STATE ENERGY EFFICIENCY ACTION PLAN (DRAFT)

KERALA

Prepared by

Confederation of Indian Industry

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Supported by

Energy Management Centre Kerala

ENERGY MANAGEMENT CENTRE KERALA

PREFACE

The Bureau of Energy Efficiency (BEE) has been involved in numerous of 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, BEE, with the assistance of CII, will be 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

Confederation of Indian Industry (CII) would like to express its sincere thanks to the Bureau of Energy Efficiency (BEE), Ministry of Power, Govt. of India for their role in guiding and steering this prominent assignment "State Energy Efficiency Action Plan" for Kerala.

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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.

1.2 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 Kerala** state to ensure that the allocation of resources is as per the requirement of state 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 FY 2030.

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

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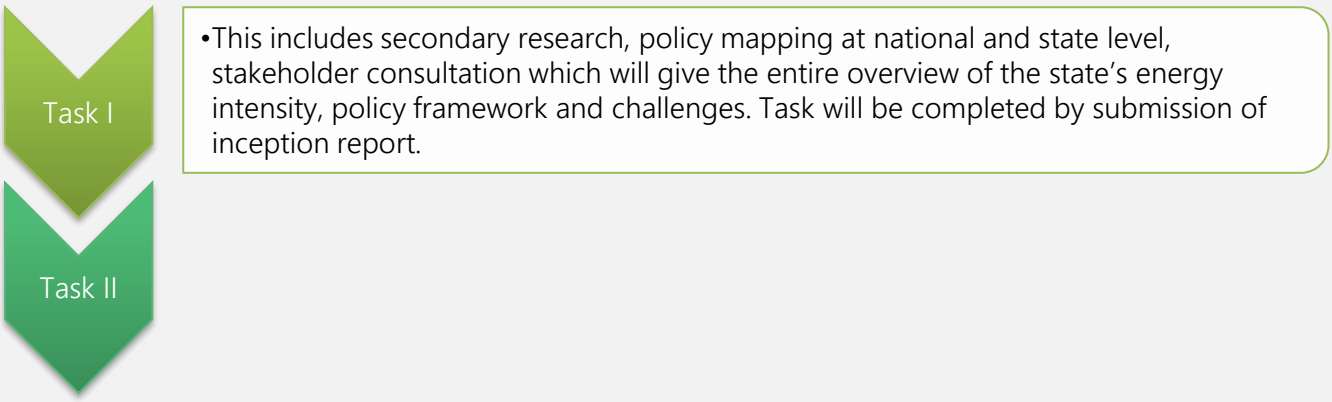
Figure 1 Key tasks in state energy action plan

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

Kerala has scored 53 points in SEEI 2020 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

Kerela depends on hydropower for a majority of its electricity generation. As the capacity expansion of hydel powerplants is limited due to technical feasibility and ecological factors, Kerala depends heavily on other states to meet the additional power demand of the state. At the same time, Kerala is the first state in the country to attain 100 percent household electrification. So, it is important to Kerala to reduce the energy consumption to become self-sufficient in power.

High Domestic electricity cost

In Kerala, the domestic consumers have telescopic tariff rate for electricity consumption, with rates at upper slabs being significantly higher. So, to limit the electricity consumption in lower slabs, people's interest in energy efficient appliances is increasing.

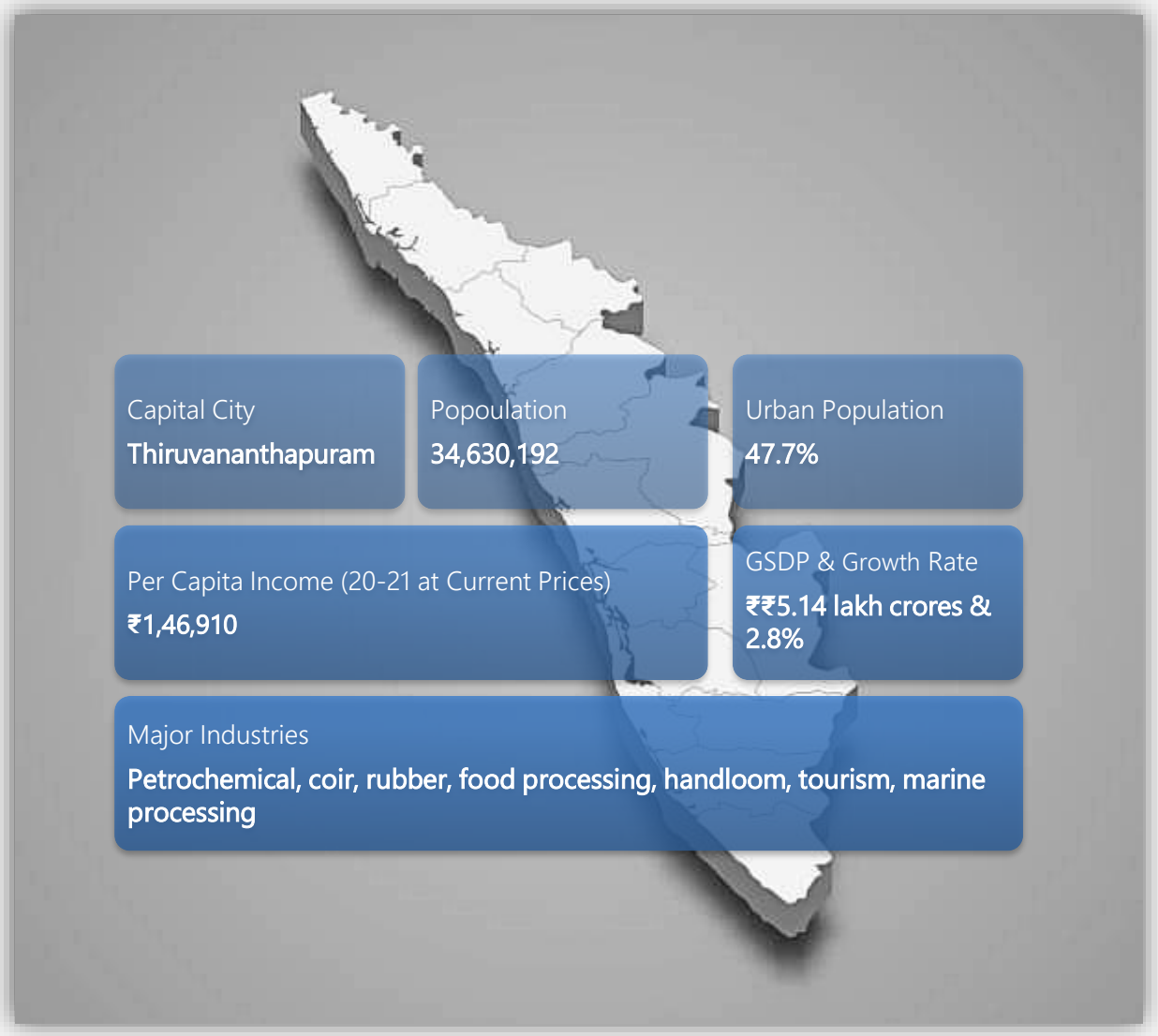
State's interest to reduce emissions.

Kerala government is trying to reduce the carbon emissions of the state and energy efficiency has a prominent role in reducing emissions. As per the latest statement by the Chief Minister of Kerala in the Assembly, a newly constituted committee under the Additional Chief Secretary, Environment, will formulate an action plan to make Kerala carbon neutral.

Increasing awareness on energy efficiency

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

1.3 Kerala State Profile



Kerala lies in the southwestern coastal region of India and stretches for about 580 km along the Malabar Coast, varying in width from 30 to 120 km approximately. It is a small state in terms of the total area and constitutes about 1 per cent of the total area of the country. Kerala is bordered in the North by the State of Karnataka, in the East by Tamil Nadu, in the South and West by the Arabian Sea. In the northwestern coast it also surrounds Mahe, a segment of the state of Puducherry. The state has 14 districts, 6 municipal corporations, 87 municipalities and 941 Panchayats.

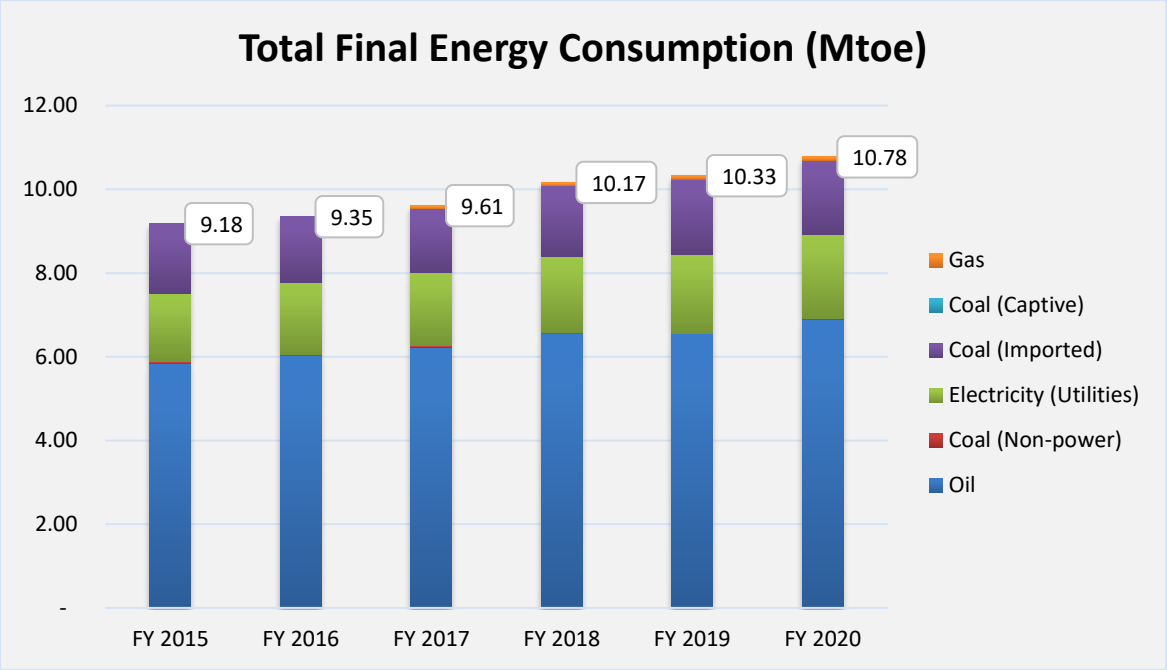
1.4 Total Final Energy Consumption (TFEC)

The Total Final Energy Consumption (TFEC), also known as gross final energy consumption, is the sum of all end-use energy utilised to provide various energy functions like electricity and secondary fuels such as coal, petrol, diesel, furnace oil, etc.

In the following section, we will examine the TFEC of Kerala sector wise and analyse the trend from FY2015-16 to FY2019-20 which will help us understand and identify energy saving potential. The baseline year is 2019-20 for all the subsequent sections.

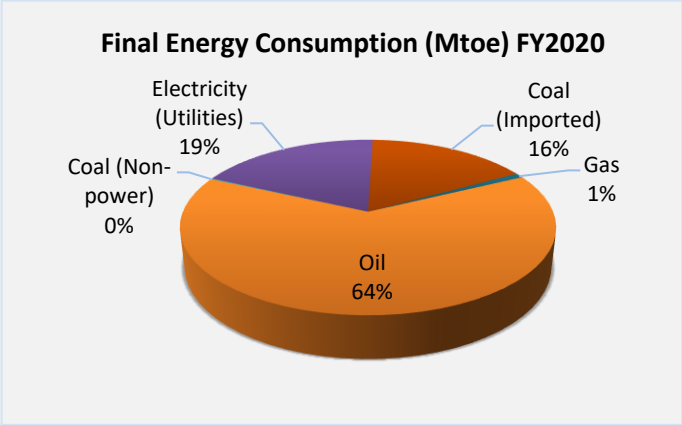
The Total Final Energy Consumption (TFEC) of Kerala for the FY2019-20 is 10.78 MTOE (Million Tonnes of Oil Equivalent). It accounts for the total energy consumed from electricity and fuel like coal, major petroleum products like LPG, diesel, ATF, furnace oil etc.

Figure 3 TFEC for Kerala state from FY2015 to FY2020



The below figure shows the distribution of various energy sources. Oil has the highest consumption with 64%, followed by electricity, coal and gas.

Figure 4 Contribution of energy sources for FY2020



Electricity Demand

Almost 99 % of the electricity needs in the state are met by KSEBL, the integrated state public sector electricity utility company. As on 31 March 2021, the total installed capacity of generation units of KSEBL was 2,174.27 MW. The transmission asset of the company includes 421 numbers of substations, and the distribution network carries 3.62 Lakh km line and more than 83,339 Distribution Transformers. Even though the internal resources are limited, capable of meeting only 30% of the energy requirement, KSEBL manages to meet the power requirement of the entire state without imposing any power restrictions by procuring power from other agencies and power exchange. After enabling the State to become 100% electrified in 2017, KSEBL continues to provide Power on Demand.

In Kerala, the total power inflow in FY 2021 was 25,132.93 MU (was 26,226 MU in FY 2020), out of which the internal generation was 7109.09 MU (5781.23 MU in FY 2020) and power imported was 18,262.34 MU (19,833.53 MU in FY 2020) . The electricity through open-access was 407.41 MU (611.32 MU in FY 2020). Electricity consumption (includes open access consumption) in 2020-21 decreased at a rate of 2.54%, to 22,540.32 MU from 23,058.91 MU in 2019-20. In 2020-21, AT&C loss decreased to 7.76 per cent from 13.15 per cent and transmission and distribution (T&D) loss came down to 10.32 per cent from 12.08 per cent. The increase in AT&C loss in 2019-20 and decrease in 2020-21 was due to the corresponding decrease or increase in collection efficiency in respective period. The Peak demand of the State in 2020-21 was 4,284 MW, indicating a slight fall from 4,316 MW in 2019-20. The fall in peak demand in 2020-2021 is due to lower economic activities in the wake of Covid-19[1].

The electricity consumption[2] in MU by the major sectors of Kerala for FY 2020 is given below.

Figure 5 Sector wise electricity consumption of Kerala

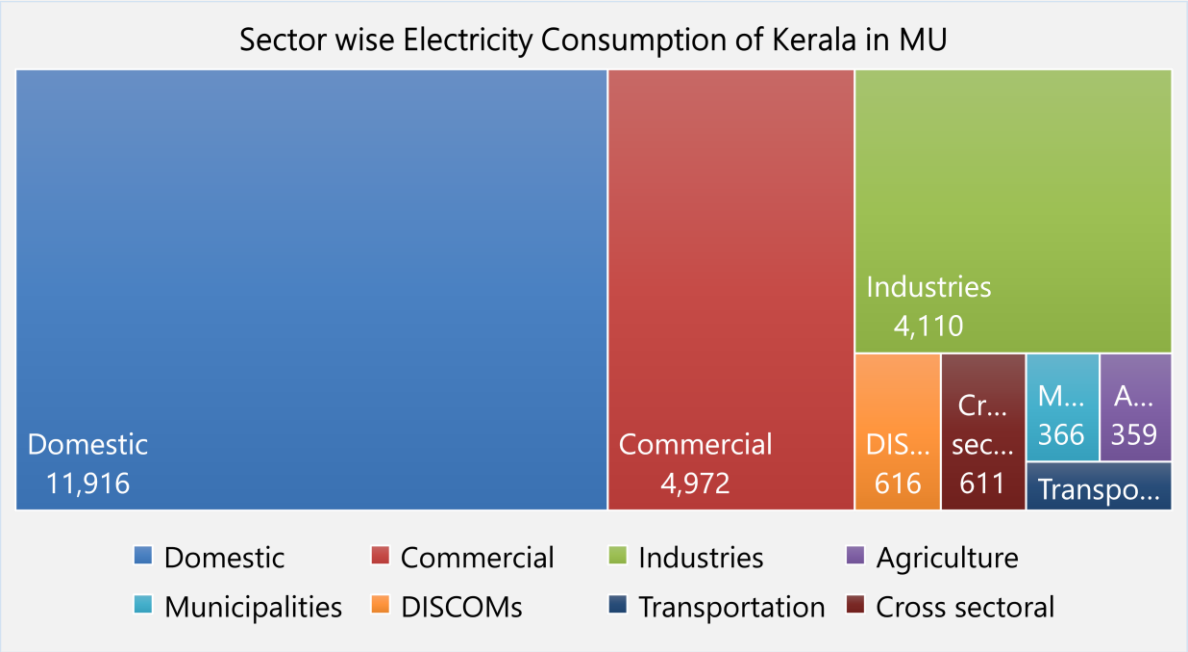


Figure 6: Sector wise Electricity Consumption of Kerala

The domestic sector is the most significant consumer of electricity and consumes about 51% of total electricity. The commercial sector comes second in electricity consumption and accounts for 18% of the total electricity consumption.

The industrial sector contributes to 18% of the total electricity consumption. In Industries, there are 6 Designated Consumers in Kerala. Kerala has the 12th largest number of MSMEs in India – around 23.79 lakh units, of which 23.58 are micro-enterprises.

DISCOMs account for 3% of total electricity consumption. KSEBL distributes power across the state, from where some companies/ institutions purchase power in bulk and distribute it further. Currently there are 10 such bulk suppliers/licensees within the state.

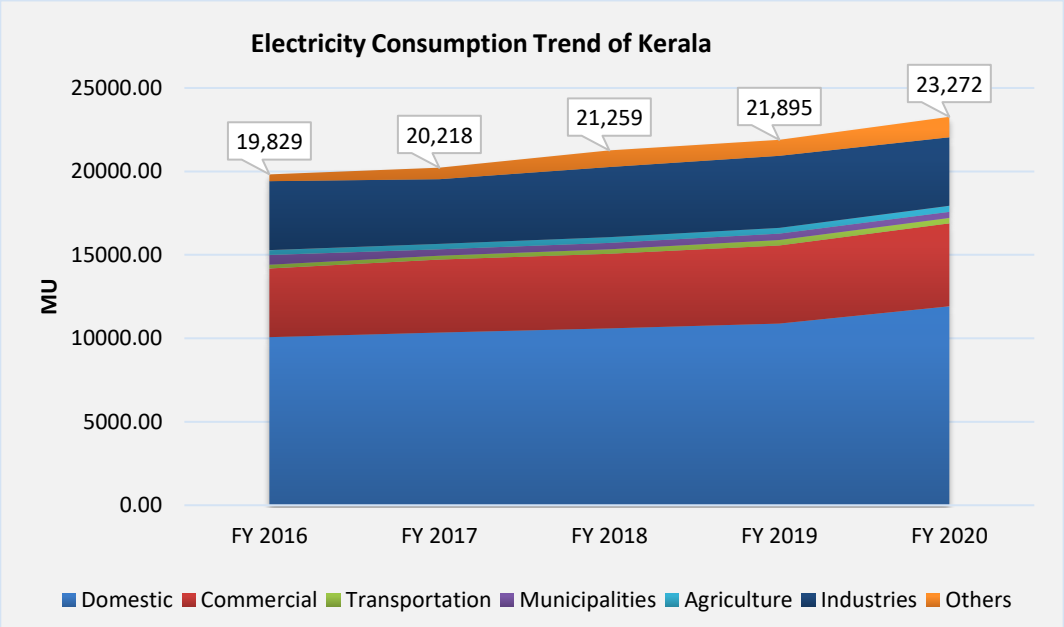
Electricity consumption from open-access is accounted as cross-sectoral consumption, as the procured electricity will be used by various consumers and bifurcation is not available. It constitutes 3% of the total electricity consumption.

[1] Economic Review of Kerala 2021
[2] ARR – ERC Petition of Kerala 2022-27

The municipality sector consumes 2% of electricity, while the transport and agricultural sectors consume 1% each. Transport sector consumption includes that by railway traction and metro services, and in municipality, the accounted consumption is from the use of streetlights. As mentioned before, the municipal pumping electricity consumption was not available as it was included in the industrial LT category and hence not included in Municipality sector. Pumps are the major electricity consumer in the agricultural sector.

Electricity consumption trend[3] of Kerala in MU for the period FY 2016 and FY 2020 is shown in Error! Reference source not found..

Figure 7 Electricity Consumption Trend of Kerala



The electricity consumption of Kerala has increased from 19,829 MU at a CAGR of 4.1% between FY 2016 and 2020. The largest contributor to electricity consumption, the domestic sector, has a CAGR of 4.3% while the commercial sector has a CAGR of 4.82%.

The transportation sector, which includes the consumption of traction is grown at a CAGR of 10%. The agricultural sector electricity consumption grew by 5.62%, primarily due to increase in electrical pumps instead of diesel pumps. As mentioned before, the electricity consumption of municipal pump works is not available and hence excluded and may be the reason for the negative CAGR of -11% in municipality sector.

[3] https://cea.nic.in/dashboard/?lang=en

1.5 Overview of Institutional framework and stakeholder mapping Energy

The Department of Power under the Government of Kerala is the apex authority in Kerala under which various agencies are working in tandem.

The Kerala State Electricity Regulatory Commission was constituted under the provisions of Subsection (1) of Section 17 of the Electricity Regulatory Commissions Act, 1998. With effect from 10th June 2003, the Commission has come under the purview of the Electricity Act, 2003, as the Electricity Regulatory Commissions Act, 1998 has since been repealed. It regulates and controls all the electricity related activities within the state like determining the tariff for generation, supply, transmission and wheeling of electricity, regulating electricity purchase and procurement process of distribution licensees, enforcing standards with respect to quality, continuity and reliability of service by licensees etc.

The Department of Electrical Inspectorate was formed by the Government vide G.O. (Ms) No.28 / 68 / PW. Dated 20-10-1968. The main function of the department is to ensure safety of all electrical installations as per the provisions of section 53 of Electricity Act 2003. The Licensing Board constituted vide Kerala State Electricity Licensing Board Rules is functioning under this Department. The main function of the Board is to issue Licences and permits to competent persons for the installation and maintenance of Electrical Installations.

The Kerala State Electricity Board Limited (formerly, Kerala State Electricity Board) which was constituted by the Government of Kerala as per order no. EL1-6475/56/PW dated 7-3-1957 of the Kerala State Government under the Electricity (Supply) Act, 1948 is the entity responsible for carrying out the business of Generation, Transmission and Distribution of electricity in the state of Kerala. It has been incorporated under the Companies Act, 1956 on 14th January 2011 and started operations as an independent company with effect from 1st November 2013 with the aim of providing quality electricity at an affordable cost to all classes of consumers in the state of Kerala.

Kerala Government is the first State Government in India to establish an Energy Management Centre (EMC) at State level, aiming primarily to remould and instrumentalise energy sector as a catalyst in promoting a development process that is economically and ecologically sustainable. It was established in Thiruvananthapuram (Trivandrum), Kerala, India in February 1996 as an autonomous organization under the Department of Power, Government of Kerala. It is the Designated Government agency or State Designated Agency (SDA) in Kerala to co-ordinate, regulate and enforce the provisions of the Energy Conservation Act 2001 (Central Act 52 of 2001).

Agency for New and Renewable Energy Research and Technology (ANERT) is an agency under the Power Department of Kerala which gathers and disseminates useful knowledge in the areas of non-conventional energy, energy conservation and rural technology; conducts studies, demonstrates, implements and supports the implementation of schemes and projects in these fields; updates the technologies used in rural areas; and introduces appropriate new technologies to reduce drudgery, increase productivity and improve the quality of life.

The institutional framework for energy efficiency in Kerala is shown in Figure 8.

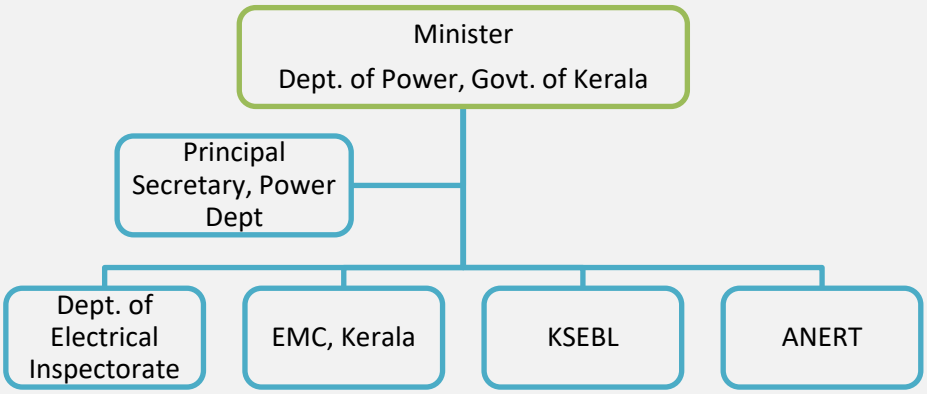


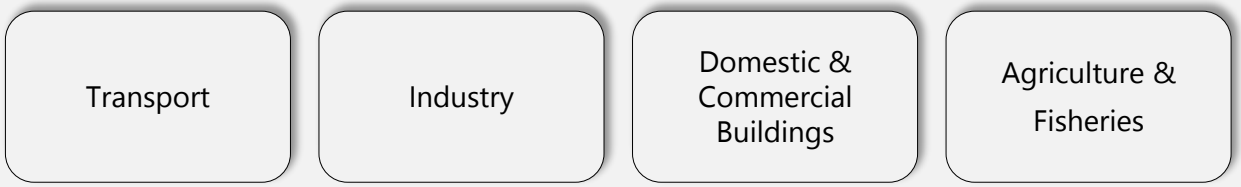
Figure 8: Institutional framework of Kerala – Energy Efficiency

2 IDENTIFICATION OF FOCUS SECTORS

2.1 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 Kerala.



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.

In the transport sector, road transport can be given more focus as the major contribution is from the consumption of fuels in road transport. Aviation sector also has a significant contribution but the scope for improvement is limited due to the sector specialties.

The domestic sector dominates in electricity consumption, followed by the commercial sector. Implementing demand side management in both groups of consumers has greater scope in reducing the energy consumption of the state.

In Kerala, MSME penetration is higher and the use of energy efficient technologies in the MSME sector, especially in MSME clusters reveals larger opportunity for energy reduction.

3 PROJECTIONS AND FORECASTING

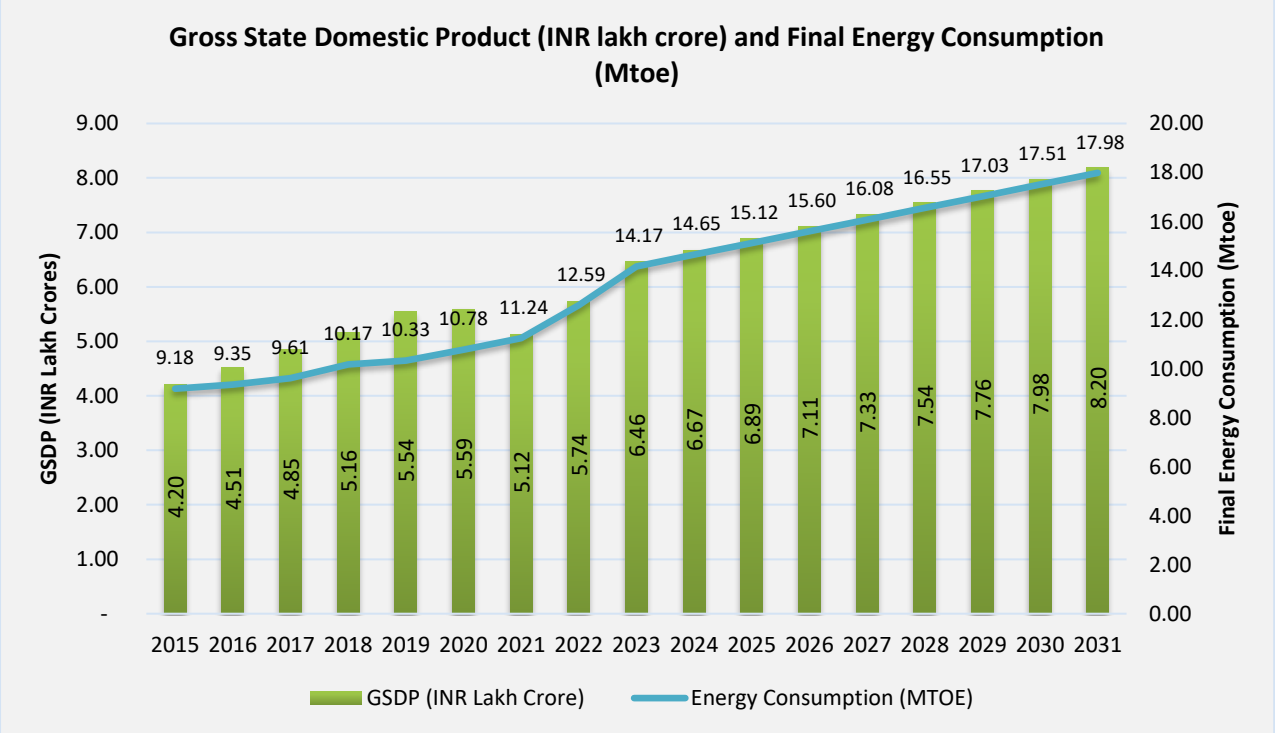
The methodology employed for estimating the TFEC projection for Kerala involved analyzing trends in final energy consumption and energy intensity, calculating the average intensity, using time-series modelling to make projections, and estimating the TFEC projection for FY FY 2030.

Base year determination: The base year for the projection was determined as FY 2015 from which TFEC data was available. FY 2015 had an actual TFEC of 9.81 MTOE.

Average intensity calculation: The average energy intensity was calculated by dividing the TFEC value by GSDP values for the years 2015-2020 and taking the average of the obtained values. This was done to identify the energy intensity trend and estimate the energy consumption for the year FY 2030.

Time-series modelling: Time-series modelling was used to analyze the trends in energy consumption and energy intensity. Historical data was used to identify patterns and make predictions about future trends. In this case, the energy intensity from 2015 till 2020 was used to estimate the energy consumption for the year FY 2030.

Figure 9 Gross State Domestic vs Final Energy Consumption



By examining energy consumption and intensity trends, it is possible to identify factors that influence energy demand, such as changes in economic conditions, shifts in technology, and alterations in government policy. Additionally, analyzing energy intensity trends can provide insights into the efficiency of energy usage and the effectiveness of energy-saving measures.

Projection estimation: Using the trends identified through the above steps, a projection was made for the TFEC for FY FY 2030. Based on the time-series modelling and average intensity calculation, the estimated TFEC projection for Kerala for the fiscal year FY 2030 will be 17.98 MTOE.

4 FOCUS SECTOR 1: INDUSTRY

4.1 Overview

As per the DIC dashboard of Kerala, 238 large scale industries (investment in plant and machinery or equipment is more than ₹50 crore and annual turnover is more than ₹250 crore) registered within the state; out of which 162 are from the manufacturing sector and 72 are from the service sector. The Table 1 shows the district wise number of large-scale industries in Kerala[4].

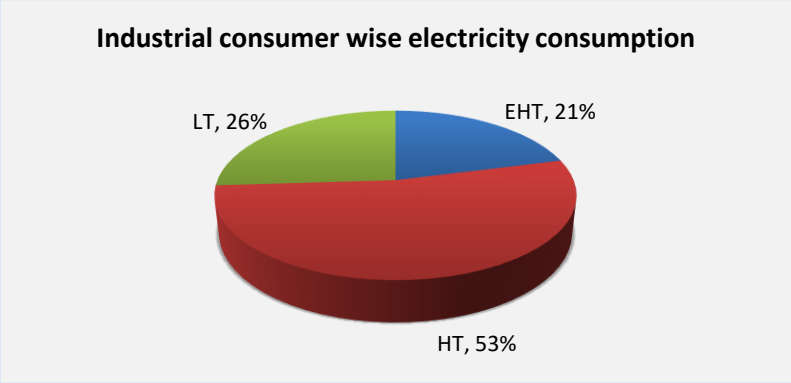
Table 1: District wise number of Large-scale industries in Kerala

Sr. No.	District	Manufacture	Service	Total
1	Thiruvananthapuram	4	12	16
2	Kollam	7	12	19
3	Pathanamthitta	26	19	45
4	Alappuzha	6	2	8
5	Kottayam	9	2	11
6	Idukki	4	2	6
7	Ernakulam	69	11	80
8	Trissur	9	12	21
9	Palakkad	11	2	13
10	Malappuram	12	7	19
11	Kozhikode	3	7	10
12	Wayanad	2	3	5
13	Kannur	2	1	3
14	Kasaragod	1	1	2
	Total	166	72	238

[4] https://schemes.industry.kerala.gov.in/public/index.php/public_dashboard

In 2019-20, the electricity consumption of large-scale industries under the EHT category is found to decrease by 18% when compared with 2018-19 data and the reason can be attributed to the impact of flood 2019 and Covid-19 in the last quarter of the year. The consumer wise electricity consumption of Industries in Kerala is given in below.

Figure 10 Industrial Consumer Electricity Consumption

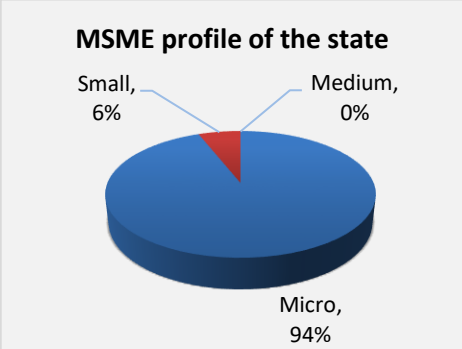


The industrial sector of Kerala was showing a decreased trend in energy consumption (-1.06 %) for the period FY 2016 and FY 2020. The average reduction in SEC of Designated Consumers in Kerala achieved through PAT cycle -1 and 2 was 2.65%. As Kerala made energy audits mandatory for all EHT/ HT consumers, it is recommended to introduce state level energy reduction targets and the estimated potential is 10%.

MSMEs

Micro, Small and Medium Enterprises (MSMEs) is the most important sector of the Indian economy, providing the largest number of employment opportunities after agriculture, with a relatively low level of capital per employee. The sector contributes about 45 per cent to India's manufacturing output and creates employment for about 11.1 crore people[5].

Kerala has a relatively high share of MSMEs in the country and the economic growth of the state is also related to the development of MSMEs. As per the DIC Dashboard, 150728 MSME units are registered in Kerala, out of which 142013 are in the micro sector, 8419 are in the small-scale sector and 296 are in the medium scale sector[6]. MSME Profile of Kerala is shown in the graph.



[5]https://msme.gov.in/sites/default/files/Accelerating%20Manufacturing%20in%20the%20MSME%20Sector_0.pdf

[6] https://schemes.industry.kerala.gov.in/public/index.php/public_dashboard

Micro Industries of Kerala has a massive contribution of 94% in terms of MSME numbers, while the medium scale industries contribution is less than 1%.

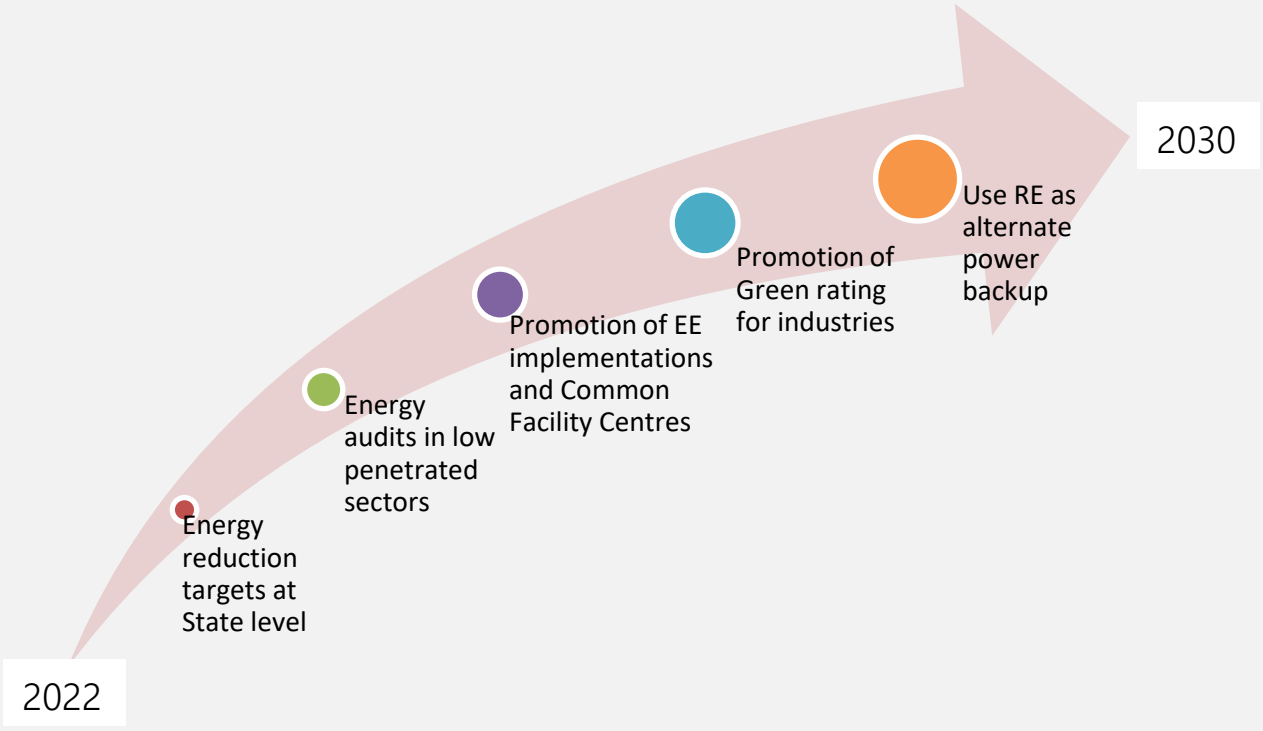
According to the Directorate of Industries and Commerce, 13,826 new MSME units were started in Kerala in 2018-19 with a total investment of ₹1,321.94 crores, and generated employment for 49,068 persons. In 2019-20, 13,695 new MSME units were started with an investment of ₹1,338.65 crores and generated employment for 46,081 persons.

Most of the SMEs in Kerala fall under the industrial LT category and the electricity consumption in 2019-20 of the above categories is 1085 MU. A small decrease in consumption is seen when compared to the 2018-19 level due to flood-19 in Kerala.

The EE penetration in the MSME sector is low and the energy efficiency interventions have a larger scope in that sector. The energy saving opportunities in MSME sector shows an average reduction potential of 13%.

4.2 Energy efficiency strategies in the industry sector

Some strategies that can be adopted to reduce the energy footprint of the industrial sector of Kerala are depicted below.

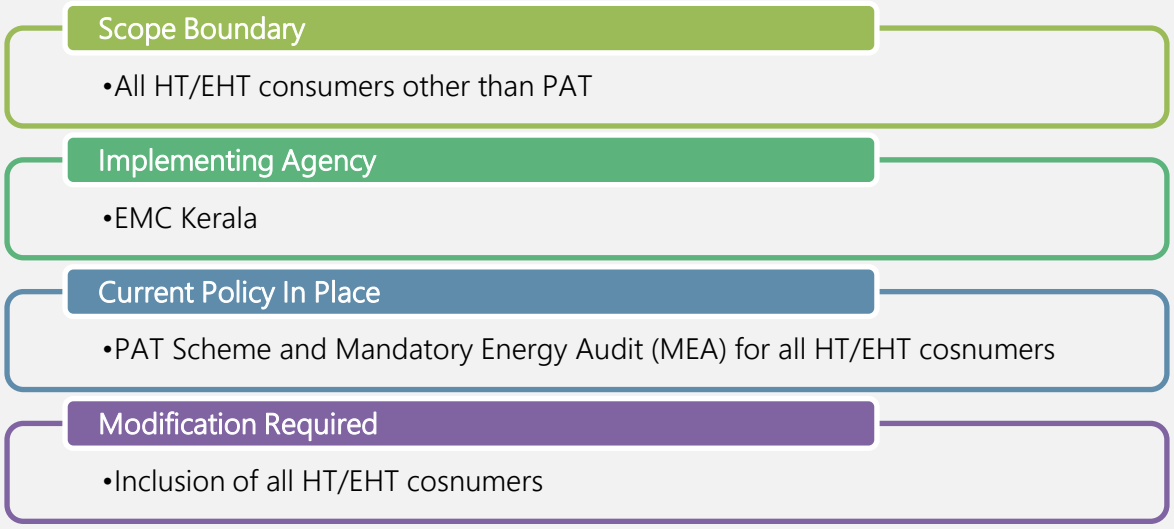


The policy aspects required at the state level for strategic actions in industrial sector is discussed in below chapters.

Strategy: State level Energy Reduction Targets – Identify, Implement & Verify scheme (IIV scheme)

In Kerala, the industrial sector is one of the major consumers of electricity, with high-tension (HT) and extra-high-tension (EHT) consumers accounting for a significant proportion of energy consumption. Therefore, policies targeting energy efficiency in this sector have the potential to have a significant impact on overall energy consumption in the state.

Kerala has mandated energy audits for all HT/ EHT consumers, which was a very good initiative to improve the energy efficiency of the sector. This scheme can be expanded further like a state level PAT scheme by introducing energy reduction targets for HT/ EHT consumers. An Identify, Implement and Verify (IIV) scheme can be introduced and penalties should be given to those who fails to comply.



Saving Potential

The methodology used to determine the potential energy savings in HT/EHT consumers is based on the electric consumption data from the entire industry sector in Kerala.

In a moderate scenario, it is estimated that there is a potential energy reduction of approximately 4% of the total energy consumption in the HT/EHT sector.

In ambitious scenario, the potential energy reduction increases to approximately 7%[7] of the total energy consumption in the HT/EHT sector. This scenario considers a more proactive approach and assumes the implementation of additional energy-saving measures and technologies.

[7] The percentages for energy saving potential have been derived from the extensive audit expertise of the Confederation of Indian Industry (CII)

Table 2: Energy Saving Potential

Particulars	Moderate Scenario for 2026	Ambitious Scenario for 2026	Moderate Scenario for 2031	Ambitious Scenario for 2031
Energy Saving Potential (MTOE)	0.075	0.132	0.081	0.141
GHG Emission Reduction Potential ($MtCO_2$)	0.236	0.413	0.252	0.442

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.

A) Identify, Implement and Verify (IIV) scheme	
Timeframe: Long Term	

Introduction:

The "Identify, Implement, and Verify (IIV)" scheme can be designed to further enhance energy efficiency in industries across Kerala. Building upon the successful energy audit mandate for High Tension (HT) and Extra High Tension (EHT) consumers, this scheme aims to expand energy reduction targets and promote the implementation of energy efficiency technologies. Non-compliance with the scheme should in penalties to ensure active participation and adherence to energy efficiency practices.

Energy Reduction Targets:

1) Implementation Scope: The IIV scheme will apply to all HT and EHT consumers in the industrial sector in Kerala. These consumers will be categorized into appropriate sectors based on their energy consumption patterns and industry types.
2) Energy Reduction Targets: Each categorized sector will be assigned energy reduction targets based on their historical energy consumption levels. These targets will be set in consultation with relevant industry associations, experts, and government agencies.

Components:

Identify Phase:

a. Energy Audit Compliance: All HT and EHT consumers will be required to conduct regular energy audits as mandated by existing regulations. Compliance with energy audits will be monitored and enforced strictly.

b. Technology Assessment: Consumers failing to achieve specified energy reduction targets in previous cycles will be required to undergo a comprehensive technology assessment. This assessment will identify potential energy efficiency technologies and practices suitable for their

industry.

Implement Phase:

a. Implementation Plans: Consumers failing to meet energy reduction targets will be required to develop and submit an implementation plan outlining the energy efficiency technologies and measures they intend to adopt. The plan should include a timeline, estimated energy savings, and cost-benefit analysis.

b. Financial Assistance: The government will offer financial assistance programs, incentives, and grants to support the implementation of energy efficiency technologies. These programs will be designed to encourage and facilitate the adoption of cost-effective energy-saving measures.

Verify Phase:

a. Performance Monitoring: Consumers implementing energy efficiency technologies will undergo regular performance monitoring to assess the effectiveness of their measures in achieving the set energy reduction targets.

b. Verification Audits: Independent third-party audits will be conducted periodically to verify the reported energy savings and assess the overall compliance of consumers with the IIV scheme. The audits will ensure transparency, accuracy, and reliability of the reported energy savings.

Penalties for Non-Compliance:

a. Non-compliance penalties will be imposed on HT and EHT consumers failing to comply with the IIV scheme, including not conducting energy audits, not meeting energy reduction targets, or not implementing proposed energy efficiency technologies.

b. Penalty amounts will be proportionate to the extent of non-compliance and may include financial penalties, reduction in benefits, or other suitable penalties as determined by the regulatory authority.

c. Penalties collected will be utilized for further promoting energy efficiency initiatives and providing additional support to compliant consumers.

Awareness and Capacity Building:

a. The government will conduct awareness campaigns and capacity-building programs to educate HT and EHT consumers about the benefits of energy efficiency technologies, the IIV scheme, and the penalties associated with non-compliance.

b. Training programs and workshops will be organized to enhance the technical knowledge and skills of consumers in implementing energy efficiency measures.

Strategy: Energy Efficiency Intervention in energy intensive MSME clusters

The Micro, Small, and Medium Enterprises (MSME) sector in Kerala is a significant contributor to the state's economy. However, energy intensive MSME clusters have been identified as a major source of energy consumption in the state. Statistics from the Kerala State Electricity Board (KSEB) show that electricity consumed by MSMEs increased by 11.6% from the financial

year 2015-16 to 2016-17. This increase can be attributed to the increase in manufacturing production in the MSME sector. To ensure that the incremental energy use does not increase energy demand, an energy efficiency intervention by the MSME clusters can reduce energy consumption.

The major energy intensive MSME clusters in Kerala are engaged in various manufacturing activities such as textiles, chemical production, electronics manufacturing, metal fabrication, food processing, and packaging. For instance, the Kinfra Apparel Park in Trivandrum, Kalamassery Industrial Estate in Ernakulam, and the Cochin Special Economic Zone in Kochi are large clusters that house several MSMEs engaged in energy-intensive activities.

Scope Boundary

- MSME clusters like dairy, seafood, rice mill cluster, plywood cluster & other Energy intensive MSMEs.

Implementing Agency

- EMC Kerala

Current Policy In Place

- Mandatory Energy Audit for all HT/ EHT consumers

Modification Required

- Inclusion of energy intensive MSMEs in the policy

Saving Potential

Figure 11 Baseline Production vs Projected for FYFY 2030[8]

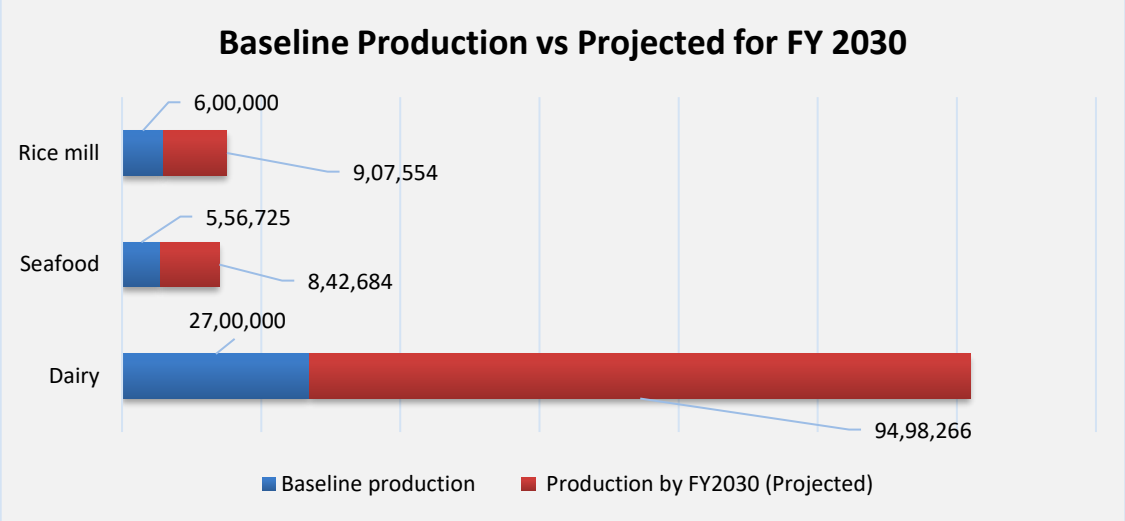


Figure 12 Specific Energy Consumption

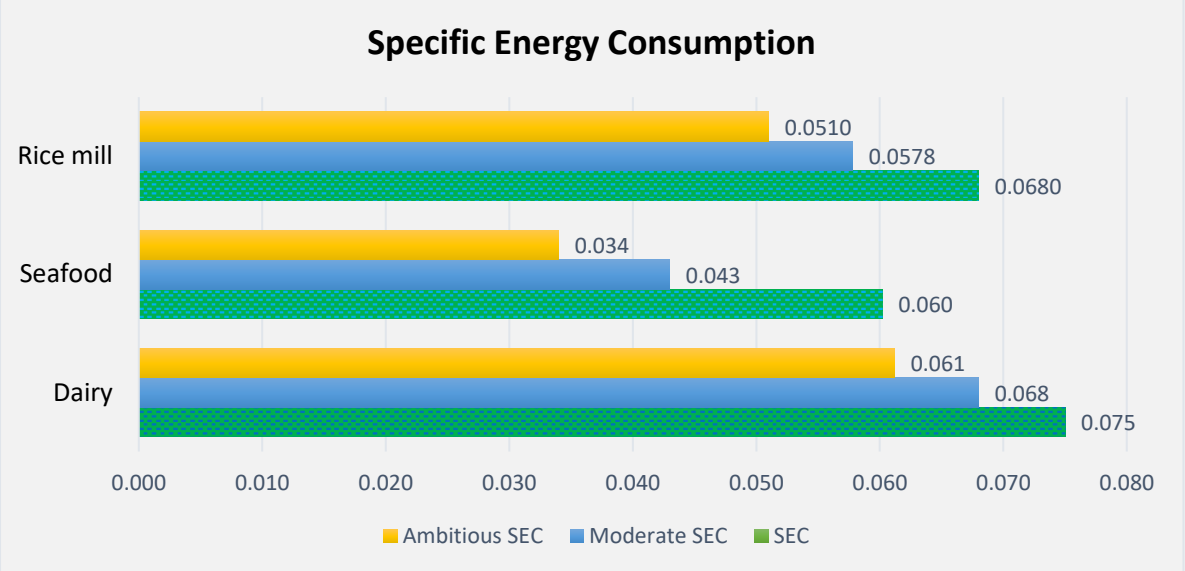


Table 3: Energy Saving Potential

Particulars	Moderate Scenario for FY 2030	Ambitious Scenario for FY 2030
Energy Saving Potential (MTOE)	0.06	0.15
GHG Emission Reduction Potential ($MtCO_2$)	0.19	0.5

[8] 1. Dairy Production 2021 2. Seafood Production 2021 3. Rice Production 2021

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.

A) Energy Audit Subsidy Scheme (EASS)	
Timeframe: Long Term	

Introduction:

The Energy Audit Subsidy Scheme (EASS) can be an initiative designed to incentivize energy audits in Micro, Small, and Medium Enterprises (MSMEs) in Kerala. The scheme should aims to increase the penetration of energy audits and promote the adoption of energy-efficient technologies in MSMEs. The Energy Management Centre (EMC) Kerala will allocate funds in each budget specifically for this activity.

Subsidy for Energy Audits:

. MSMEs will be eligible for subsidies to conduct energy audits in their facilities. The subsidies will cover a percentage of the total cost of the energy audit, including consultancy fees, instrumentation, and data analysis.

b. The subsidy rates will be determined by the EMC Kerala and communicated to the eligible MSMEs.

Fund Allocation and Target Utilization:

a. The EMC Kerala will allocate funds in each budget specifically for the Energy Audit Subsidy Scheme (EASS).

b. A minimum target for fund utilization or the number of energy audits will be set to ensure the efficient utilization of the scheme and maximize the coverage of MSMEs.

c. Regular monitoring and evaluation will be conducted to track the utilization of funds and the progress of the scheme.

MSME Clusters:

a. Initially, priority will be given to MSME clusters where sampling is possible and replication potential is higher. Some major MSME clusters in Kerala include the Dairy cluster, Seafood cluster in Kochi, Rice mill cluster in Kalady, and Plywood cluster in Perumbavoor.

b. The scheme will target MSMEs within these clusters to encourage comprehensive energy audits and facilitate the implementation of energy efficiency measures.

Application Process:

a. MSMEs interested in availing subsidies for energy audits under the EASS shall submit an application to the EMC Kerala.

b. The application shall include relevant information about the MSME, such as the nature of the business, energy consumption data, and the estimated cost of the energy audit.

Evaluation and Approval:

a. The EMC Kerala will evaluate the applications based on predefined criteria, such as the potential for energy savings, the existing energy efficiency measures, and the feasibility of conducting the energy audit.

b. Approved MSMEs will be notified and provided with the necessary instructions to proceed with the energy audit.

Subsidy Disbursement:

a. Upon completion of the energy audit, the MSMEs will submit the audit report and related documentation to the EMC Kerala.

b. The approved subsidy amount will be disbursed to the MSMEs based on the eligible expenses incurred during the energy audit.

Public Awareness and Capacity Building:

a. The EMC Kerala, in collaboration with industry associations and other stakeholders, can conduct awareness programs and capacity-building initiatives to educate MSMEs about the importance of energy audits and the benefits of energy efficiency.

b. Training sessions, workshops, and informational materials can be provided to assist MSMEs in understanding the energy audit process and implementing energy-saving measures.

B) Case of Rajasthan State Pollution Control Board (RSPCB)[9]

RSPCB launched the 'Green rating scheme for Industries in Rajasthan', on 7th July 2021. The program is aimed at enhancing and motivating the environmental performance of companies in Rajasthan, thereby enabling them to compete globally, in addition to achieving resource conservation and cost benefits. To ensure maximum participation of the industries in the scheme and to provide financial and other benefit to the green rated industries, the State Board has decided to provide the following incentives and recognition to the Green Rated industrial units:

Rating Category	Reduction in consent fee
Platinum	50%
Gold	25%
Silver	10%
Bronze	5%
Certified	-

Implementing a green rating system that evaluates these parameters and promotes sustainable practices in the industrial sector can contribute to improving energy efficiency

[9]https://environment.rajasthan.gov.in/content/environment/en/rajasthan-state-pollution-control-board/GreenRatingScheme.html

and sustainability in Kerala. By incentivizing and recognizing industries that adopt environmentally friendly practices, the state can foster a culture of sustainability and promote the adoption of greener technologies and practices.

4.3 Energy saving potential of the sector & monitoring mechanism

Energy saving potential of the industry sector is 0.29 MTOE and 0.52 MTOE for moderate and ambitious scenarios FYFY 2030 respectively as seen from Table 4.

Table 4 Summary of energy saving from the strategies.

Strategies	Energy Savings in FY 2025 under moderate scenario (Mtoe)	Energy Savings in FY 2030 under ambitious scenario (Mtoe)
1. State level Energy Reduction Targets – Identify, Implement & Verify scheme (IIV scheme)	0.08	0.14
2. Energy Efficiency Intervention in energy intensive MSME clusters	0.06	0.15
TOTAL:	0.14	0.3

Emission Reduction Potential (mTCO2)

Particulars	FY 2025 under moderate scenario	FY 2030 under ambitious scenario
Emission Reduction Potential (mTCO2)	0.4	0.9

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

Particulars	Monitoring Mechanism
Regulatory	The State Electricity Regulatory Commission (APERC) is responsible for regulating the power sector in the state, including the implementation of energy policies for industries. They 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 SDA 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.

5 FOCUS SECTOR 2: TRANSPORT

5.1 Overview

Kerala has a well-developed transport sector that comprises various modes of transportation such as roadways, railways, waterways, and airways. Kerala has a well-connected road network with a total length of around 145,704 km, out of which 4,341 km are national highways. The state has an extensive network of state highways, district roads, and village roads, which are maintained by the Kerala Public Works Department. The state-run Kerala State Road Transport Corporation (KSRTC) operates a fleet of buses that provide intercity and intracity transport services to the people. Apart from this, private operators also provide bus services in the state. The state of Kerala has an extensive network of backwaters and canals, which are used for transportation purposes. The Inland Waterways Authority of India has developed waterways in the state for cargo and passenger transportation. The major ports in Kerala are the Kochi Port and the Vizhinjam Port.

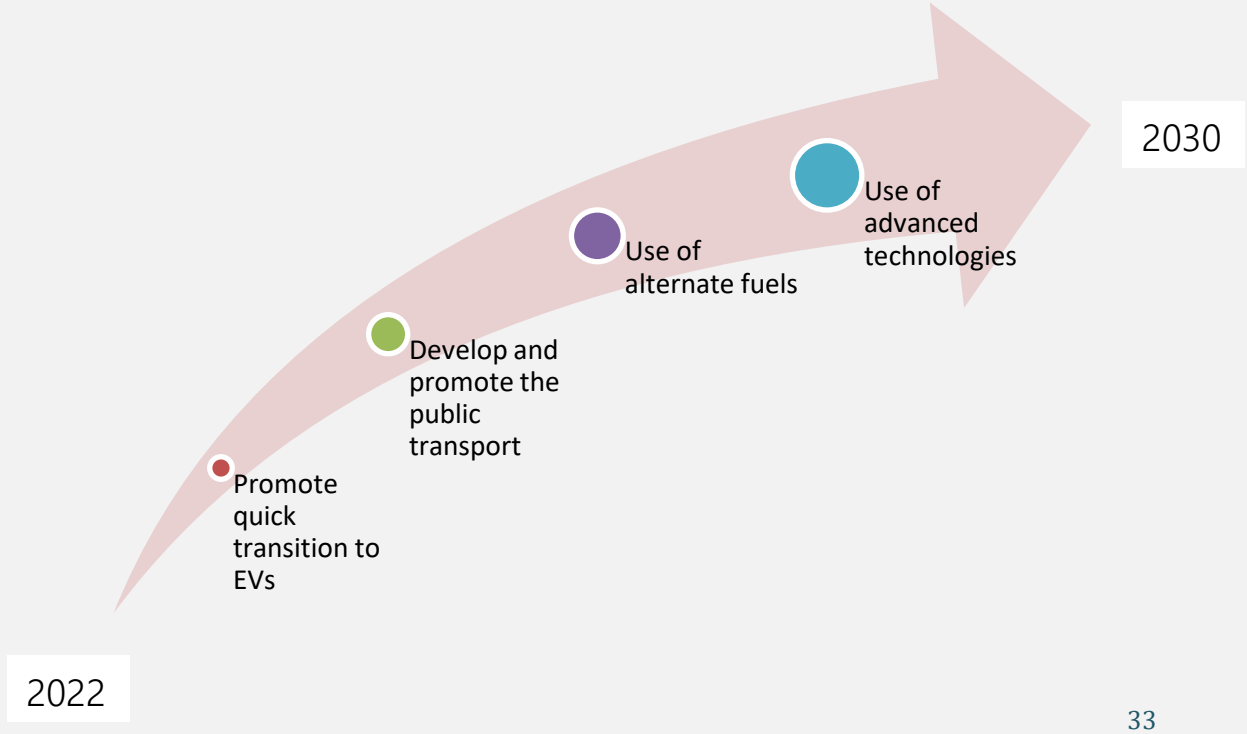
5.2 Energy efficiency strategies in the transport sector

The most commonly used vehicles in Kerala are motorcycles, scooters, and auto-rickshaws. Cars and buses are also commonly used for transportation, especially for long-distance travel. Kerala has a high density of vehicles, with over 14 million registered vehicles as of 2021. This has resulted in traffic congestion and pollution in some of the major cities in the state.

In recent years, the state government has been promoting the use of electric vehicles as a means of reducing pollution and dependence on fossil fuels. There are a few electric vehicle charging stations in the state, and the government has announced plans to set up more of them in the coming years.

Kerala also has a well-developed public transportation system, with state-run buses and private buses operating on various routes. The state government also operates a metro rail system in Kochi, which is the only metro rail system in the state currently. Water transport is also available in some parts of the state, with ferries and boats operating on various routes.

The strategic areas that can be focused in short term and long term for reducing the energy consumption of transportation sector is shown below.



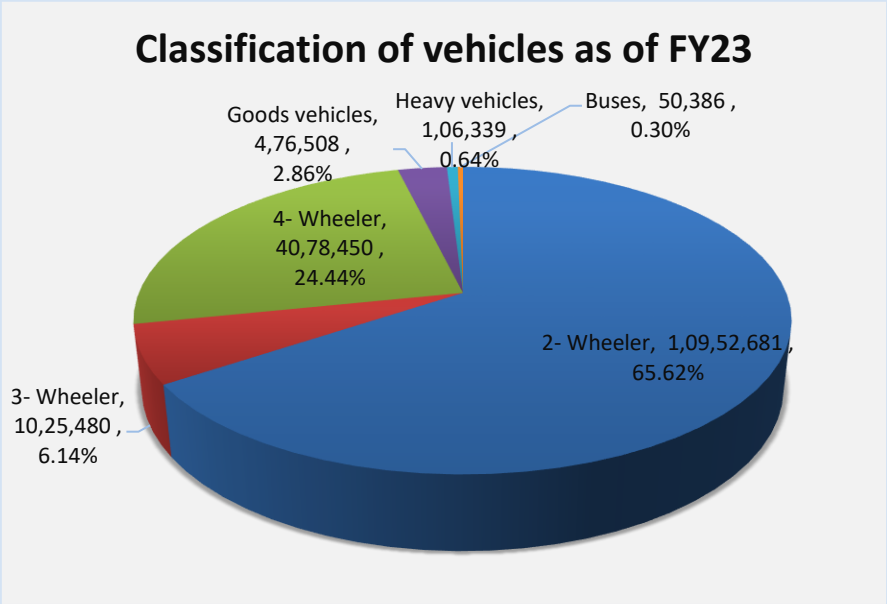
The policy interventions required for reducing the energy consumption of transportation sector is discussed in the subsequent section.

Strategy: Facilitating Electrification of Road Transport

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.

According to the data from Vahan dashboard[10], the state has nearly 66% of two wheelers out of the total share of vehicles followed by four wheelers and three wheelers respectively.

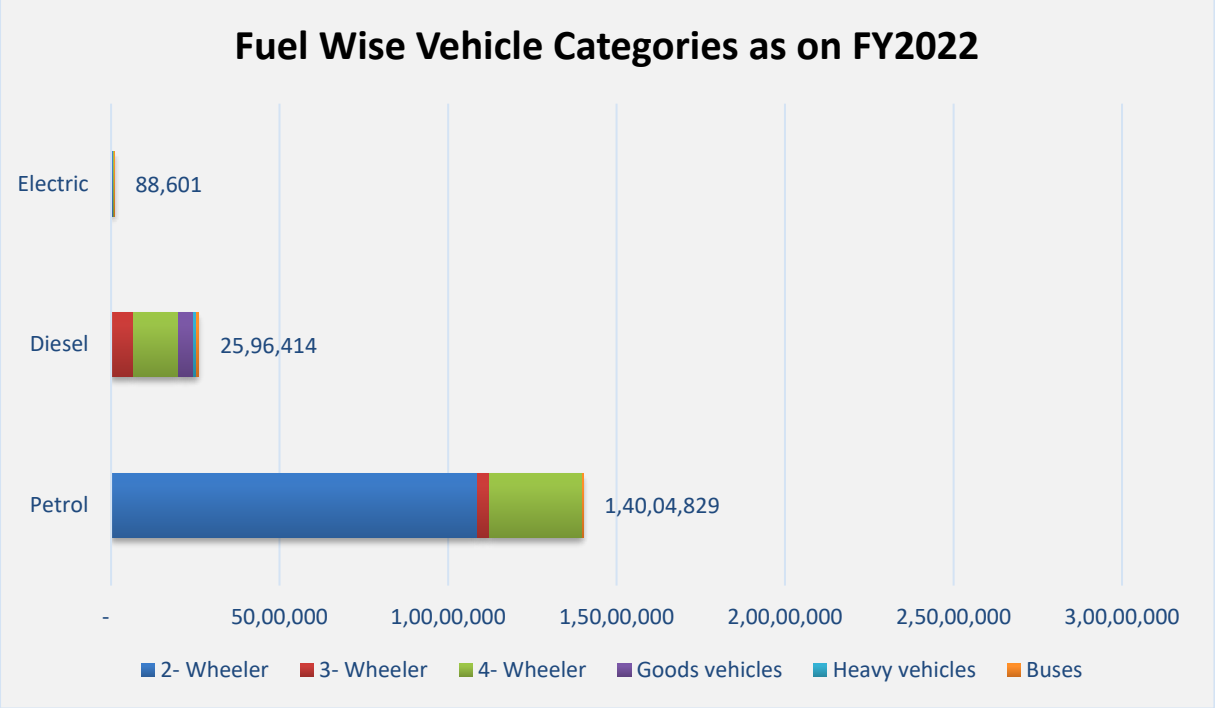
Figure 13 Classification of vehicles as on FY2022



There are nearly 1.4 crore petrol vehicles and 25 lac diesel vehicles. The adoption of electric vehicles is increasing steadily in Kerala, with more and more people opting for electric two-wheelers and cars. There are more than 85,000 electric vehicles in Kerala. However, this only constitutes to 0.5% share of fuel source as opposed to petrol and diesel which stands at 84% and 16% respectively.

[10] Online dashboard for national visibility of vehicle registration and related services.

Figure 14 Fuel Wise Vehicle Categories as on FY2022



The strategy for electrification of vehicles and its implementation is explained below.

Scope Boundary

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

Implementing Agency

- EMC, ANERT, KSEB

Current Policy In Place

- Kerala EV Policy

Saving Potential

Below figure shows the actual number of electric vehicles in the state as of FY2021 categorized into vehicle types. If these numbers are projected under "business as usual" scenario based on the historic economic and energy growth rate (6%) of this sector, there is only a slight rise in EV numbers. However, after the implementation of the policy of converting existing petrol and diesel fleet, taking into account the conversion percentage of ICE vehicles for the moderate scenario and ambitious scenario as per below figure, it can result into significant energy saving of nearly 1 MTOE under the ambitious scenario.

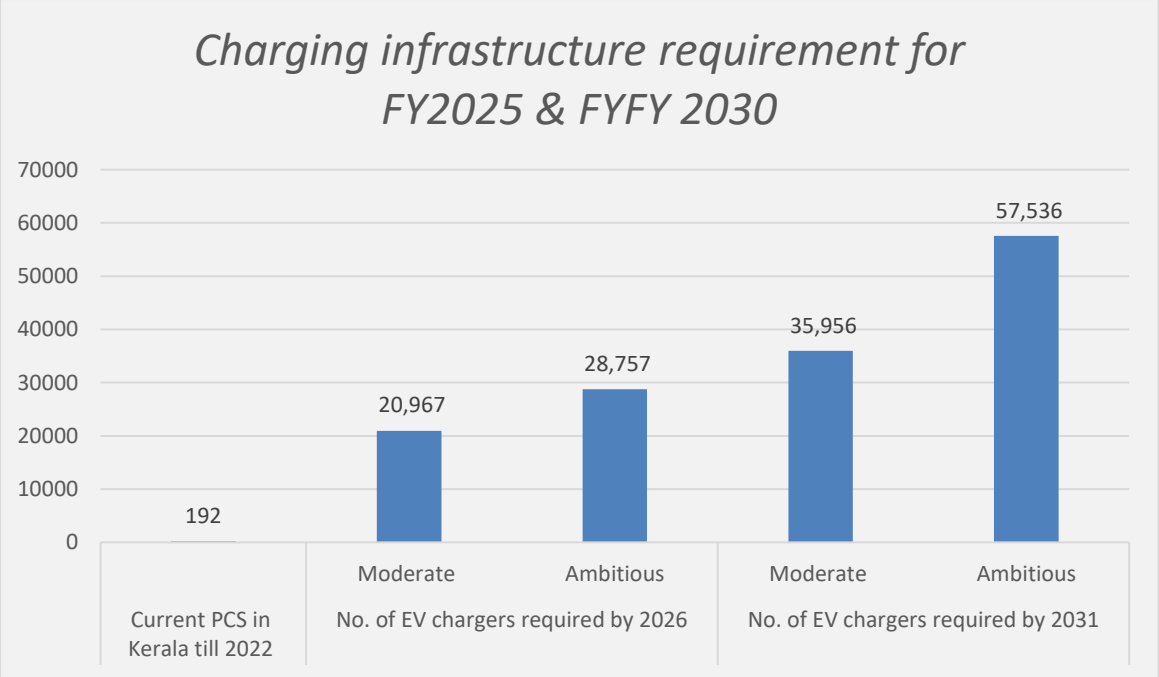
From 0.5% of EVs of total numbers of vehicles in FY21, the state can aim to achieve 2.5% of EVs by 2030 under moderate scenario and 4% under ambitious scenario as per the estimation below.

Figure 15 Actual EVs till FY21 vs projected EVs of till FY30

	% conversion of existing fleet onto EVs		No of Vehicle Converted to EV in 2026		No of Vehicle Converted to EV in 2031	
Category	Moderate %	Ambitious %	Moderate	Ambitious	Moderate	Ambitious
2- Wheeler	-5%	-8%	4,24,925	5,82,755	7,28,714	11,65,943
3- Wheeler	-5%	-8%	39,823	54,614	68,293	1,09,268
4- Wheeler	-5%	-8%	1,58,883	2,17,897	2,72,472	4,35,955
Goods vehicles	-1%	-2%	3,722	6,380	6,382	12,764
Heavy vehicles	-1%	-2%	831	1,424	1,424	2,849
Buses	-25%	-35%	9,827	11,793	16,853	23,594
		Total	6,38,010	8,74,862	10,94,138	17,50,373

In order to accommodate the addition of these electric vehicles following number of charging stations will be required.

Figure 16 Charging infrastructure requirement for FY2025 & FYFY 2030



By increasing the share of EVs in the vehicle stock of Kerala with nearly 10 lakh EVs in moderate scenario and 17 Lakh EVs in ambitious scenario by 2031, additionally 35,000 charging stations and battery swapping infrastructure by 2026 and 56,000 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 FY 2030.

Table 5: Energy Saving Potential

Particulars	Moderate Scenario for FY 2030	Ambitious Scenario for FY 2030
Energy Saving Potential (MTOE)	0.56	0.84
GHG Emission Reduction Potential ($MtCO_2$)	1.7	2.6

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.

Particulars	Action Plan	Timeline
Awareness & Capacity Building	1. Awareness on Standard & Labelling Program for Tyres	Short Term
	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
	2. Charging stations based on open access	Long Term
	3. Pilot projects on Hydrogen Fuel Cell Vehicles	Long Term
	4. Pilot projects on Battery Swapping stations in all 10 model cities	Long Term

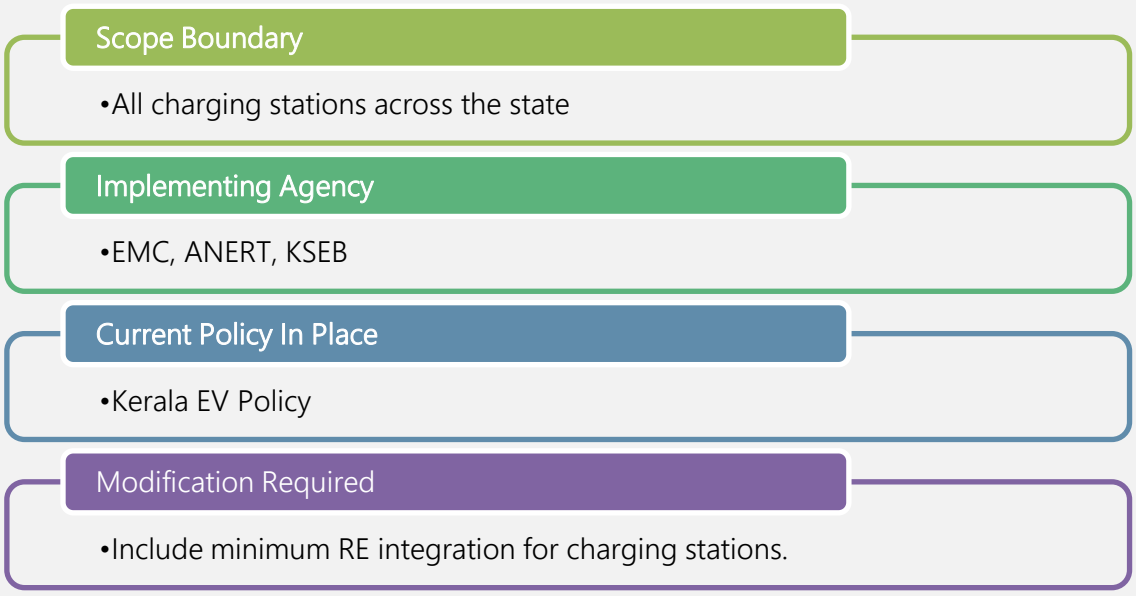
Strategy: Minimum renewable energy integration (60%) for EV charging stations

The adoption of electric vehicles (EVs) is growing rapidly in Kerala, and this trend is expected to continue. As more EVs hit the road, the demand for electricity will increase, which could strain the existing power grid. However, if EV charging stations are powered by solar energy, the additional demand can be met without putting additional pressure on the grid. According to the Ministry of New and Renewable Energy, India had a total installed solar capacity of 41.09 GW as of 31 December 2021. Kerala's electricity generation is heavily dependent on fossil fuels. According to the Central Electricity Authority, fossil fuels account for 78% of the state's installed capacity as of March 2021. However, solar energy can be a clean and renewable source of power that can help reduce Kerala's dependence on fossil fuels for electricity. As of March 2021, Kerala had an installed solar capacity of 128 MW, which is only a small fraction of its total installed capacity.

According to the Kerala State Electricity Board, the state's peak demand for electricity in 2020-21 was 4,423 MW, while the average power consumption was around 78,000 MU. If we assume that EVs will account for 10% of the total vehicles in Kerala by 2030 and that each EV requires an average of 20 kWh to charge, the total energy demand for EVs will be around 5,040 MU per year. If 60% of this demand is met through solar energy, it would require an additional 3,024 MU of solar energy per year.

In conclusion, implementing a policy mandating solar energy integration of at least 60% for EV charging stations can help Kerala meet the increasing demand for electricity from EVs, reduce its dependency on fossil fuels, and promote clean energy.

The strategy and its implementation are explained below.



Saving Potential

Based on assumptions from Table 21, following kW panel requirement was estimated.

Figure 17 kW Panel Required for 60% RE integration till FY2025 & FY 2030

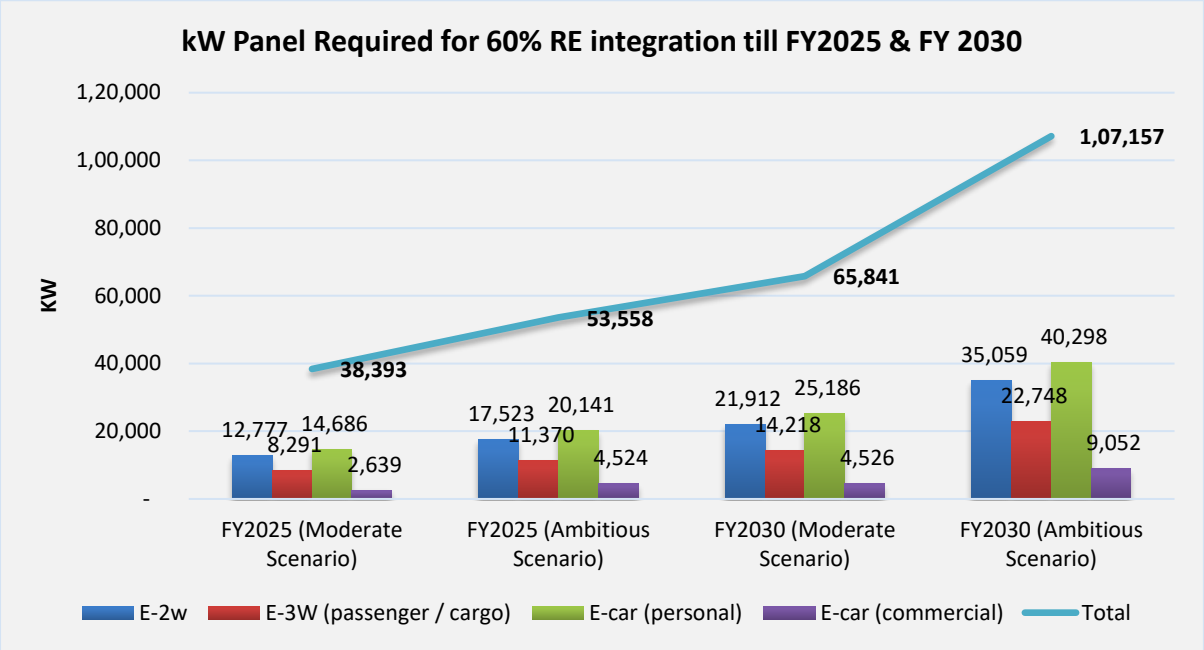


Table 6: Energy Saving Potential

Particulars	Moderate Scenario for FY 2030	Ambitious Scenario for FY 2030
Energy Saving Potential (MTOE)	0.04	0.07
GHG Emission Reduction Potential ($MtCO_2$)	0.12	0.21

Strategy: Ethanol Blending

The ethanol blending policy of fuels can have a significant impact on the economy and environment of Kerala. By blending ethanol with petrol, the state 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.

Scope Boundary

- Cars, public transport vehicles like three-wheelers, four-wheelers, buses..

Implementing Agency

- State Transport Department

Saving Potential

The saving potential is estimated based on following assumptions.

	FY 2025		FY 2030	
Blending of fuel	Moderate	Ambitious	Moderate	Ambitious
Fuel Blending %age	15%	20%	20%	25%
Already Blending in Fuel%	10%	10%	10%	10%
Incremental Fuel Blending	5%	10%	10%	15%
Energy consumption by petrol vehicles	2.17	2.17	2.61	2.61
Energy Saved (MTOE)	0.11	0.22	0.26	0.39
Emission Factor for Oil ($kgCO_2$/MTOE)	3.13	3.13	3.13	3.13
Emission Avoided (Mn TCO2)	0.34	0.68	0.82	1.23

Table 7: Energy Saving Potential

Particulars	Moderate Scenario for FY 2030	Ambitious Scenario for FY 2030
Energy Saving Potential (MTOE)	0.26	0.39
GHG Emission Reduction Potential ($MtCO_2$)	0.8	1.2

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.

Particulars	Action Plan	Timeline
Technological Intervention	1. Enabling infrastructure for ethanol availability for blending	Short Term
Subsidy	1. State can ease storage, movement, and permit norms for industrial fuel-grade ethanol.	Long Term
	2. Incentive to setup new distilleries to produce ethanol and to install any method approved by CPCB, Capital subsidy (technical civil works, Plant and machinery)	Long Term
	3. Interest subsidy at 7% on term loan for 5 years with cap in addition to the assistance received under central govt	Long Term

Strategy: Personal Rapid Transit (PRT) in Tier-2 & Tier-3 Cities

Implementing a policy on Personal Rapid Transit (PRT) in Tier-2 & Tier-3 Cities can significantly contribute to energy efficiency in Kerala. PRT systems consist of small, driverless electric vehicles that run on dedicated tracks, which eliminates the need for large-scale infrastructure and minimizes energy consumption. According to a study by the International Energy Agency, PRT systems can reduce energy consumption by up to 90% compared to traditional modes of transportation.

Kerala has a high population density and is heavily reliant on fossil fuels for transportation, which contributes to air pollution and greenhouse gas emissions. By adopting PRT systems in Tier-2 & Tier-3 Cities, Kerala can reduce its energy consumption and carbon footprint while providing a convenient and sustainable mode of transportation to its residents. Additionally, PRT systems have the potential to increase access to public transportation and reduce traffic congestion, which can lead to further energy savings and environmental benefits.

According to the Ministry of New and Renewable Energy, Kerala has a target of achieving 15% renewable energy generation by 2022. Adopting PRT systems in Tier-2 & Tier-3 Cities can contribute to achieving this target by reducing the demand for fossil fuel-based transportation.

This is particularly important for cities like Kozhikode and Trivandrum, which have high population densities and suffer from traffic congestion and poor air quality.

Scope Boundary

•Cities in Kerala like Kozhikode, Trivandrum.

Implementing Agency

•State government

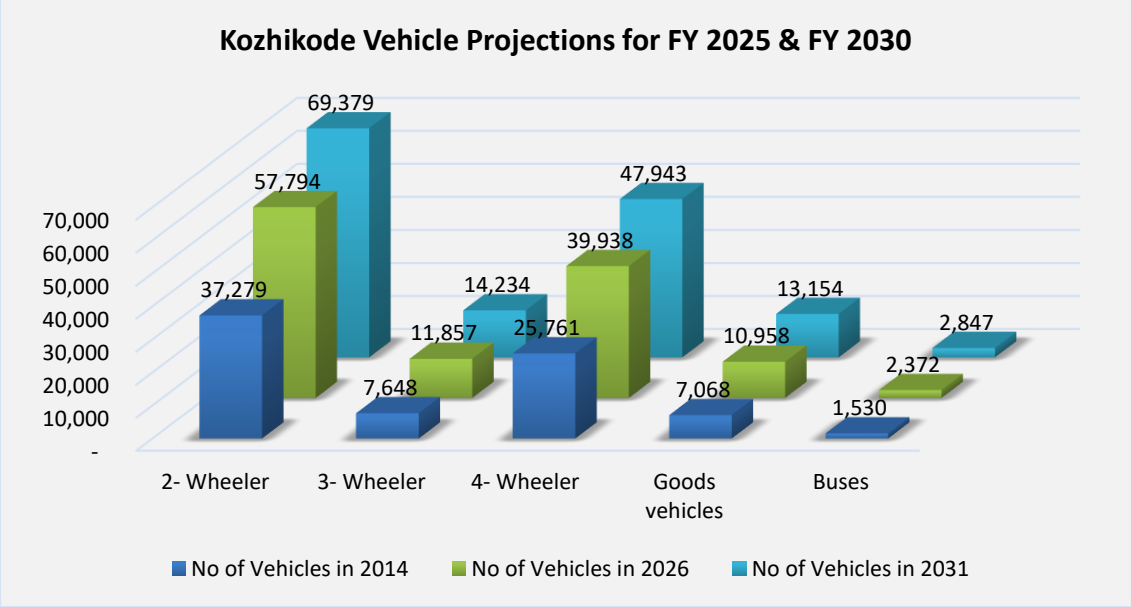
Current Policy In Place

•No current policy

Saving Potential

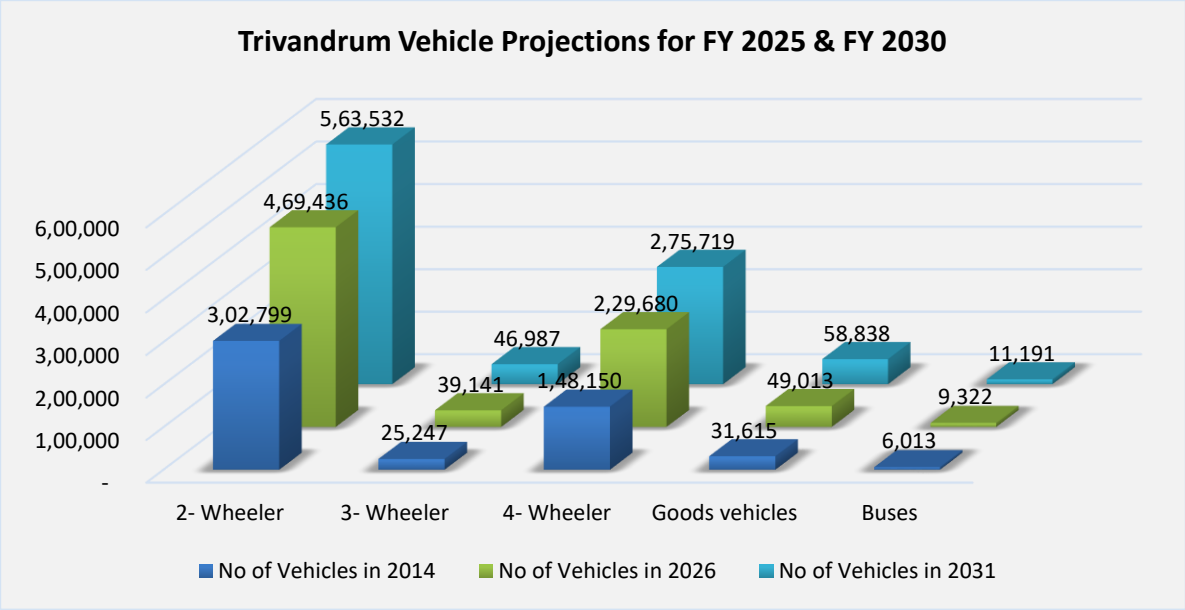
Total number of vehicles in Kozhikode for FY 2025 and FY 2030 is projected below.

Figure 18 Kozhikode Vehicle Projections for FY 2025 & FY 2030



Similarly, total number of vehicles in Trivandrum for FY 2025 and FY 2030 is projected below.

Figure 19 Trivandrum Vehicle Projections for FY 2025 & FY 2030



The saving potential is estimated based on following assumptions.

Category of Vehicle	Moderate	Ambitious
2- Wheeler	15%	20%
3- Wheeler	20%	25%
4- Wheeler	15%	20%
Goods vehicles	10%	15%
Buses	20%	25%

Cumulatively, if Kozhikode and Trivandrum vehicle consumers based on above percentages switch to PRT mode of transport, 0.16 MTOE energy can be conserved.

Table 8: Energy Saving Potential

Particulars	Moderate Scenario for FY 2030	Ambitious Scenario for FY 2030
Energy Saving Potential (MTOE)	0.12	0.16
GHG Emission Reduction Potential ($MtCO_2$)	0.3	0.5

Strategy: Inland waterways development for goods and passenger transport

Inland waterways transportation is a highly energy-efficient mode of transport as it requires less fuel than road transport. According to a study conducted by the National Waterway (NW) 3 and 4, the energy consumption per ton-km of inland water transport is about one-tenth that of road transport. This will help in reducing the fuel consumption of the transport sector in Kerala, resulting in significant energy savings.

Inland waterways transportation emits fewer greenhouse gases per tonne-kilometer than road transport. According to a study by the International Association of Ports and Harbors (IAPH), the carbon dioxide emissions per tonne-kilometer for inland waterways transport are about 50% lower than for road transport. This reduction in emissions can help Kerala meet its climate change goals and contribute to global efforts to reduce greenhouse gas emissions.

Kerala is known for its narrow and congested roads, especially in urban areas. By shifting goods and passengers to inland waterways, the state can reduce road traffic congestion, leading to shorter travel times, improved road safety, and lower fuel consumption. This can also help in reducing the maintenance costs of roads, as they will experience less wear and tear. The development of inland waterways in Kerala is primarily driven by the State Water Transport Department (SWTD), Coastal Shipping and Inland Navigation Department (CSIND), and Kerala Shipping and Inland Navigation Corporation (KSINC). These agencies play significant roles in advancing the infrastructure and operations of inland water transportation systems in the region.

Scope Boundary

- Cities in Kerala like Kozhikode, Trivandrum.

Implementing Agency

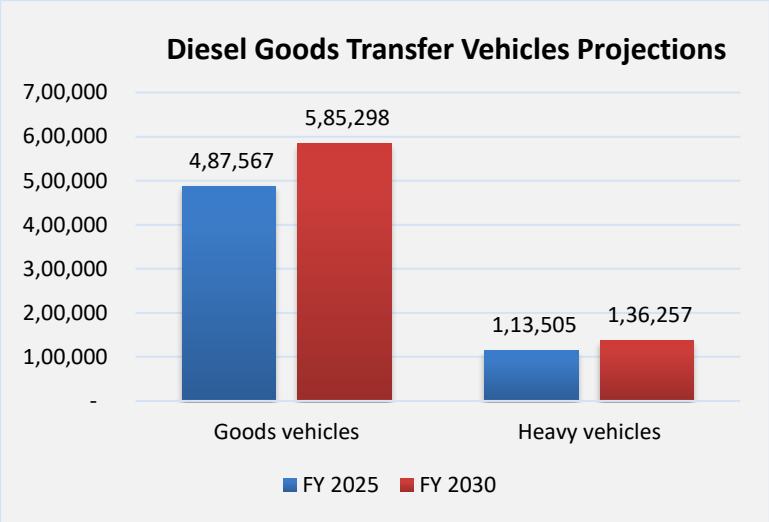
- Kerala State Water Transport Department

Current Policy In Place

- No current policy

Saving Potential

Figure 20 Diesel Goods Transfer Vehicles Projections



Considering 5% of goods transfer through water in moderate scenario and 8% in ambitious scenario, following energy potential can be achieved.

Table 9: Energy Saving Potential

Particulars	Moderate Scenario for FY 2030	Ambitious Scenario for FY 2030
Energy Saving Potential (MTOE)	0.15	0.24
GHG Emission Reduction Potential ($MtCO_2$)	0.5	0.7

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.

Particulars	Action Plan	Timeline
Incentives	To encourage the use of inland waterway transport, the government could provide financial incentives such as tax breaks, subsidies, and other financial support to transport operators who switch to this mode of transport. This can help to offset the initial capital costs involved in setting up and maintaining the infrastructure required for inland waterway transport.	Long Term

Regulations	Regulations and standards for inland waterway transport can help to ensure that the transport system is safe, efficient, and environmentally sustainable. The government should establish regulations and standards for inland waterway transport, including safety regulations, environmental standards, and operational guidelines.	Short Term

5.3 Energy saving potential of the sector & monitoring mechanism

Energy saving potential of the transport sector is 0.6 MTOE and 0.9 MTOE for moderate and ambitious scenarios FYFY 2030 respectively as seen from Table 4.

Table 10 Summary of energy saving from the strategies.

Strategy	Energy Saving Potential in FY2025 (Moderate)	Energy Saving in FY2030 (Ambitious)
1. Electrification of vehicles	0.56	0.84
2. Minimum renewable energy integration (60%) for EV charging stations	0.04	0.07
3. Ethanol Blending	0.26	0.39
4. Personal Rapid Transit (PRT) in Tier-2 & Tier-3 Cities	0.12	0.16
5. Inland waterways development for goods and passenger transport	0.15	0.25
TOTAL:	1.13	1.7

Emission Reduction Potential (mTCO2)

Particulars	FY 2025 under moderate scenario	FY 2030 under ambitious scenario
Emission Reduction Potential (mTCO2)	3.53	5.3

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

Particulars	Monitoring Mechanism
Data Collection	Regular data collection and analysis can help track progress towards these targets and indicators. The state government can collect data on the number of electric vehicles on the road, the amount of fuel consumed, and the usage of public transportation. This data can be analysed to assess the effectiveness of policies and identify areas where improvements can be made.
Reporting	The state government can publicly report on progress towards climate change targets and indicators. This can be done through annual reports or other public documents. By making this information public, the government can increase accountability and transparency, and encourage public engagement and participation.
Stakeholder engagement	Engaging with stakeholders, including industry, civil society, and the public, can help ensure that policies are effective, and that progress is being made. The state government can establish stakeholder groups or committees to provide feedback on policies, identify potential challenges, and suggest improvements.
Technology Assessment	Regularly assessing emerging transport technologies and their potential impact on greenhouse gas emissions can help inform policy decisions and ensure that policies remain up to date with the latest developments.

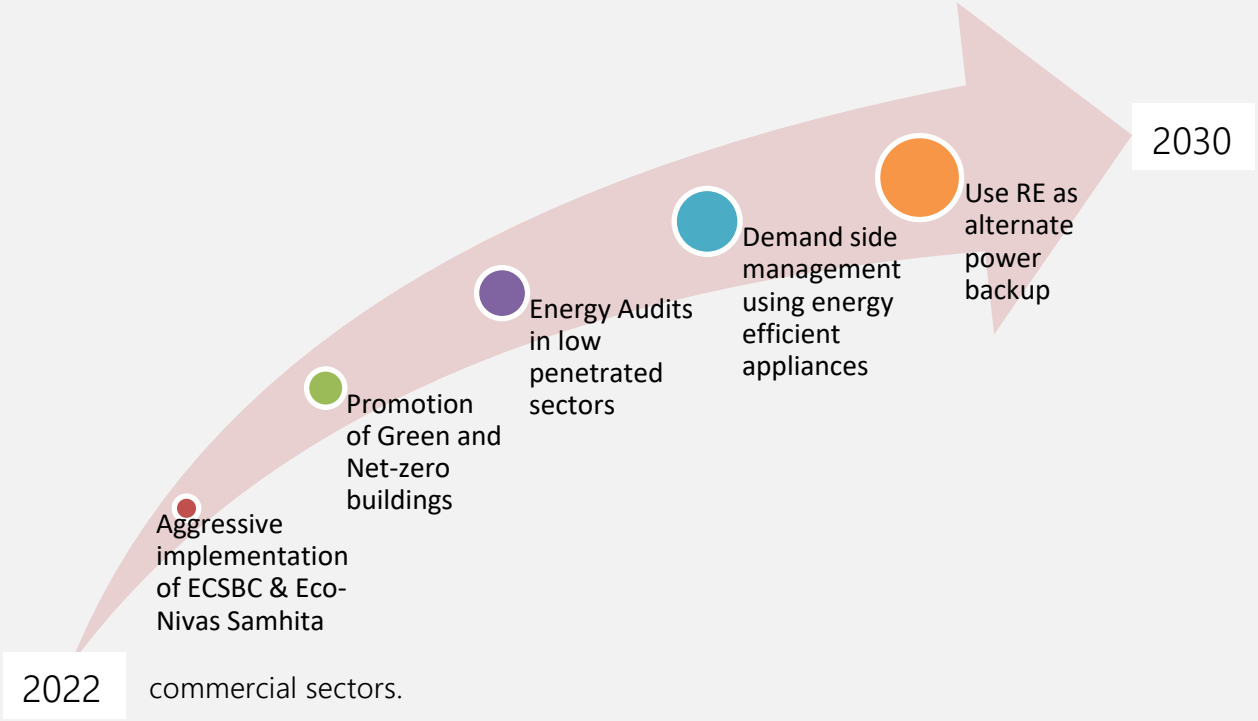
6 FOCUS SECTOR 3: BUILDINGS

6.1 Overview

In Kerala, the residential buildings sector is dominated by individual houses and apartments. The state has a high number of nuclear families, and as a result, the demand for smaller homes is increasing. The housing sector in Kerala is also witnessing a shift towards eco-friendly and sustainable building practices. The use of solar energy and rainwater harvesting systems in residential buildings is becoming increasingly popular. The commercial building sector in Kerala includes shopping malls, office buildings, hospitals, hotels, and educational institutions. The state's tourism industry is a significant contributor to the commercial building sector, with a high demand for hotels and resorts. The commercial building sector is also witnessing a shift towards sustainable building practices, with a focus on energy efficiency and waste reduction.

6.2 Energy efficiency strategies in the buildings sector

The following strategies can be used to achieve the energy reduction targets of domestic and commercial sectors.



The policy interventions required for reducing the energy consumption of domestic and commercial sector is discussed in the subsequent section.

Strategy: Implementation of ENS

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.

According to the housing Census 2011 of Kerala state, there nearly 58 lac establishments which are further categorized into residence, offices, shops, schools, hotels, hospitals, factories, etc. Total number of households were projected to 2026 and 2031.

Energy Saving Potential

The saving potential for FYFY 2030 is 0.058 MTOE which is estimated by calculating energy saving per household (kWh/household) which is then multiplied with the projected households for FY2026 and FYFY 2030 for both moderate and ambitious scenarios. Similarly, the GHG saving potential for this strategy is 0.18 $MtCO_2$.

Table 11: Energy Saving Potential

Particulars	Moderate Scenario for FY 2030	Ambitious Scenario for FY 2030
Energy Saving Potential (MTOE)	0.039	0.058
GHG Emission Reduction Potential ($MtCO_2$)	0.122	0.18

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.

Particulars	Action Plan	Timeline
Awareness & Capacity Building	1. Market Outreach for ENS compliant products, radio jingles, social media awareness.	Short Term
	2. Home Energy Auditor Training.	Short Term
Subsidy	2. Compliance structure and rebates on energy savings for first few residential projects.	Long Term
Technology Intervention	1. Development and maintenance of ENS compliance portal.	Long Term
	2. Pilot project investment for ENS as case studies.	Long Term

Strategy: Deepening of Standard & Labelling Programme

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:

Scope Boundary

- The scope boundary of this strategy includes appliances like television, air conditoner, refrigerator, geyser, fans etc used in domestic buildings in urban as well as rural areas in the state.

Implementing Agency

- EMC

Current Policy In Place

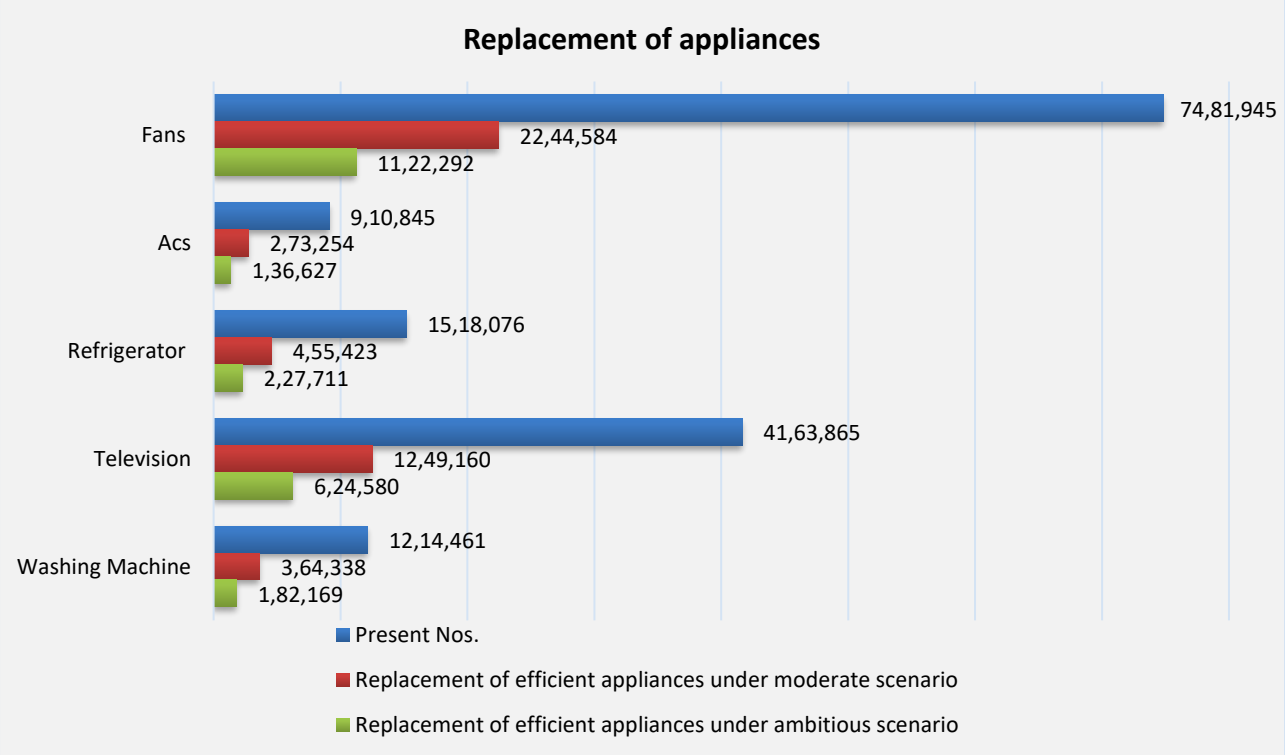
- BEE S&L Rating Programme

Saving Potential

The number of appliances has been estimated based on the population from Census 2011.[11]

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.

Figure 21 Replacement of appliances



[11] Assumptions for number of appliances mentioned in Annexures

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

Table 12: Energy Saving Potential

Particulars	Moderate Scenario for FY 2030	Ambitious Scenario for FY 2030
Energy Saving Potential (MTOE)	0.05	0.08
GHG Emission Reduction Potential ($MtCO_2$)	0.15	0.25

Action Plans

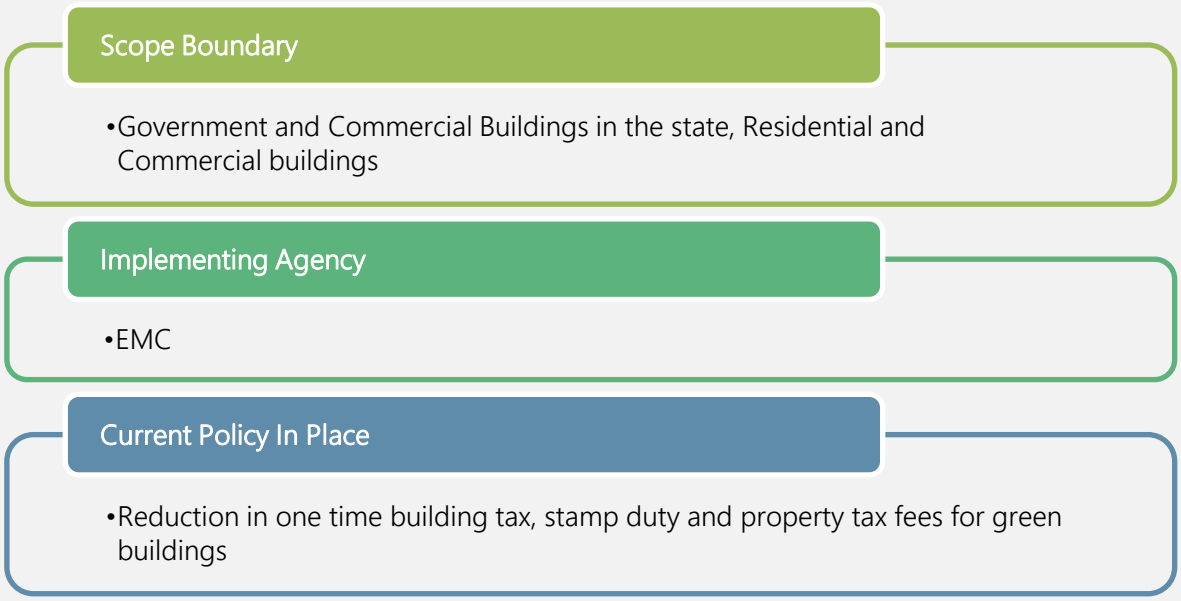
This section describes several action plans that can be implemented across the residential sector for this strategy. For each of the strategies, a short-, medium-, and long-term period has been taken into consideration for actionable instruments.

Particulars	Action Plan	Timeline
Awareness & Capacity Building	1. Energy Efficient Technology Workshops for capacity building of Technology Suppliers and Professionals	Short Term
	2. Home Energy Auditor Training.	Short Term
Subsidy	3. DSM Schemes through DISCOM for energy efficient appliances such as BLDC fans, AC	Long Term

Strategy: BEE Star Rating of Buildings, Green buildings

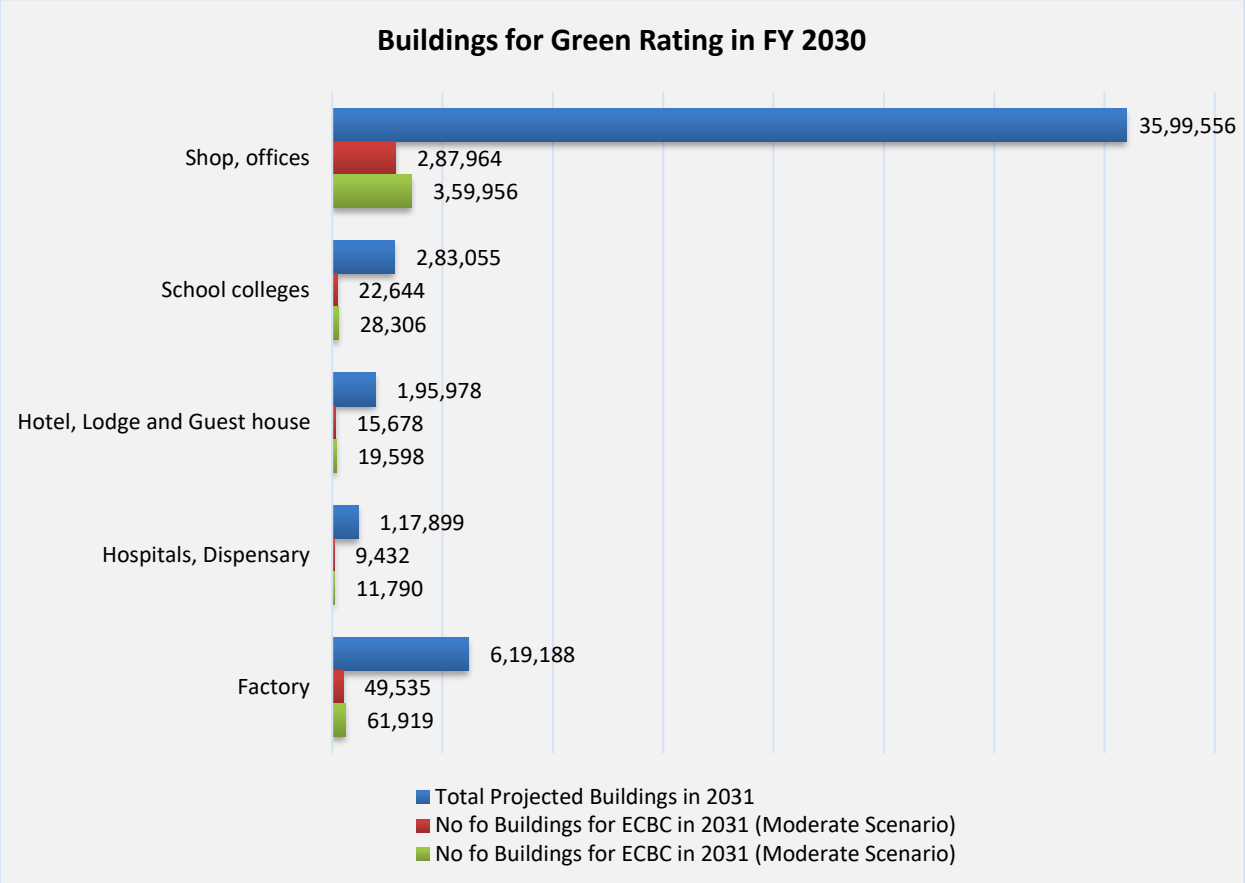
Green buildings rating in India incorporates various features such as energy-efficient lighting, heating, ventilation, and air conditioning systems, and use renewable energy sources such as solar and wind power.

Promoting Star Rating of Buildings and Green Buildings can help Kerala in achieving energy efficiency since Kerala is a state in India that faces severe energy shortages, especially during peak demand periods. By promoting energy-efficient buildings, the state can reduce its energy consumption and thereby decrease its dependence on fossil fuels, which are the primary source of energy in the state.



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 state is projected to FY2025 and FY FY 2030 and 8% penetration is assumed for moderate scenario and 10% for ambitious scenario for both FY2025 and FYFY 2030



By considering penetration of green buildings as shown above figure, 0.43 MTOE saving potential can be achieved.

Table 13: Energy Saving Potential

Particulars	Moderate Scenario for FY 2030	Ambitious Scenario for FY 2030
Energy Saving Potential (MTOE)	0.29	0.43
GHG Emission Reduction Potential ($MtCO_2$)	0.9	1.3

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.

Particulars	Action Plan	Timeline
Awareness & Capacity Building	1. Encouraging Green Education	Short Term

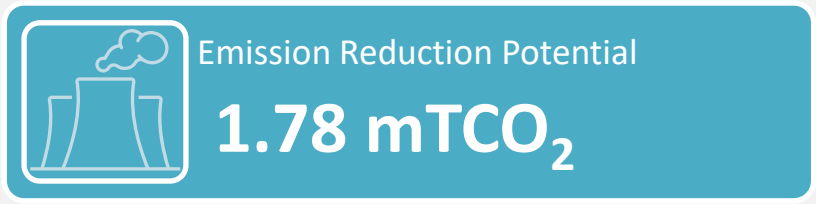
Subsidy	1. Incentives (Rebate in property Tax Additional FAR, reduction in stamp duty and faster environmental clearance for upcoming, green-rated building projects) 2. Transformation of government buildings to Net-Zero 3. Incentive policy support to encourage net zero buildings	Long Term

6.3 Energy saving potential of the sector & monitoring mechanism

Energy saving potential of the building sector is 0.38 MTOE and 0.57 MTOE for moderate and ambitious scenarios FYFY 2030 respectively as seen from Table 4.

Table 14 Summary of energy saving from the strategies.

Strategy	Energy Saving Potential (Moderate)	Energy Saving (Ambitious)
1. Implementation of ENS-Residential buildings	0.039	0.058
2. Deepening of S&L in domestic buildings	0.05	0.08
3. Green Buildings	0.29	0.43



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

Particulars	Monitoring Mechanism
Reporting & Disclosure	Establishing a system for enforcing compliance with energy efficiency codes and standards under operating conditions every few years can help ensure that buildings are meeting the required standards for reducing

	carbon emissions.
Performance contracting	The government can encourage performance contracting, where third-party contractors are responsible for implementing energy efficiency measures in buildings. The contractors can be required to report on energy savings achieved and the government can monitor these savings.

7 FOCUS SECTOR 4: AGRICULTURE & FISHERIES

7.1 Overview

The agriculture sector in Kerala is an important part of the state's economy, providing employment to a significant portion of the population and contributing to the overall GDP.

The sector is dominated by small-scale farmers who cultivate a variety of crops, including coconut, rubber, tea, coffee, spices, and cashew. The state is also known for its horticulture, with fruits like banana, mango, pineapple, and jackfruit being grown in large quantities.

In recent years, there has been a growing focus on energy efficiency in the agriculture sector in Kerala. The state has implemented several initiatives to promote renewable energy in the sector, such as solar-powered irrigation systems, biogas plants, and biomass-based power generation.

Solar-powered irrigation systems have become popular in Kerala, particularly in areas where the power supply is unreliable or non-existent. These systems use solar panels to power the water pumps, reducing dependence on diesel generators or grid electricity. This has not only improved the reliability of water supply for agriculture but also reduced greenhouse gas emissions.

Biogas plants have also become popular in Kerala, particularly in rural areas where there is a ready supply of agricultural waste. These plants use organic waste to produce biogas, which can be used for cooking or generating electricity.

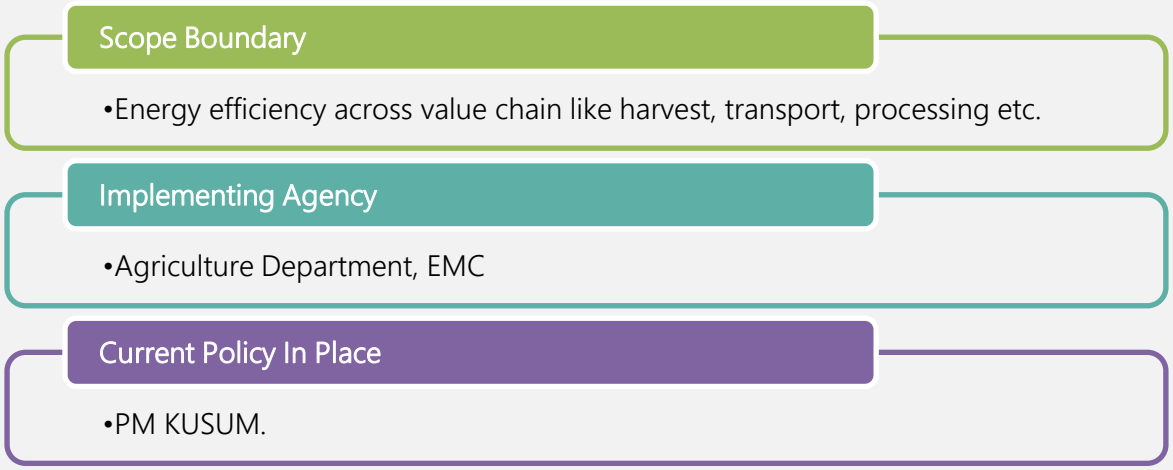
7.2 Energy efficiency strategies in the agriculture & fisheries sector

Strategy: Transition of diesel and electrical pumps to solar powered pumps

Transitioning to solar-powered pumps can improve energy access in remote and rural areas of Kerala, where electricity supply is limited or unreliable. According to a report by the Ministry of New and Renewable Energy, around 4.5 lakh households in Kerala are still without electricity. Solar-powered pumps can provide a reliable and sustainable source of energy for irrigation and other purposes, improving livelihoods and economic development in these areas.

Diesel and electrical pumps require a constant supply of fuel or electricity to operate, which can be expensive in the long run. In contrast, solar-powered pumps have a one-time installation cost and require minimal maintenance, resulting in significantly lower operating costs over their lifetime. A study by the International Water Management Institute (IWMI) found that solar-powered pumps can reduce irrigation costs by up to 80% compared to diesel pumps.

In conclusion, transitioning from diesel and electrical pumps to solar-powered pumps can significantly help in energy conservation in Kerala by reducing dependency on fossil fuels, lowering operating costs, and improving energy access in remote and rural areas. The adoption of solar-powered pumps in the state is still in its nascent stage, but there is significant potential for growth and expansion in the coming years. According to the Ministry of New and Renewable Energy, Kerala has a target of installing 2,500 solar-powered pumps by 2022, which will save around 9.75 lakh liters of diesel per year and reduce carbon emissions by 25,000 tonnes.



Saving Potential

The energy saving potential for this scheme is estimated with following assumptions:

a) Transition of 100 % Diesel pumps to Solar powered pumps by FY 2026 and Transition of 50% electrical pumps to solar powered pumps by FY 2031.

b) Transition of 75% electrical pumps to solar powered pumps by FY 2031.

Following numbers are considered for the transition of diesel and electrical pumps to solar pumps for moderate and ambitious scenario.

Table 15 Agricultural Pumpsets as of 2018

Agricultural Pumpsets as of 2018		
Electric Pumps	Diesel Pumps	Total Pumps
4,45,223[12]	21,838[13]	4,67,061

Based on 1.31% growth rate of agriculture sector, following pumps are projected.

Table 16 Agricultural Pumpsets projections

Pumps Projected as of 2026	Pumps Projected as of 2031
5,18,313	5,53,164

[12] 2018 Pumpsets

[13] Assuming 10% of diesel consumed in agriculture sector is by pumps

Figure 22 Transition of diesel and electrical pumps to solar pumps (moderate scenario)

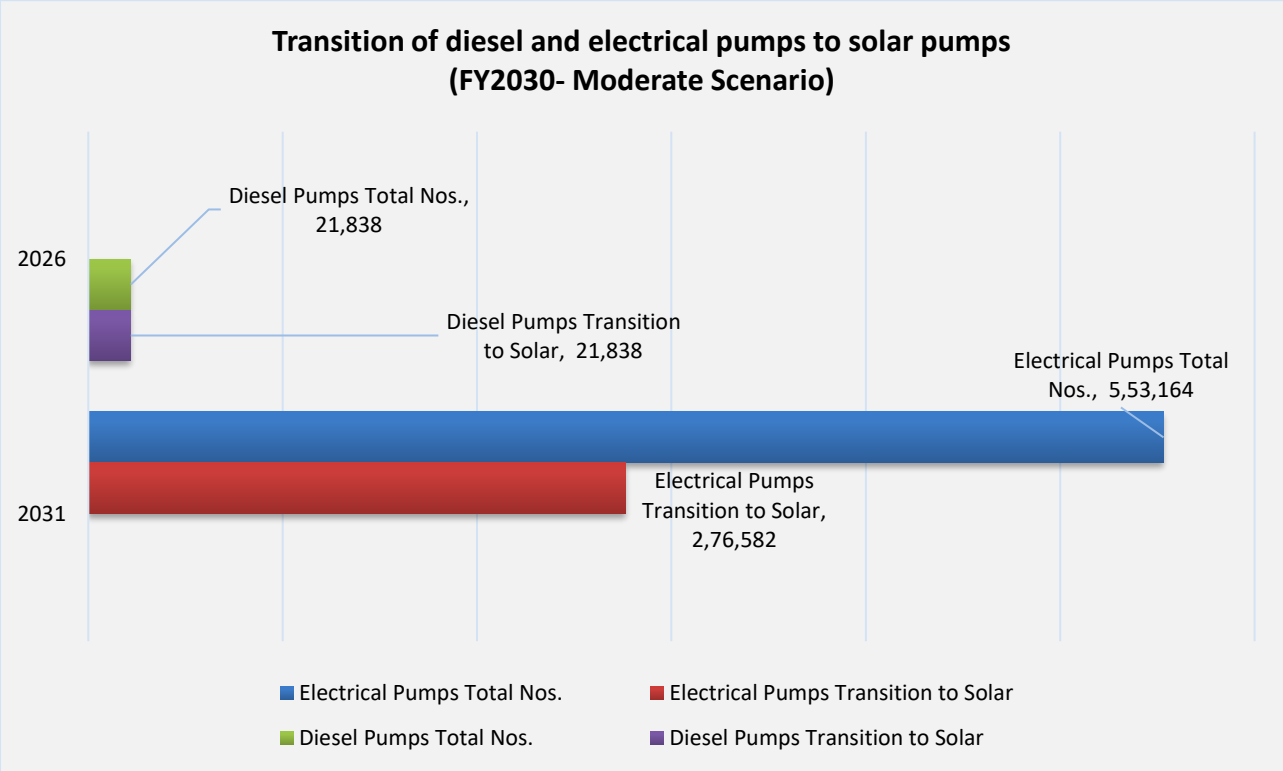


Figure 23 Transition of diesel and electrical pumps to solar pumps (ambitious scenario)

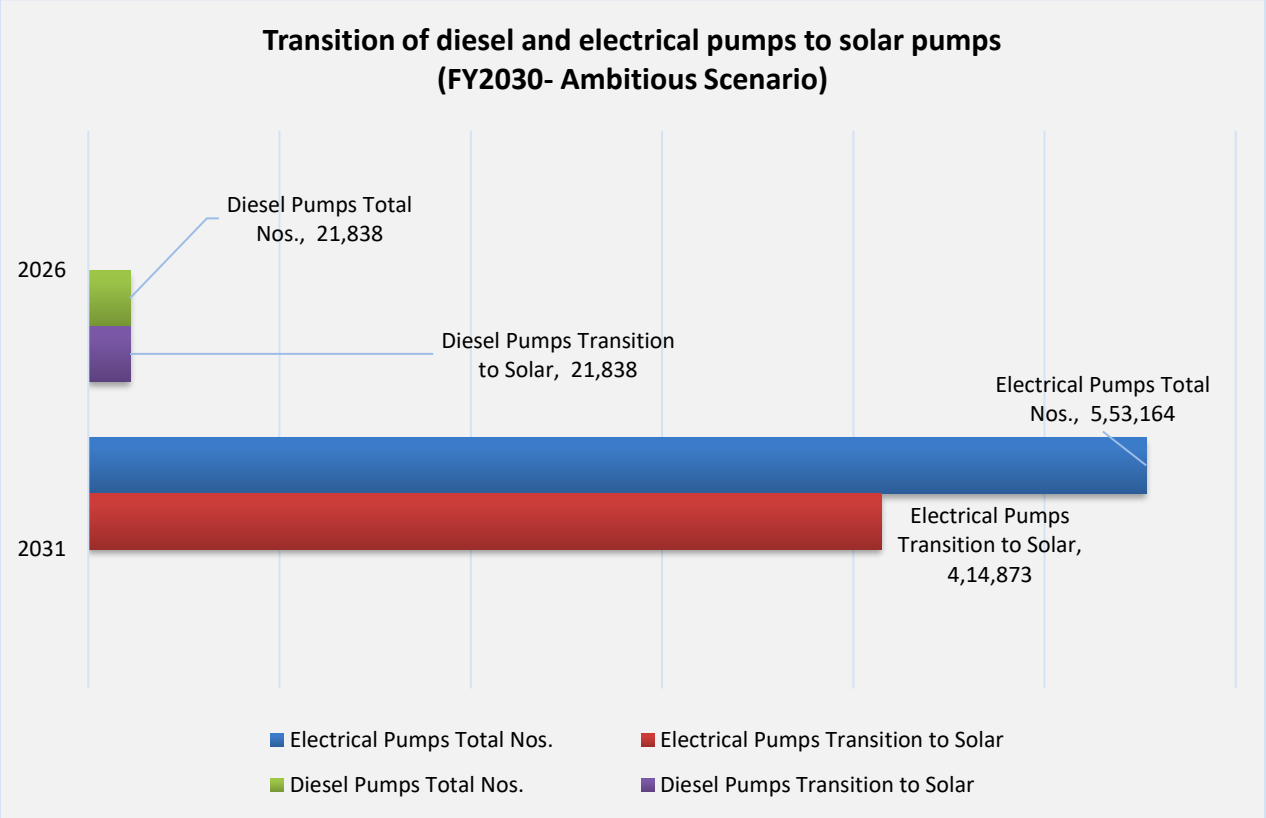


Table 17: Energy Saving Potential

Particulars	Moderate Scenario for FY 2030	Ambitious Scenario for FY 2030
Energy Saving Potential (MTOE)	0.08	0.12
GHG Emission Reduction Potential ($MtCO_2$)	0.25	0.4

Strategy: Replacement of inefficient pumps with BEE 5 Star Rated Pumps along with smart control panel

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.

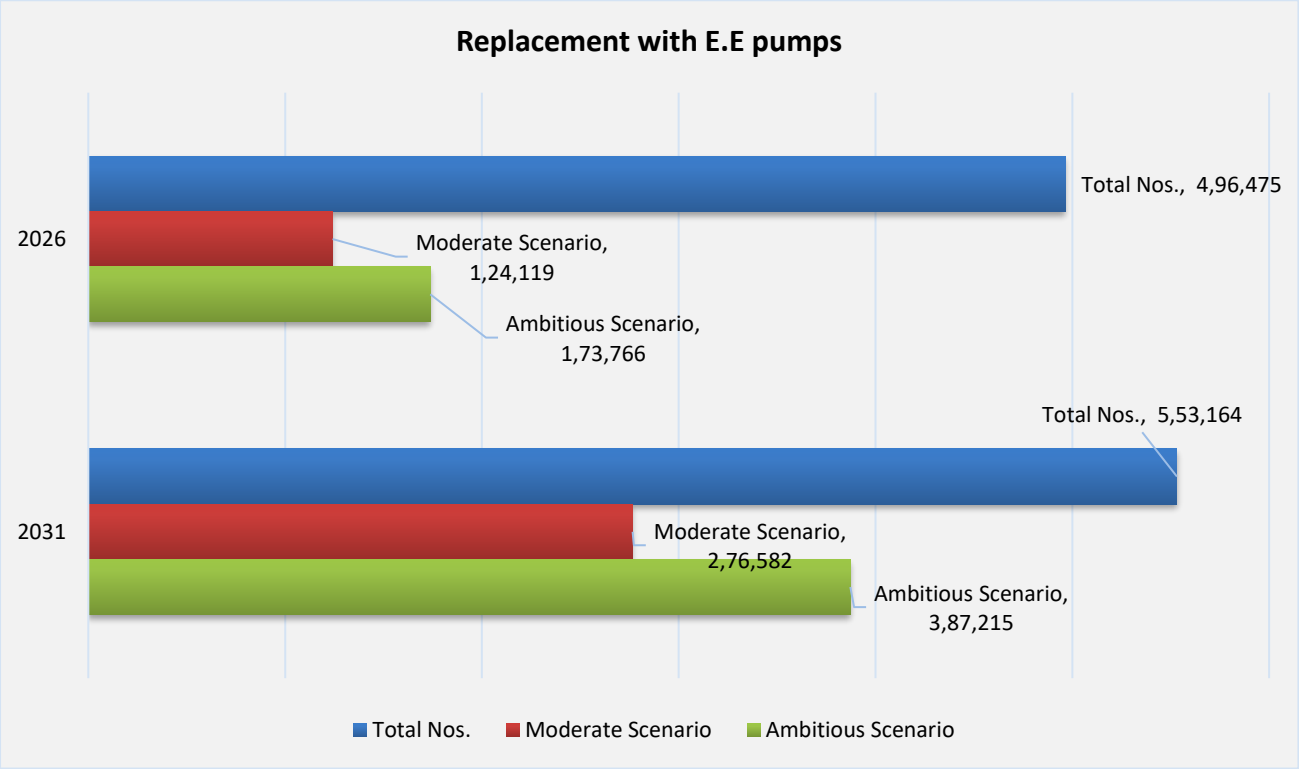
The BEE report also highlights that a large proportion of agricultural pumps in India are inefficient and outdated. Out of the estimated 20 million agricultural pumps in India, only 10% are estimated to be energy-efficient, while the remaining 90% are inefficient and consume more energy than required. 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.

Scope Boundary

- Agricultural pumps

Saving Potential

Figure 24 Replacement with E.E pumps for FY 2030



Considering replacement of 25% pumps and 35% for FY 2025, similarly, 50% pumps and 70% pumps for FY 2030 with star rated pumps under moderate and ambitious scenarios respectively, 0.02 MTOE savings can be achieved.

Table 18: Energy Saving Potential

Particulars	Moderate Scenario for FY 2030	Ambitious Scenario for FY 2030
Energy Saving Potential (MTOE)	0.01	0.02
GHG Emission Reduction Potential ($MtCO_2$)	0.03	0.06

Strategy: Energy efficiency across value chain of fisheries

The state of Kerala, located in the southwestern part of India, has a coastline of about 580 kilometers along the Arabian Sea. The fisheries sector is a significant contributor to the state's economy, providing livelihoods to over one million people.

Marine fisheries are the dominant sector of Kerala's fisheries, accounting for about 85% of the total fish production in the state. The major fishing centers in Kerala are Thiruvananthapuram,

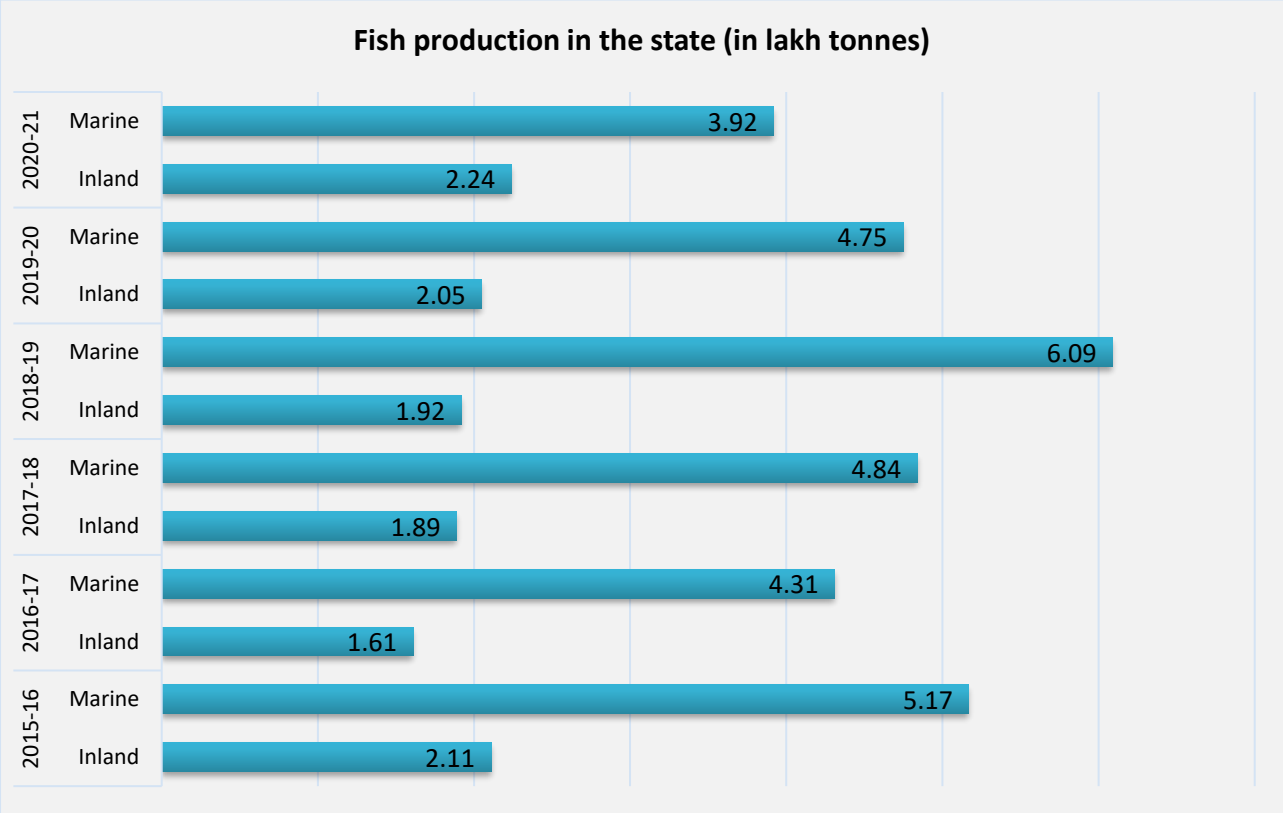
Kollam, Alappuzha, Kochi, Thrissur, Kozhikode, Kannur, and Kasaragod. The most commonly caught fish species in Kerala include sardines, mackerel, tuna, prawns, crabs, and lobsters.

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.

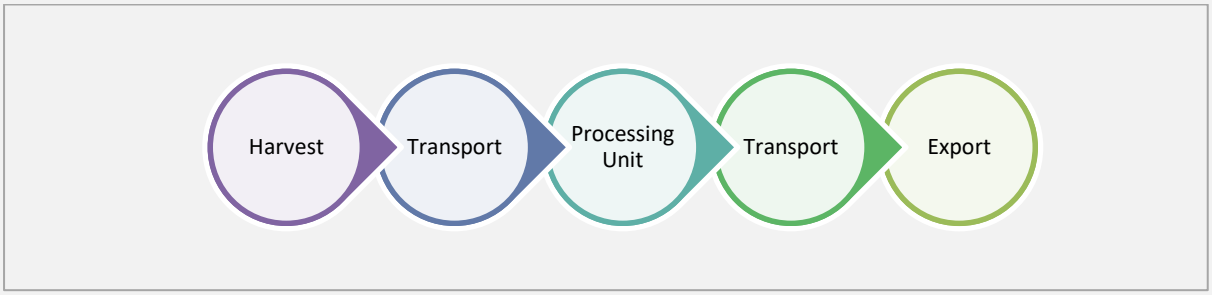
Inland fisheries in Kerala are carried out in rivers, lakes, reservoirs, and ponds. The state has a vast network of water bodies that support freshwater fish farming, which is an important source of livelihood for many small-scale farmers. The major inland fish species cultivated in Kerala include catfish, tilapia, carp, and prawns.

However, the fisheries sector in Kerala 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.

Figure 25 Fish production in the state



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 state can bring numerous benefits, including reduced greenhouse gas emissions, cost savings for fishers and processors, and increased competitiveness in the global market.

Scope Boundary

- Energy efficiency across value chain like harvest, transport, processing etc.

Saving Potential

The energy saving potential has been estimated by accounting for both thermal and electrical consumption across harvest, land transport, processing unit chain.[14]

[14] Assumptions for thermal and electrical consumption in Annexures

Table 19: Energy Saving Potential

Particulars	Moderate Scenario for FY 2030	Ambitious Scenario for FY 2030
Energy Saving Potential (MTOE)	0.17	0.23
GHG Emission Reduction Potential ($MtCO_2$)	0.5	0.7

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.

Particulars	Action Plan	Timeline
Awareness & Capacity Building	Provides skill development support. Creating awareness Resource efficiency and cleaner refrigerant	Short Term
Audit	Conducting energy audits and assessments of fisheries can help identify areas of energy inefficiency and provide recommendations for improvement.	Short Term
Technological Interventions	First and last mile transportation: • Phase Changing Materials (PCM) technology in Coolers/ Freezers • Energy Efficient Aerators • Adoption of EV	Long Term
	Cold storage & Processing: • Solar PV System for Fishery/cold storage • Efficient Ammonia / CO_2 Brine system in Cold storage • Use of Evaporative condenser for cooling • Low charge Ammonia refrigeration system	Long Term
	Reefer Transport • Mobile Chilling for Reefer trucks • Swapping the PCM material	Long Term
	Multiple Areas • Variable Frequency drive solution for Refrigeration systems • Electronic Level Control for Refrigeration system • IOT for Refrigeration systems	Long Term
	The use of solar-powered equipment in the fisheries sector can help reduce energy consumption and carbon emissions. The	Long Term

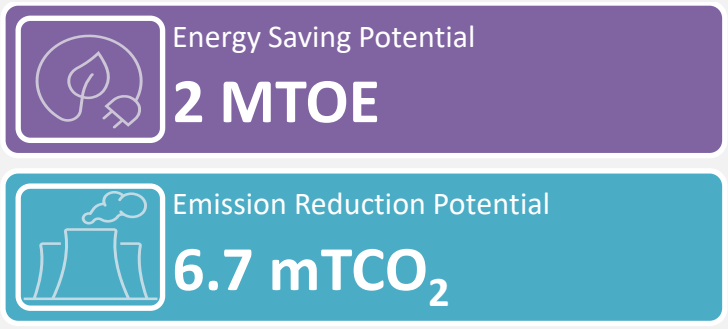
	government can encourage fishermen and fishery enterprises to adopt solar-powered boats, refrigeration systems, and other equipment by providing them with subsidies. According to a report by the Ministry of New and Renewable Energy, solar-powered refrigeration units can reduce energy consumption by up to 70%	
	The fishing vessels used in Kerala are mostly traditional and rely on diesel engines, which are inefficient and emit high levels of pollutants. Upgrading fishing vessels with efficient and eco-friendly engines can reduce energy consumption and emissions. According to a study by the Food and Agriculture Organization, the installation of fuel-efficient engines can reduce fuel consumption in fishing vessels by up to 30%.	Long Term

7.3 Energy saving potential of the sector & monitoring mechanism

Energy saving potential of the agriculture & fisheries sector is 0.3 MTOE and 0.4 MTOE for moderate and ambitious scenarios FYFY 2030 respectively as seen below.

Table 20 Summary of energy saving from the strategies.

Strategy	Energy Saving Potential (Moderate)	Energy Saving (Ambitious)
Transition to solar powered pumps	0.08	0.12
Replacement of inefficient pumps with BEE 5 Star Rated Pumps along with smart control panel	0.01	0.02
Energy efficiency across all value chain in fisheries sector	0.17	0.23



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

Particulars	Monitoring Mechanism
Benchmarking	Benchmarking can be used to compare the energy consumption patterns of different farms in the same region. This can help identify the most efficient farms and highlight areas where other farms can improve their energy efficiency.
Awareness Programs	Educating farmers about the benefits of energy efficiency and providing training on energy-saving practices can help increase adoption rates and improve the effectiveness of energy efficiency policies.
Reporting and Monitoring	Regular reporting and monitoring can help ensure that energy efficiency policies are being implemented effectively and that progress is being made towards energy-saving goals. This can include regular reporting on energy consumption patterns, energy savings achieved, and greenhouse gas emissions
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.

8 INVESTMENT POTENTIAL

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

Sector	Emissions Reduction (MtCO2) - FY2031		Energy Consumption Reduction (Mtoe) - FY2031		Investment Potential[15]
	Moderate	Ambitious	Moderate	Ambitious	
	MtCO2 reduction	MtCO2 reduction	Mtoe Reduction	Mtoe Reduction	INR Crores
Industry	0.9	1.6	0.29	0.52	₹957
Buildings	1.2	1.8	0.4	0.6	₹1,104
Transport	1.8	2.7	0.6	0.9	₹1,656
Agriculture	0.8	1.2	0.3	0.4	₹736
Total					₹4,453

The energy saving investment potential of the state is estimated to be ₹4,453 crores by the year 2031, under the ambitious savings scenario, with the transport sector constituting highest energy saving investment potential followed by building and industry sector.

9 WAY FORWARD

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

The "State Energy Efficiency Action Plan" report for Kerala provides a roadmap for the state to achieve its energy efficiency goals.

The report outlines opportunities for energy savings and greenhouse gas emissions reductions across multiple sectors, including industry, buildings, transportation, and agriculture. The proposed strategies are designed to help the state allocate resources to meet its targets in line with the NDCs.

To achieve these objectives, the state should publish the report as a guiding document and consider the proposed strategies when developing policies.

To successfully implement the action plan, it is essential to create a task force or working group comprising representatives from government, industry, NGOs, energy experts, and other stakeholders. This group should establish priorities, timelines, and progress monitoring.

Adequate funding, including grants, loans, and public-private partnerships, must also be secured to support the plan. Additionally, innovative financing mechanisms, such as energy efficiency bonds, can be used to attract private investment in energy efficiency projects.

The implementation of the plan also requires training and capacity building for stakeholders, and the government should encourage innovation and research in energy-efficient technologies through collaborations between industry and academia/research institutes.

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

10 REFERENCES

Sr No.	Description
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4.	Energy Statistics India 2021, Ministry of Statistics and Programme Implementation (MoSPI)
5.	NITI Aayog: India Energy Dashboards
6.	Kerala Statistical Abstract
7.	Annual Survey of Industries
8.	BEE PAT Cycle
9.	Vahan Dashboard
10.	Census of India 2011

11 ANNEXURES

Table 21 Assumptions for charging stations

	Charger Types	Daily-Km driven	Battery Capacity	Driving range in km/full charge	Daily charging demand in kWh	Total no of-EVS by 2026 (Moderate)	kWh required/day	kWh required/annual	60% by renewable energy
E-2w	Single phase 15A charge	40	2.5	80	1.3	4,08,869	5,11,086	15,33,25,868	9,19,95,521
E-3W (passenger / cargo)	Single phase 15A charger	120	7	100	8.4	39,479	3,31,623	9,94,86,811	5,96,92,087
E-car (personal)	Type-2 AC (70%) 50kW DC charger (30%)	40	30.2	312	3.9	1,51,727	5,87,454	17,62,36,204	10,57,41,722
E-car (commercial)	Type-2 AC (60%) 50kW DC charger (40%)	100	21.2	181	11.7	9,013	1,05,565	3,16,69,610	1,90,01,766

Table 22 Gross Calorific Value of Indian Coal (in kcal/kg)

Gross Calorific Value of Indian Coal (in kcal/kg)							
	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Coal – Import	5,534	5,586	5,586	5,541	5,557	5,659	5,852
Coal dispatch- Power Sector	4,384	4,384	4,384	4,388	4,367	4,281	4,242
Coal Dispatch - Non - Power	5,548	5,548	5,548	5,644	5,669	5,564	5,624

Table 23 Gross Calorific Value of Fuels

Type of Fuel	**kcal/kg**
Crude Oil	10,237
Liquefied Petroleum Gases	11,318
Motor Gasoline	10,717

Gasoline Type Jet Fuel	10,717
Kerosene Type Jet Fuel	10,667
Kerosene	10,467
Gas/Diesel Oil	10,357
Fuel Oil	9,866
Naphtha	10,767
Non-specified Oil Products	9,616

Table 24 Assumptions for number of appliances

Appliances	Assumptions
Fans	1. Assuming 3 fans per urban household 2. Assuming 1 fan per rural household
AC	1. Assuming 1 AC every four urban households
Refrigerator	1. Assuming 1 fridge every three urban households
Television	1. Assuming 1 TV per urban household 2. Assuming 1 TV for 5 rural household
Washing Machine	1. Assuming 1 per urban household in 40% houses

Table 25 Fisheries saving potential[16]

Marine Catch		2019-20
Particular	Unit	Value
Fuel Consumption	lit/Tonnes	933
Equivalent energy	kgoe/tonne	860
Equivalent energy	TOE/Tonnes	0.86
Emission	Tco2/T	2.5
Ice	T/T	4
Production	Lakh Tonnes	6.8
Fuel Consumption	MTOE	0.5848
Energy saving-Moderate	%	15%
Energy saving-Ambitious	%	20%
Energy saving-Moderate	MTOE	0.088
Energy saving-Ambitious	MTOE	0.117

[16] Based on CII study on fisheries sector

Processing Unit		2020
Electricity Consumption	kWh/tonne	550
Thermal Energy	kg toe/tonne	350
Overall energy toe	kg toe/tonne	450
Energy consumption for 2031		
Fish for processing	Lakh Tonnes	4.76
Fuel Consumption	MTOE	0.2142
Energy saving-Moderate	%	15%
Energy saving-Ambitious	%	20%
Energy saving-Moderate	MTOE	0.032
Energy saving-Ambitious	MTOE	0.043

Proposed committee for State Energy Efficiency Action Plan

Sr No	Department	
1	Chief Secretary to State Government	Chairman
2	State Electrical Distribution Companies	Member
3	State Generation & Transmission Companies	Member
4	State Department of Industries & Commerce	Member
5	State Transport Department	Member
6	State Irrigation Department	Member
7	State Housing Corporation Limited	Member
8	State Agriculture Department	Member
9	State Department of Development/Planning	Member
10	State Department of Finance	Member
11	The Chief Electrical Inspector to Government	Member
12	Municipal Administration & Urban Development	Member
13	MSME Development Department	Member
14	State Department of Environment & Forest	Member
15	Other invitees as considered by the Chairman and as per the agenda of the respective meeting	Member (s)
16	State Designated Energy Agency	Member Convenor

NOTES

Bureau of Energy Efficiency

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