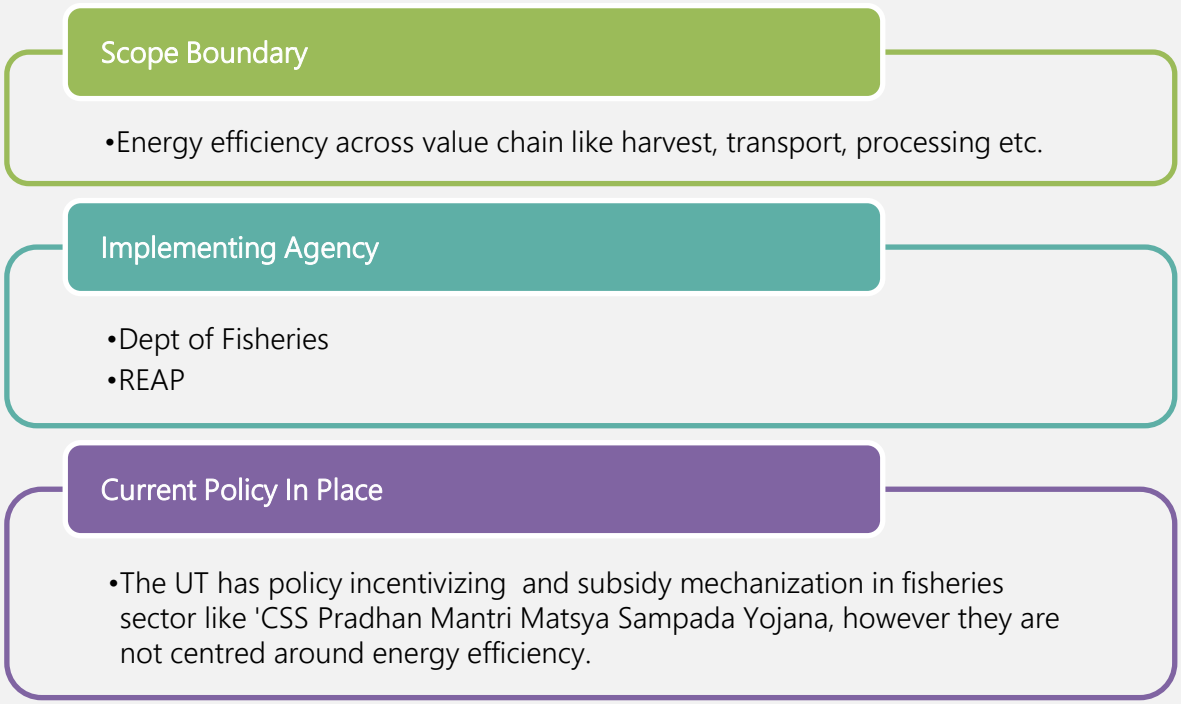
The fisheries sector in India encompasses a wide range of activities, from fishing to processing, marketing, and distribution of fish and fish products. Improving energy efficiency across all value chains in the fisheries sector can lead to significant environmental and economic benefits, including reduced greenhouse gas emissions, decreased energy consumption, and cost savings for fishers and processors.



In the processing and packaging stages, energy is mainly consumed for cooling, freezing, and drying of fish products. The use of energy-efficient refrigeration and drying equipment can significantly reduce energy consumption and associated costs. Additionally, adoption of renewable energy sources such as solar and wind can further reduce energy consumption and greenhouse gas emissions.

The transportation and distribution of fish and fish products also require significant energy input, mainly in the form of fuel for vehicles and refrigeration systems. The use of energy-efficient vehicles and refrigeration systems, as well as improved logistics and distribution systems, can reduce energy consumption and transportation costs.

Overall, improving energy efficiency across all value chains in the fisheries sector in the U.T. can bring numerous benefits, including reduced greenhouse gas emissions, cost savings for fishers and processors, and increased competitiveness in the global market.



Saving Potential

The energy saving potential has been estimated by accounting for both thermal and electrical consumption across harvest, land transport, processing unit chain.

Table 16: Energy Saving Potential - Fisheries

Particulars	Moderate Scenario for 2030	Ambitious Scenario for 2030
Energy Saving Potential (MTOE)	0.0090	0.0120
GHG Emission Reduction Potential ($MtCO_2$)	0.028	0.037

Action Plans

This section describes several action plans that can be implemented across the commercial sector for this strategy. For each of the strategies, a short, medium, and long-term period has been taken into consideration for actionable instruments.

Policy Type	Action Plan	Timeline	Estimated Investment (in lakhs)
Awareness & Capacity Building	1. Provides skill development support. 2. Resource efficiency and cleaner refrigerant focus missing 3. Interventions and incentives needed to promote improved designs for fish transportation, transportation of live fish, mobile kiosks for street vendors under Make in India	Short Term	108
Policy Intervention	1. Guidelines for usage of BEE star-rated products. 2. Partial support for conducting Energy audits in the value chain in line with the facility available. 3. Mandatory Collection and submission of basic data from processing units on Energy and emissions - facilitating data collection procedures/ISO 50001 to be mandated in all processing units. 4. Standardization of cold chain technologies and practices covering investment, ROI, energy specifications, vendor names and other operational benefits	Long Term	65
	Total		173

7.3 Energy saving potential & monitoring mechanism

Energy saving potential of the fisheries sector is 0.8 MTOE and 1.8 MTOE for moderate and ambitious scenarios FY2030 respectively as seen from Table 2.

Table 17 Summary of energy saving from the strategies - Fisheries

Strategy	Energy Saving Potential (Moderate)	Energy Saving (Ambitious)
Energy efficiency across all value chain in fisheries sector	0.0090	0.0120

Following are the monitoring mechanisms that could be implemented to track the progress and effectiveness of the policies in the fisheries sector in Puducherry.

Policy Type	Monitoring Mechanism
Data Reporting	Remote sensing and GIS mapping: Remote sensing and GIS mapping can be used to monitor changes in ocean temperatures and salinity, which can affect fish distribution and abundance. These tools can also help identify areas where vulnerable fish species are concentrated.

CASE STUDY

FISHERIES

Efficiency across Value chain

Value chain in fisheries is used as a managerial tool to reduce processing costs and improve quality and productivity of the product and reduces distribution cost. The advantages of studying value chain in fisheries are as follows:[19]

1. Increase the producers share.
2. Minimum cost of the processes
3. Increase the efficiency and effectiveness of the analysis
4. Eliminate the unwanted processes i.e., non-value addition
5. Quality assurance in product development
6. Ensure consumer satisfaction.

The value chain approach is a useful practical tool towards assessing the status of development of fisheries and aquaculture. It also analyses the opportunities and constraints for future development. It is useful for the key analysis such as fishers, managers and policy makers towards streamlining their activities in a cost-effective way.

[19] Source: ICAR-Central Institute of Fisheries Technology
https://krishi.icar.gov.in/jspui/bitstream/123456789/24974/1/38_Value%20chain%20management.pdf

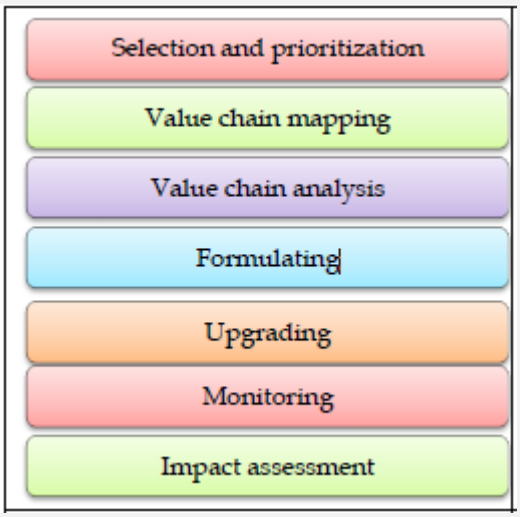


Figure 27 Steps of Value chain analysis

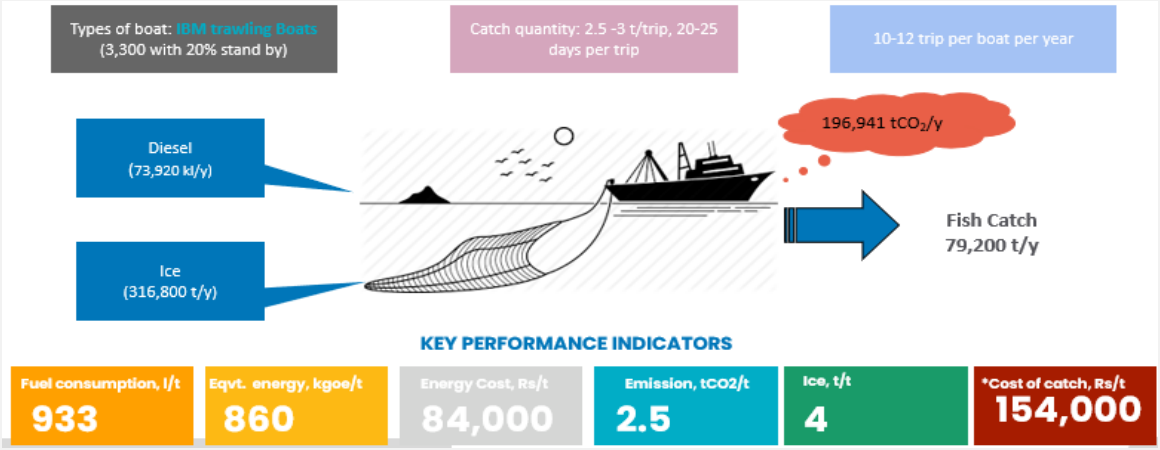
Environmentally Friendly Cold Storage for Fish on Lake Victoria

As fish is a vital source of essential macro- and micronutrients, it could also play an important role in reducing the high prevalence of undernutrition. However, up to 60% of the fish spoils due to interrupted cold chains. The Fish Cold Store on Lake Victoria keeps fish fresh with technology that protects the environment and saves energy, therefore, more fish can make it to the market. As a result, fishermen can earn more for their catches.[20]

A cold store is not simply a room used to keep food cold. It is a room specifically designed to meet the conditions for safe storage of perishable goods. Before the Cold Store was built, local fishermen often had to throw away 40 to 60% of their catch because they had no way to keep the fish cool. Now, 5 tons of fish can be stored and kept fresh for two to three days in the Fish cold store. The technology is powered by solar energy, and ice to cool the fish is made from lake water.

Energy Efficiency and reduction of use and emission in Fisheries Sector

Energy Audit: Marine catch



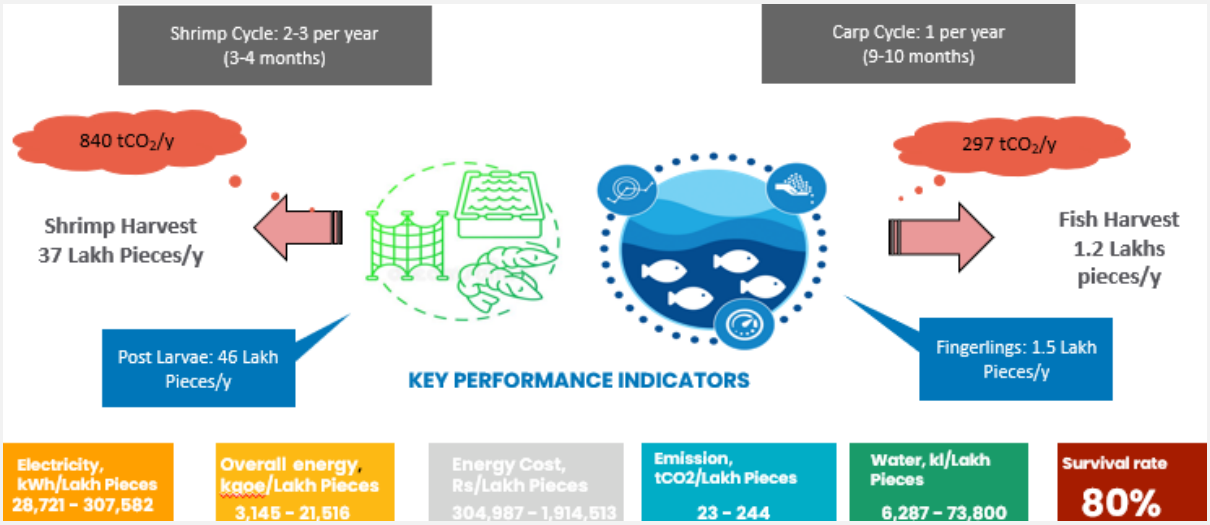
Veraval, Gujarat

[20] Source: Energy pedia
https://energypedia.info/wiki/Sustainable_Energy_Use_in_the_Fish_Value_Chain

Energy savings and corresponding GHG Emission Reduction:

- ❖ Opportunities to reduce energy consumption by 5% to 25% across different operations in the value chains.
- ❖ The potential includes fuel switch and renewable energy interventions. Opportunities range:
  - ● Operational improvements
  - ● Technology interventions some of which are well established, while some are techno-economically viable, but not yet mainstream.
  - ● Technology interventions which are more novel (require further work to assess the economic viability)

Energy audit: Aquaculture: Shrimp and IMC (farming)



Veraval, Gujarat

HGWPR and ODS Elimination:

- ❖ Most of the Cold Storages, Processing Facilities and Ice Plants use ammonia based.
- ❖ Of course, there are a few HFC based chillers.
- ❖ HFC based chillers are however the mainstay in refrigerated trucks.

Efficiency of Water and Other Resources:

- ❖ Various specific opportunities to reduce usage of water, promote re-use of water.
- ❖ However, unavailability of benchmarks is an issue (comparison not plausible)
- ❖ In established aquaculture value chains, the feed to product ratio in is optimal (~well managed corporate businesses)

- ❖ Smaller (value-chain independent) firms need training and handholding. Fish Wastes:
- ❖ Wastage levels are high (even if for established value chains wastage is minimized)
- ❖ Many examples of reuse of wasted fish i.e., offal (fish, kitten, and chicken litter feed)
- ❖ However, not enough information if these are the best use of fish waste.
- ❖ Quantification of actual wastage resulting in solid waste emissions (of GHG) Possible Targeting of Policy and Program Interventions market:
- ❖ States with high contributions in sourcing. Value chains targeting domestic market/consumption (86% of the sourced fish are transported unprocessed for domestic consumption)
- ❖ Main opportunities are in (a) aquaculture farms, (b) fishing boats, (c) logistics – transport and wholesale markets, and (d) retail kiosks and shops.

Case Study: Energy Efficiency in fisheries value chain[21]

Energy & GHG Audit of selected Fisheries Sector Value Chains + Recommendations of Best/ Appropriate Transformation. Facilitating adoption of best energy efficiency and GWP + ODS reducing practices in fisheries sector cold chain and encouraging private sector participation

Project activities:

- Understanding the need and appraisal of local/ national and international best practices in existing cold chain processes towards energy efficiency (EE), and reduction of HGWPR and ODS
- Detailed energy audit of fisheries sector value chains in India
- Recommendations for improvement of the value chains.
- National Design Challenge for newer ideas – Mobile Kiosk for Fish Vending & Live fish transport.
- Stakeholder consultations to facilitate the adoption of best practices in the fisheries sector cold chain and encourage private sector participation

Impact: The purpose of the energy & GHG audit of selected value chains is to establish mass balance and estimate benchmarks of SEC, GHG emissions and energy consumption and to know the best practices in the value chain

[21] PowerPoint Presentation (unep.org)

Value Chain	Elements	Resource savings (%)				GHG
		Electrical energy	Thermal energy	Water	Ice	
Aquaculture shrimp	Farm	16%	-	-	-	15%
	Processing	7%	43%	3%	40%	10%
IMC	Farm	20%	-	-	-	19%
	Processing	8%	24%	18%	40%	13%
Finfish	Processing	11%	-	-	-	11%
Crab and Lobster	Processing	6%	-	-	-	5%

Some of the findings on major technologies practised in the cold chain are Phase change material technology in coolers to avoid delivery issues, solar PV systems for cold storage and EV to reduce emissions, Reefer trucks, aerators to Improve the quality of water, VFD for refrigeration systems, etc.

National Design Challenge for newer ideas is also conducted, where more than 150+ participants under each category from college students, innovators, start-ups, associations, and practising officials in the sector. The main objective of the challenge was to get the best mobile kiosk for fish vending while maintaining the safety and hygiene of fish, and facilitate a circular economy based on reducing fish waste and energy efficiency.

The fishery value chain has been analysed through stakeholder consultation to help increase the private sector participation. It is recommended to,

1. Develop a compendium for investment potential & highlight current best practices in the fisheries sector that can be created across different supply chains and value chains.
2. Organise B-to-B workshops and Matchmaking for the fisheries sector along with financing institutions.
3. Implement pilot projects that can be replicated, and case studies can be published to attract private investors to the sector.

Energy audit and resource efficiency measures

Resource efficiency measures	Marine catch	Farm	Transport	Processing	Transport (Reefer truck)
Installation of Chiller management system				√	
Installation of IOT system in farming pond		√			
Usages of phase change material boxes to reduce ice usages	√	√	√	√	√
Installation of portable oxygen generator		√			
Fuel switch to solar-battery hybrid (OBM Boats)	√				
Fuel switch to diesel to LNG (IBM Trawling boats)	√				
Replacement of diesel fired boiler with electric boilers				√	
Installation of RTEMS				√	
Steam pressure reduction				√	

Resource efficiency measures	Marine catch	Farm	Transport	Processing	Transport (Reefer truck)
Replacement of existing blower motor with energy efficient motor				√	
Replacement of inefficient pumps		√		√	
Periodic maintenance of air blower				√	
Replacement of metal blade with FRP blade in cooling tower				√	

Resource efficiency measures	Marine catch	Farm	Transport	Processing	Transport (Reefer truck)
Waste heat recovery condensate				√	
Replacement of old inefficient motor with IE3 motor		√		√	
Installation of solar streetlights		√		√	
Installation of solar PV for power generation		√		√	

Alternate energy for fishing vessels

Solar powered boats:

- Solar powered boats get their energy from the sun. Using electric motors and storage batteries charged by solar panels and photovoltaic cells, solar powered boats can significantly eliminate their use of fossil fuels. Solar boats are uniquely suited to transform light energy into movement.

The main advantages are:

- No fuel cost
- No pollution from the burning of fuel
- Less carbon footprint
- Clean FRP surface
- Wider boat and low rolling during fishing
- More deck area
- Suitable for shallow waters
- No sound pollution

Srav, a solar offshore fishing vessel designed and developed by Kochi-based NavAlt Solar and Electric Boats.

It can host up to six fishermen. It has a 50-km range and is ideal for small fishers. The energy bill would be less than Rs 10,000, while fossil fuels would cost roughly Rs 3 lakh. Wear and tear too will be much less.

The Sagar Haritha vessel was constructed at the Goa Shipyard by CIFT under a public-private partnership model.

A hull made of marine grade steel to reduce weight and improve carrying capacity; a 400HP engine power, which is 20% lower compared with a regular vessel; a 600-watt solar panel for lighting; and bulbous bow, which reduces wave resistance on the sea, improving energy efficiency.

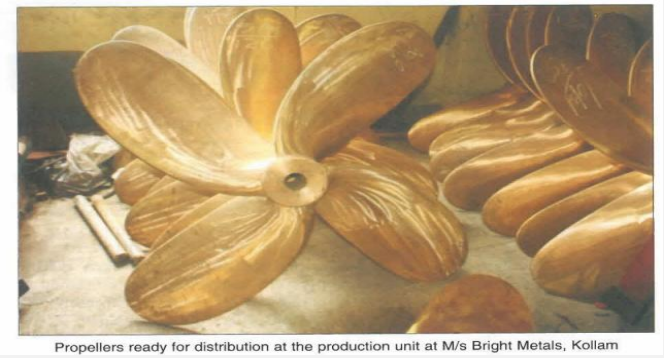
The Sagar Haritha designed by Central Institute of Fisheries Technology is an energy efficient fishing vessel

- LNG powered fishing vessels
  - A marine LNG engine is a dual fuel engine that uses natural gas and bunker fuel to convert chemical energy into mechanical energy.
  - The natural gas is stored in liquid state (LNG) and the boil-off gas is routed to and burned in dual fuel engines. There are three benefits which, taken together, make LNG as ship fuel one of the most promising new technologies for shipping.
  - The use of LNG as ship fuel will reduce sulphur oxide (SOx) emissions by 90- 95%.
  - A lower carbon content of LNG compared to traditional ship fuels enables a 20-25% reduction of carbon dioxide (CO2) emissions.

Use of fuel-efficient propellers

- Improvement in blade element design of propellers provide fuel saving in ring seiners by 18-21%.

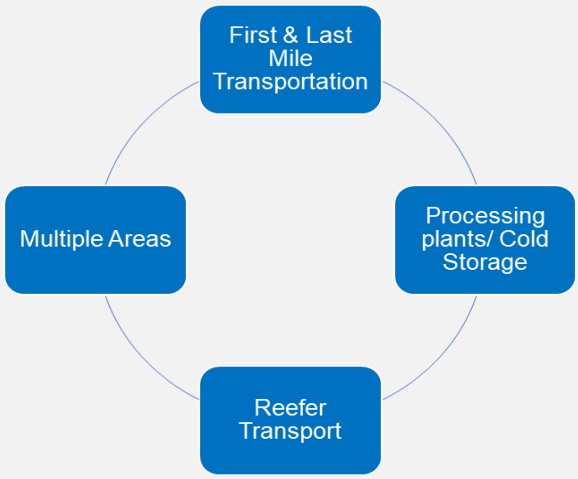
With the improved propellers, a fuel saving of average minimum 750 litres of diesel per month of per boat can be obtained in fishing.



Propellers ready for distribution at the production unit at M/s Bright Metals, Kollam

Opportunities for energy saving in Cold chain and Retail

Opportunities exist to improve energy efficiency, reduce use of HGWPR (high GWP refrigerants) and eliminate use of Ozone Depleting Substances (ODS) across the value chain in the following segments: primary transportation, cold storage, processing plant and reefer transport.



Focus Areas – Opportunities in Fisheries cold chain

Phase changing materials (PCM) technology in coolers/ chest freezers

- Benefits of using PCM in delivery trucks
  - Able to serve more distance as the temperature is maintained
  - Ice melting, ice disposal after product delivery issues avoided
  - Ice usage and cost will come down

Energy efficient aerators

- Improve quality of water
- Enhances the growth of fish.
- Help regulate fluctuating water temperatures.

Solar PV system for Fishery Cold storage

- Operating costs reduced drastically since system requires no electricity.
- Reduction in GHG emissions since renewable energy is used.

Efficient Ammonia / CO2 Brine system in Cold storage

- Zero Global warming potential (GWP)
- CO2 is non-hazardous and non-flammable (low ODP and GWP of 1)
- Increase in system safety due to reduced use of ammonia.

Evaporative condenser for cooling

- Reduction in GHG emission due to energy savings
- Energy saving potential of upto 15%
- Environmentally friendly (No ODS)

Low charge Ammonia refrigeration system

- Significant reduction in operating costs due to lower energy consumption
- Zero Global Warming Potential & Ozone Depleting Potential
- Lesser safety concerns are compared to traditional NH3 refrigeration systems.

Hybrid Freezer with Thermal Energy storage

- Reduction in GHG emission due to energy savings
- Avoidance of generator & Use of low GWP & Zero ODP Refrigerant
- Reduction in peak demand
- Improvement in product quality / shelf life

Mobile Chilling for Reefer trucks

- Lower costs as expensive diesel is replaced with grid electricity.
- Eliminates compressor from the truck.
- More eco-friendly as carbon footprint for the grid generation

8. FOCUS SECTOR 5: AGRICULTURE

8.1 Overview

The agriculture sector is an important contributor to the economy of the U.T. of Puducherry, located on the south-eastern coast of India.

To address these challenges, there have been efforts to promote energy efficiency in the agriculture sector in Puducherry. These include the adoption of energy-efficient agriculture techniques, Energy efficiency strategies in the agriculture sector.

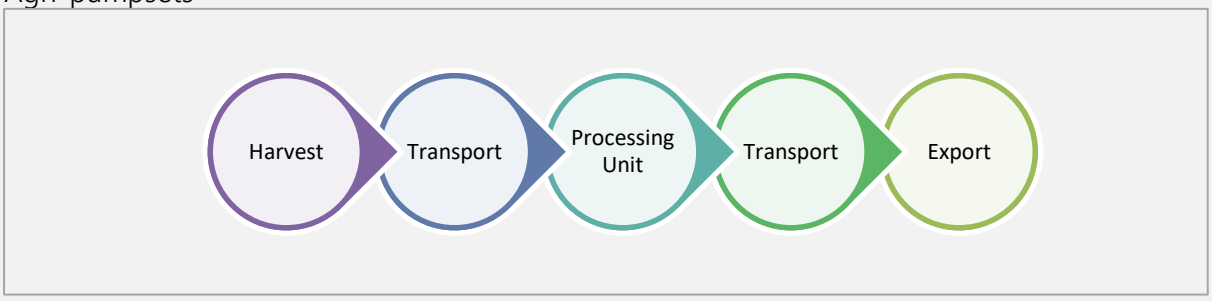
Strategy: Transition of conventional agricultural pumps to solar powered pumps

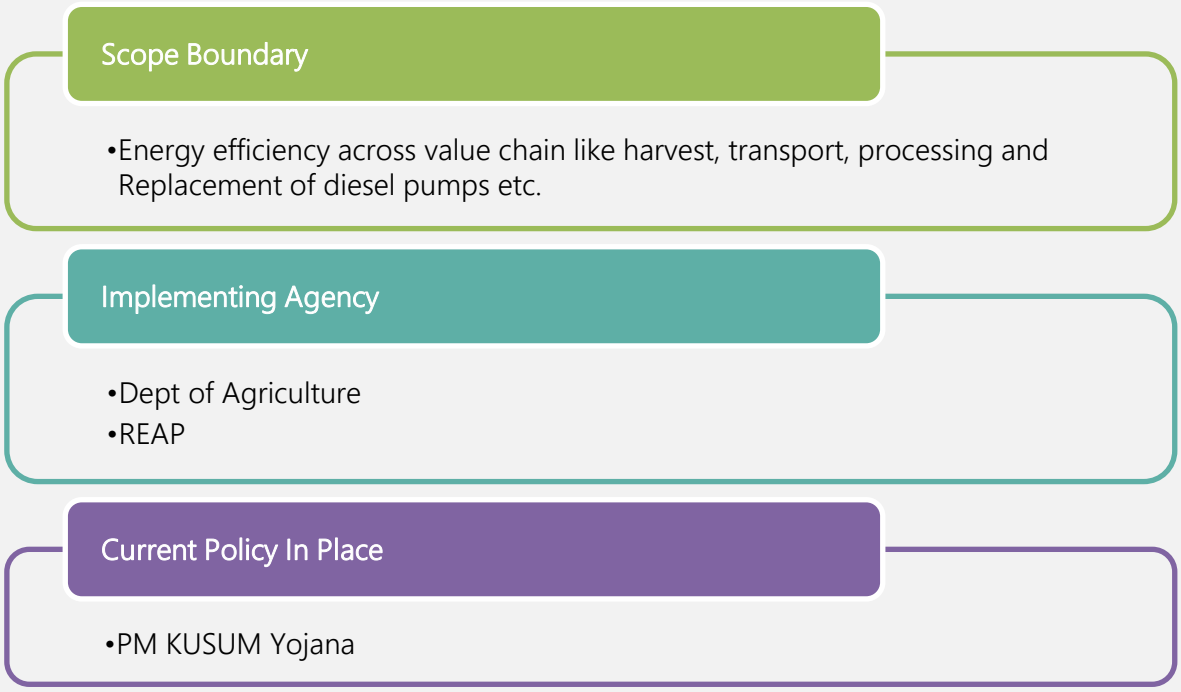
Agriculture and allied sectors hold a major role in employing people, providing food, and ensuring food security in any development process. It also has a significant position in achieving the Sustainable Development Goals (SDG) of no poverty, zero hunger, and good health and well-being.

Agriculture is one of the most important occupations for the people of Puducherry. About 45% of the total population of Puducherry depends directly or indirectly on farming and contributes less than 2% of the GSDP of the Government of Puducherry.

The main crop of this territory is paddy. Puducherry is one of the largest producers of bananas, flowers, tapioca, coconut, groundnut, and sugarcane.

The major consumption of energy in the agricultural sector of Puducherry is from the use of Diesel. Diesel is mainly used in Tractors, Agri-implements like rice harvesting machines and Agri-pumpsets





Saving Potential

The energy saving potential has been estimated by accounting for both thermal and electrical consumption across harvest, land transport, processing unit chain.

Table 18: Energy Saving Potential - Agriculture

Particulars	Moderate Scenario for 2030	Ambitious Scenario for 2030
Energy Saving Potential (MTOE)	0.00011	0.00022

Action Plans

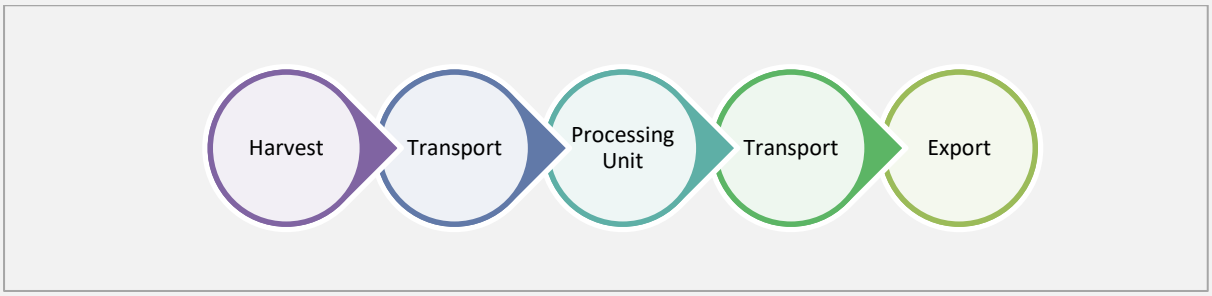
This section describes several action plans that can be implemented across fisheries sector for this strategy. For each of the strategies, a short, medium, and long-term period has been taken into consideration for actionable instruments.

Policy Type	Action Plan	Timeline	Estimated Investment (in lakhs)
Awareness & Capacity Building	1. Provides skill development support. 2. Creating awareness Resource efficiency and cleaner refrigerant	Short Term	11
	Total		11

Strategy: Replacement of inefficient electric pumps with efficient electric pumps

According to a report published by the Bureau of Energy Efficiency (BEE), inefficient pumps account for a significant portion of the energy consumption in India's agricultural sector. The report states that up to 30% of the energy consumed by agricultural pumps in India is wasted due to inefficient pump sets, resulting in a loss of about Rs. 50,000 crores annually. The BEE report also highlights that a large proportion of agricultural pumps in India are inefficient and outdated. Out of the estimated 20 million agricultural pumps in India, only 10% are estimated to be energy-efficient, while the remaining 90% are inefficient and consume more energy than required. This highlights the importance of replacing inefficient pumps in the agricultural sector with more energy-efficient options to reduce energy consumption and reduce electricity bills. Traditional agricultural pumps i.e. inefficient grid-powered motors, show significant vulnerabilities with regards to water and energy management. However, advancements in digital control systems have introduced intelligent agricultural pumps equipped with advanced control panels. These embedded modules operate as dedicated microcontrollers, utilizing sensor data and algorithms to optimize irrigation and pump operation.

EESL is implementing the Energy Efficient Pump Programme to distribute BEE 5-star energy efficient agricultural pumps and ensures a minimum of 30% reduction in energy consumption with smart control panels which can be remotely operated to enhance the ease of operation of pumps by the farmers.



Scope Boundary

- Energy efficiency across value chain like harvest, transport, processing and Replacement of inefficient electric pumps with efficient electric pumps.

Implementing Agency

- Dept. of Agriculture
- REAP
- DISCOMs

Current Policy In Place

- PM KUSUM Yojana

Saving Potential

The energy saving potential has been estimated by accounting for both thermal and electrical consumption across harvest, land transport, processing unit chain.

Table 19: Energy Saving Potential Electric Pump replacement - Agriculture

Particulars	Moderate Scenario for 2030	Ambitious Scenario for 2030
Energy Saving Potential (MTOE)	0.152	0.380

Action Plans

This section describes several action plans that can be implemented across fisheries sector for this strategy. For each of the strategies, a short, medium, and long-term period has been taken into consideration for actionable instruments.

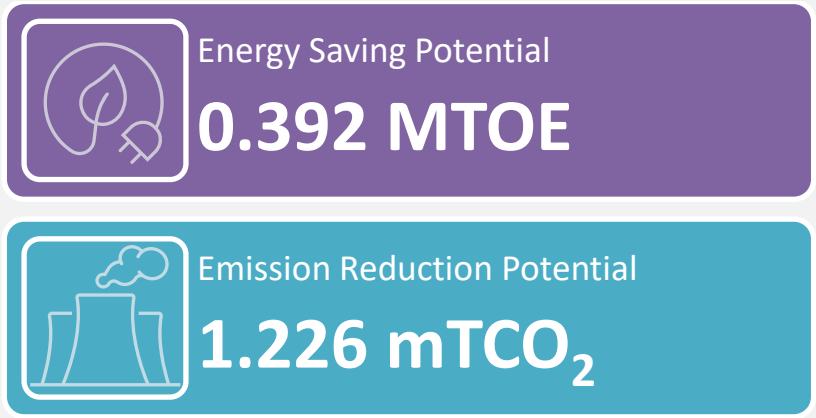
Policy Type	Action Plan	Timeline	Estimated Investment (in lakhs)
Awareness & Capacity Building	1. Provides skill development support. 2. Creating awareness Resource efficiency and cleaner refrigerant	Short Term	-
	Total		-

8.2 Energy saving potential & monitoring mechanism

Energy saving potential of the agriculture sector is 0.152 MTOE and 0.380 MTOE for moderate and ambitious scenarios FY2030 respectively as seen from Table 2.

Table 20 Summary of energy saving from the strategies - Agriculture.

Strategy	Energy Saving Target (Moderate)	Energy Saving (Ambitious)
Transition of conventional agricultural pumps to solar powered pumps	0.0090	0.0120
Replacement of inefficient electric pumps with efficient electric pumps	0.152	0.380



Following are the monitoring mechanisms that could be implemented to track the progress and effectiveness of the policies in the fisheries sector in Puducherry:

Table 21 Monitoring Mechanism - Agriculture

Policy Type	Monitoring Mechanism
Data Reporting	Remote sensing and GIS mapping: Remote sensing and GIS mapping can be used to monitor changes in ocean temperatures and salinity, which can affect fish distribution and abundance. These tools can also help identify areas where vulnerable fish species are concentrated.

CASE STUDY

AGRICULTURE

Replacement Potential of solar agriculture pumps in Eastern States of India

This analysis has been done for the eastern states of India including West Bengal, Uttar Pradesh, Orissa, Bihar, Jharkhand, and Assam. Other prominent eastern states are not part of this analysis as their agriculture data was dated and, in the absence of current data, the analysis would not have been meaningful.[22]

These states have unique set of climatic, geographical, and socio-economic features.

• The water table depth is relatively shallow in these states (>80% of area with water table depth up to 10 meters below ground level). Up to 10 meters water table depth, surface pumps can function, and they are relatively cheaper than submersible solutions.

• The summer season is extremely hot and receives little to no rainfall. In absence of reliable supply of water, some farmers lose the opportunity of growing third crop of the year during the summer season. On the other hand, the winter season witnesses heavy fog typically in the months of December and January. Foggy and cloudy conditions tend to weaken the output from solar panels.

• Most of these states have very poor electric grid reach, especially for agriculture purposes. These states account for ~60% of the diesel agriculture pump sets installed in the country and only about 8% of the agriculture electric pump sets installed in the country. Even if grid is available, supply of electricity is either unreliable or at odd hours.

[22] Feasibility analysis for solar agricultural water pumps in India - https://shaktifoundation.in/wp-content/uploads/2014/02/feasibility-analysis-for-solar-High-Res-1.pdf

As a result, despite availability of desired levels of subsidy, farmers would be constrained by some non-economic considerations that can impact solar pumps adoption such as –

•Weather limitations – limited usability of solar pumps during foggy days in Northern and Eastern parts of India

•Security issues – theft of panels, vandalism etc. Market creation support needed from Govt over the next four years and 13th Plan period.

•Limited awareness and lack of after sales service support

Through various industry discussions and farmer interactions, it has been estimated that these noneconomic considerations can constrain adoption of around 40% of economically viable pumps.

The overall analysis has been done assuming that the farmers will be willing to contribute to the solution cost only the amount that they save against the fuel expense they would have incurred over a 5-year timeframe. This is in line with the primary interactions and farmers may seek loan to cover this upfront cost at an EMI which must not exceed the average monthly fuel spend.

Identification of pump distribution

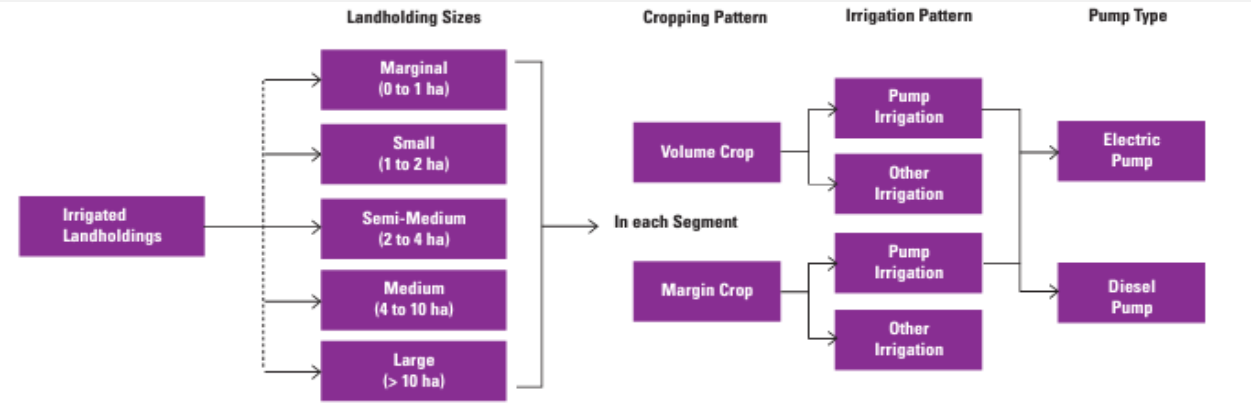


Figure 28 Pump distribution

Identification of subsidy requirement

Willingness to pay for the solution = fuel savings only (for 5 years)

Segment-wise subsidy requirement = [Cost of pump – Loan Amount (Annual EMI = Annual electric bill savings / Annual diesel cost savings)] * No. of pumps in each segment

The following table summarises state-wise replacement potential of diesel based agri-pumps with solar pumps at a subsidy provision of 70%

State	Potential (Number of diesel pumps replaceable) - in lakhs
West Bengal	3.2
Uttar Pradesh	17.8
Bihar	4.0
Jharkhand	0.9
Total	26.3

9. INVESTMENT POTENTIAL

This chapter outlines the sectoral investment potential for each of the demand sectors.

Table 22 Investment Potential – sector wise

Sector	Emissions Reduction (MtCO2) - FY2031		Energy Consumption Reduction (Mtoe) - FY2031		Investment Potential[23]
	Moderate	Ambitious	Moderate	Ambitious	
	MtCO2 reduction	MtCO2 reduction	Mtoe Reduction	Mtoe Reduction	INR Lakhs
Industry	0.0255	0.0382	0.00815	0.0122	₹227.5
Transport	0.0559	0.0883	0.1749	0.2765	₹376
Buildings	0.0246	0.0634	0.0770	0.1983	₹1126
Agriculture	0.0085	0.0143	0.00013	0.00026	₹11
Fisheries	0.0325	0.0433	0.0103	0.0138	₹173
Total	0.147	0.2475	0.2704	0.5010	₹1913.5

The energy saving investment potential of the U.T. is estimated to be ₹ 1913.5 lakhs by the year 2030, under the ambitious savings scenario, with the buildings sector constituting highest energy saving investment potential followed by transport sector.

[23] Market Potential calculated using cost of 1 tonne of oil equivalent as INR 18,402 and assuming a payback of 3 years.

10. WAY FORWARD

The “State Energy Efficiency Action Plan” report for Puducherry provides a roadmap for the state to achieve its energy efficiency goals. The report covers various sectors, including industry, buildings, transportation, and agriculture, and identifies opportunities for energy savings and greenhouse gas emissions reductions. Moving forward, it is essential that the state prioritizes the implementation of the action plan's recommendations.

One of the first steps in moving forward is to create a task force or working group that will oversee the implementation of the action plan. This group should include representatives from government, industry, and non-governmental organizations, as well as energy experts and other stakeholders. The task force should be responsible for identifying priorities, establishing timelines, and monitoring progress.

Another critical step in moving forward is to secure funding for the implementation of the action plan. The state should explore various funding options, including grants, loans, and public-private partnerships, to ensure that adequate resources are available to support the implementation of the plan. Additionally, the state should consider developing innovative financing mechanisms, such as energy efficiency bonds, to attract private investment in energy efficiency projects. By taking these steps, states can ensure that they are on track to achieving their energy efficiency goals and contributing to a more sustainable future.

In conclusion, the State Energy Efficiency Action Plan report for Puducherry provides a comprehensive framework for achieving energy efficiency goals in the state. The successful implementation of the plan will require the involvement of various stakeholders and the allocation of sufficient resources. By adopting the above ways forward, the state can achieve its energy efficiency goals, reduce greenhouse gas emissions, and contribute to a sustainable future

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