Bureau of Energy Efficiency
Government of India, Ministry of Power

STATE ENERGY EFFICIENCY ACTION PLAN

MAHARASHTRA

Prepared by
Confederation of Indian Industry

Supported by
Maharashtra Energy Development Agency

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Azadi Ka Amrit Mahotsav

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BUREAU OF ENERGY EFFICIENCY
(Ministry of Power, Government of India)

Foreword

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

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

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

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

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

October, 2024

(Dr. Srikant Nagulapalli)

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PREFACE

The Bureau of Energy Efficiency (BEE) has been involved in numerous 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 2030.

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

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

ACKNOWLEDGEMENT

The Confederation of Indian Industry (CII) 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 Maharashtra.

CII is grateful to Shri Srikant Nagulapalli, Director General, BEE, and Shri Milind Deore, Secretary, BEE, for their overall guidance and encouragement for the successful completion of Task 1, 2 and 3 of this project. We are also thankful to Shri Abhishek Sharma, Joint Director and Shri Vikash Kumar Jha, Project Engineer with whom the team regularly consulted during the project for assistance, feedback, and valuable input.

CII is grateful to the proactive management of Maharashtra Energy Development Agency (MEDA) for its role in guiding and steering this first task of this prestigious assignment and their support in coordination throughout the study.

We would like to specifically mention the guidance and cooperation received from Dr Kadambari Balkawade, IAS, Director General, Maharashtra Energy Development Agency (MEDA), Shri Pankaj Tagalpallewar, Additional Director General, MEDA who helped to complete the study in a timely manner.

CII team is also grateful to all the stakeholders, for showing keen interest and providing their wholehearted cooperation throughout the study.

EXECUTIVE SUMMARY

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

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

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

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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 Maharashtra** 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 2030.

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

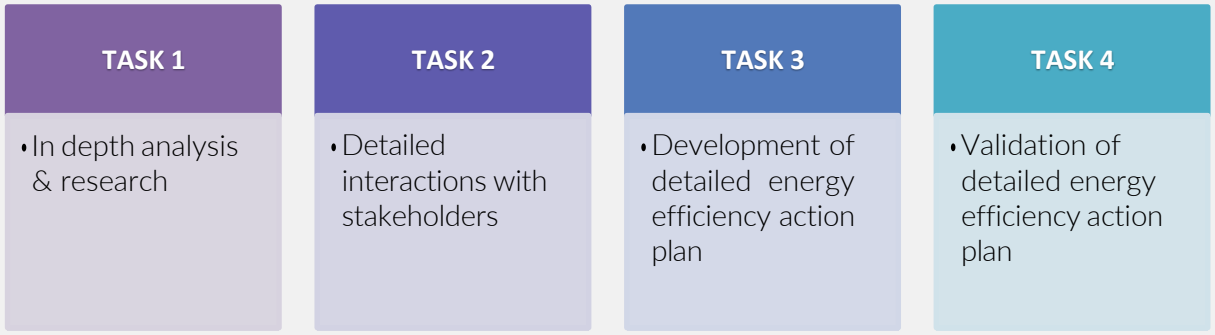


Figure 1 Key tasks in state energy action plan

Outcome

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

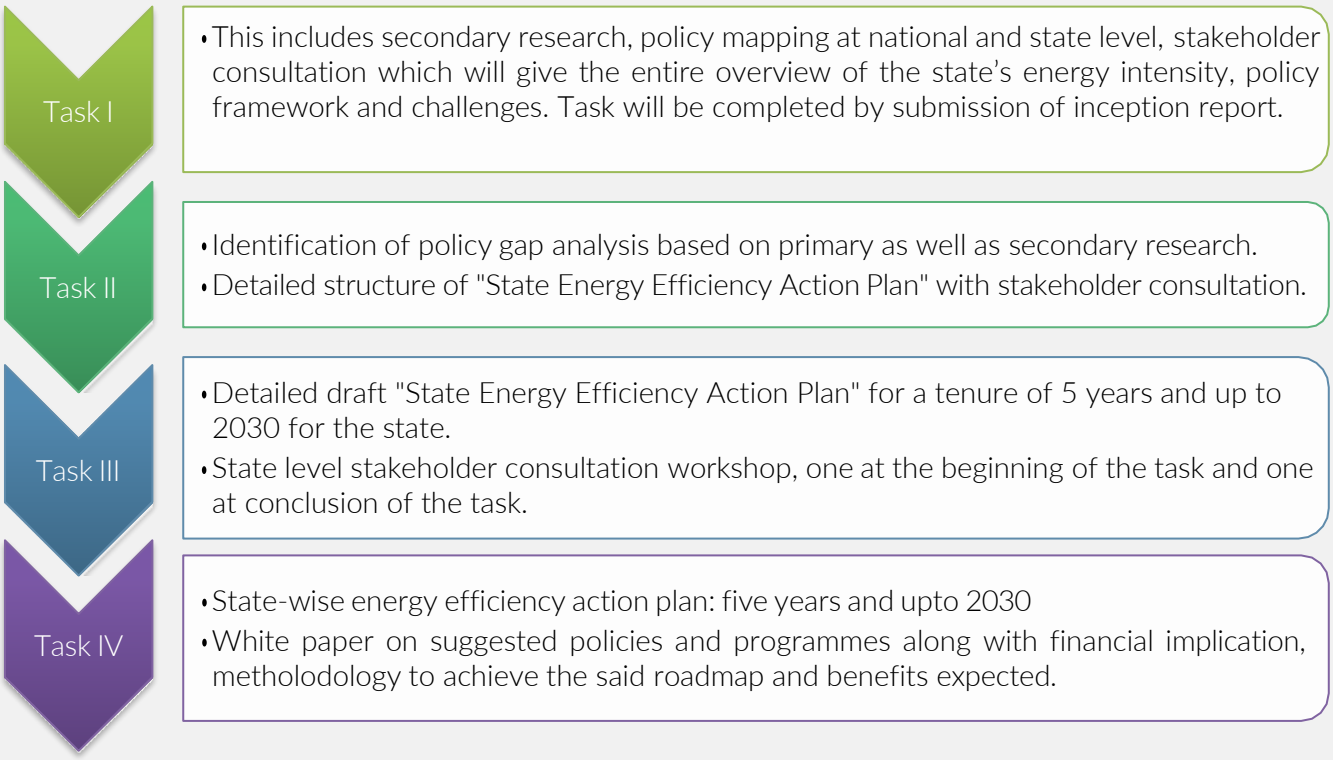


Figure 2 Task wise expected outcome of the study

Energy efficiency drivers for state

Maharashtra ranks 4th with a total score of 57.5 and improved by 19.5 points with respect to SEEI 2019[1,2], worked on various areas to upscale energy efficiency. Maharashtra has developed various programs such as energy efficiency in street lighting, electric mobility, charging

[1] https://stateenergyefficiencyindex.in/wp-content/uploads/2021/10/SEEI-2020-PAMPHLET-FINAL.pdf

[2] https://stateenergyefficiencyindex.in/wp-content/uploads/2021/10/SEEI-2020-Report-Final-web.pdf

infrastructure, water pumping, sewage treatment and a smart grid program. The above intervention is driven by key drivers.

- Cost reduction
- Advancement in Technology
- Customer stakeholders pull
- Sustainability factor
- New Investment opportunities
- Policy Push

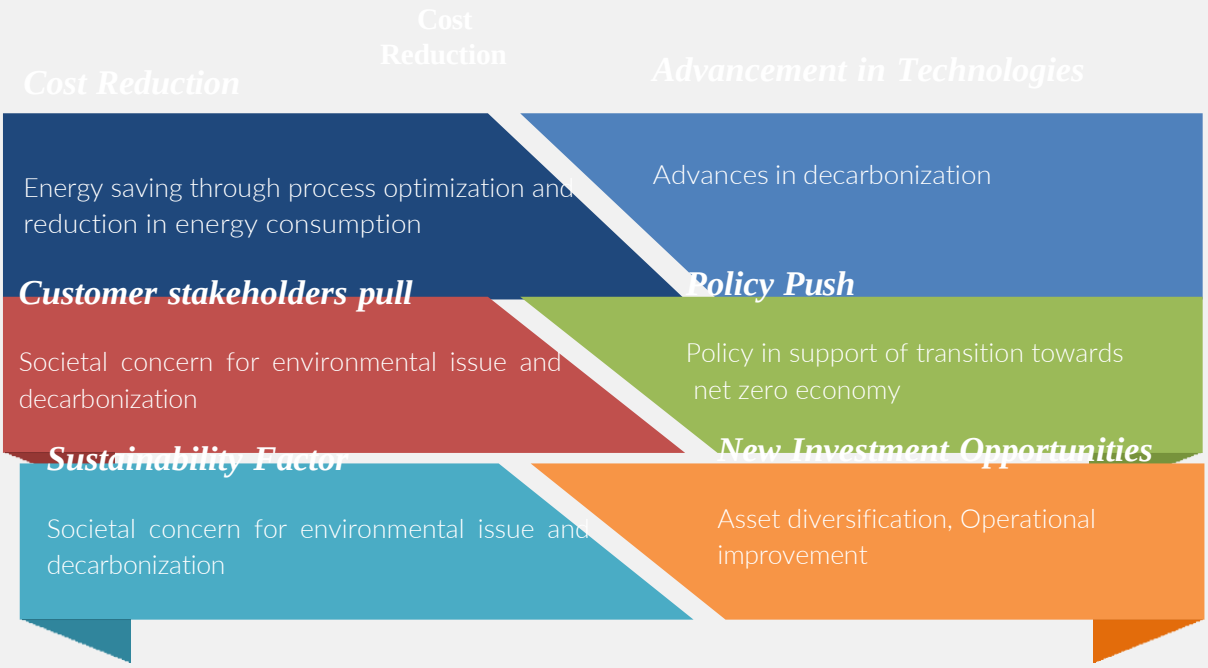


Figure 3 Energy efficiency drivers of the state

1.3 Maharashtra State Profile

Maharashtra is one of the most industrialized in India. The state's capital, Mumbai is India's financial and commercial capital. India's largest stock exchange Bombay Stock Exchange, the oldest in Asia, is also located in the city. The state has played a significant role in the country's social and political life and is widely considered a leader in terms of agricultural and industrial production, trade and transport, and education. Maharashtra is among the most developed Indian states and continues to be the single largest contributor to the national economy with a share of 14% of India nominal GDP. The economy of Maharashtra is the largest in India, with a gross state domestic product (GSDP) of ₹31.97 trillion and GSDP per capita of ₹225,073. The service sector dominates the economy, accounting for 69 percent of the value of the output of the country. Although agriculture accounts for 1% of the state GDP, it employs nearly half the population of the state. Maharashtra is the fifteenth-highest ranking among Indian states in the human development index.

According to the provisional results of the 2011 national census, Maharashtra is the richest state in India and the second-most populous state in India with a population of 112,374,333, contributing to 9.28 percent of India's population. The number of males and females are 58,243,056 and 54,131,277, respectively. The total population growth in 2011 was 15.99 percentile in the previous decade it was 22.57 percent Since independence, the decadal growth rate of the population has remained higher (except in the year 1971) than the national average.

However, in the year 2011, it was found to be lower than the national average. The 2011 census for the state found percent of the population to be rural with 45 percent being urban based. The state also includes a substantial number of migrants from other states of India. Uttar Pradesh, Gujarat, and Karnataka account for the largest percentage of migrants to the Mumbai metropolitan area.

Table 1: Comparison of Share of GVA by Major Sectors in Maharashtra and India in 2020-21[3]

	Sector	Maharashtra (GSVA %)	India (GVA %)
1	Services Sector	51.4	54
2	Industry Sector	23.3	26
3	Agriculture & allied activities sector	12.5	20

Maharashtra is one of the top-performing states in the State Energy Efficiency Index (SEEI) of 2020 and ranks 4th with a total score of 57.5 and improved by 19.5 points with respect to SEEI 2019[4]. SEEI assesses the performance of states in energy efficiency through numerous indicators across six sectors: Buildings, Industry, Municipalities, Transport, Agriculture and distribution companies (DISCOMs), and Cross-Sector initiatives. The indicators cut across Policy and Regulation, Financing Mechanisms, Institutional Capacity, Adoption of Energy Efficiency Measures, and Energy Savings. The jump of 19.5 points showcases the efforts of the state to improve the energy efficiency.

[3] Economic Survey of Maharashtra 2021-22

[4] https://stateenergyefficiencyindex.in/wp-content/uploads/2021/10/SEEI-2020-PAMPHLET-FINAL.pdf

1.4 Current Energy Scenario of Maharashtra

The Total Final Energy Consumption (TFEC) of Maharashtra in Million TOE (MTOE) is 53.59. It accounts for the total energy consumed from electricity[5], coal, gas and Oil[6].

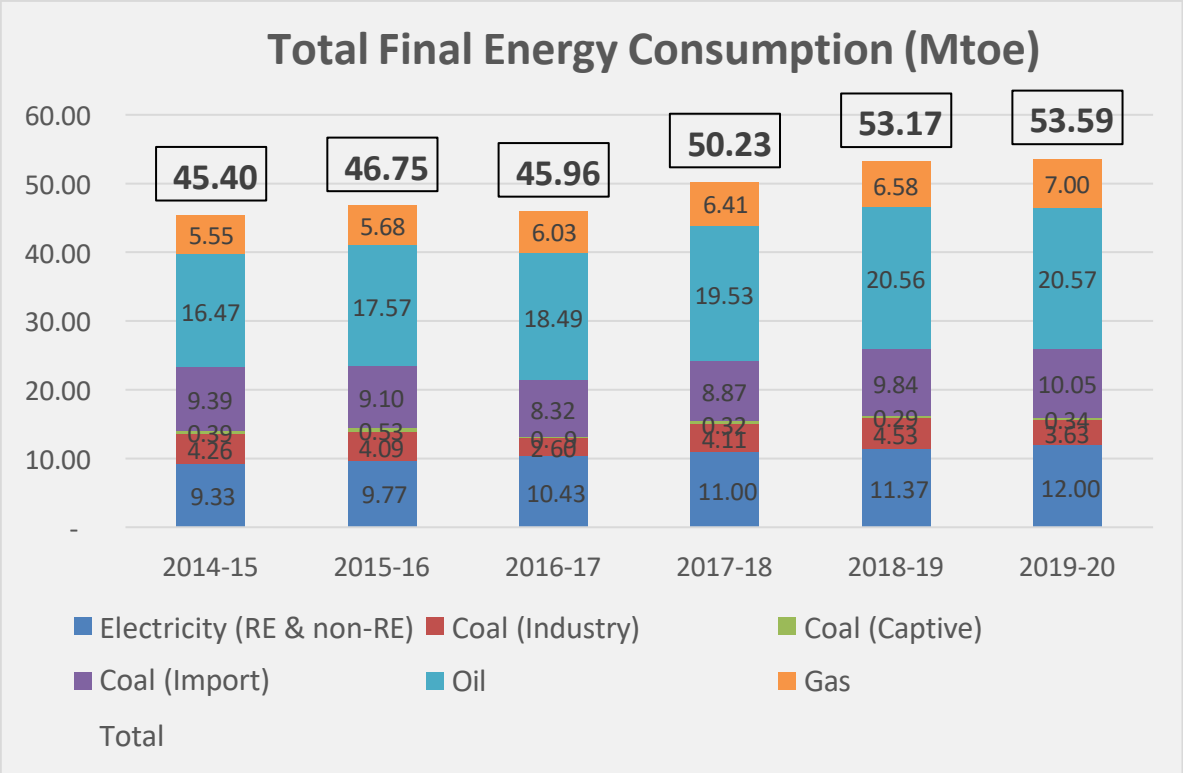


Figure 4: Energy sources wise TFEC of Maharashtra

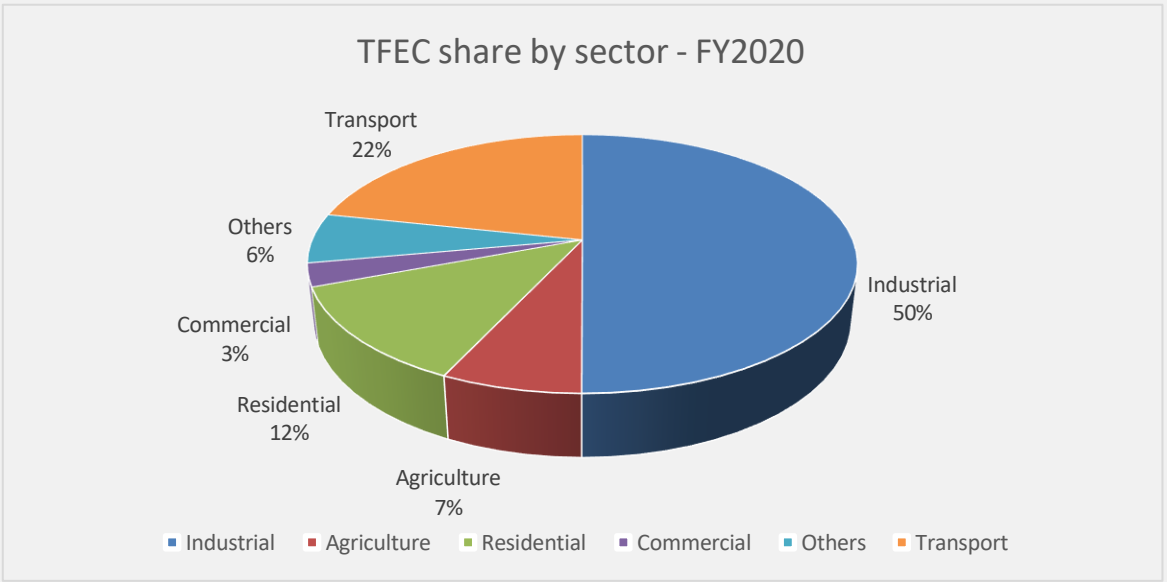


Figure 5 Sector wise TFEC of Maharashtra

[5] Niti Ayog Energy India Dashboards
[6] Indian Petroleum & Natural Gas Statistics 2019-20

The industrial sector is the largest energy consumer and accounts for 26.81 MTOE, which is about 50% of the total energy consumption. Electricity, Diesel and furnace oil are the major sources of energy used in the sector.

Transport is the second largest energy consumer in the state, contributing to 22% of TFEC of the State, equivalent to about 11.59 MTOE of energy; the major fuels consumed are petrol, diesel and CNG.

Domestic sector accounts for nearly 12% of the TFEC of the state and consumes 6.56 MTOE. Electricity, LPG and PNG are the major fuels consumed in Domestic sector. 20% of total electricity consumption and 86% of total LPG[7] [8] consumption is consumed by residential consumers.

Agricultural sector consumes 3.73 MTOE, which is nearly 7% of the total energy consumption and the Commercial sector consumes 1.55 MTOE of energy, which is 3% of the TFEC.

Cross sector accounts for 3.34 MTOE, which constitutes of LPG and Diesel consumption that cannot be mapped sector-wise, due to the unavailability of data.

The TFEC trend of Maharashtra from FY 2015-16 to FY 2019-20 in MTOE is shown in 6.

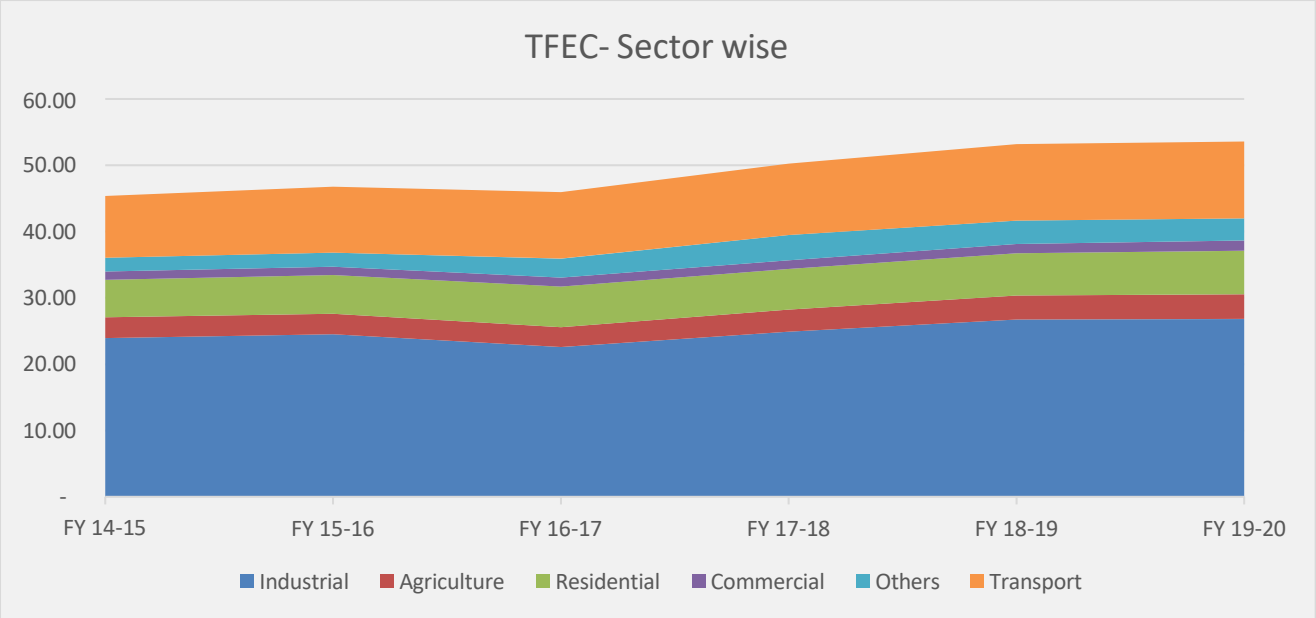


Figure 6: Sector wise TFEC Trend of Maharashtra

1.4.1 Electricity Sub-sector

Maharashtra State Electricity Distribution Company Limited (MSEDCL), a wholly owned corporate entity under the Maharashtra Government, was incorporated under the Companies Act on 31st May, 2005 after restructuring the erstwhile Maharashtra State Electricity Board to distribute electricity from the end point of transmission to the end consumers. MSEDCL is a Public Company in the category of 'State Government Company' registered under the

[7] India's Oil & Gas Ready Reckoner December 2021 by PPAC
[8] LPG Profile 1-10-2021 by PPAC

Companies Act 1956, with the main objectives of developing, operating and maintenance of distribution system for supplying electricity to the consumers in its area of supply. As a deemed distribution licensee under section 14 of the Electricity Act 2003, MSEDCL is carrying out the supply of power to the end users as well as maintaining the wire business for supply of such power. Currently, MSEDCL provides electricity throughout the State of Maharashtra and in few suburbs of Mumbai city and considered to be one of the largest power distribution Company both in the country and in Asia, in terms of number of consumers and electricity supplied whereby it serves more than 2.70 Crores consumers with around 70000+ employees.

In Maharashtra, the total power inflow in FY 2020 is 1,57,910 MU, out of which the internal generation is 1,31,890 MU and the electricity received from central sector is 26,020 MU. The source wise installed capacity (MW) for electricity generation in Maharashtra from FY 2015 to FY 2020 is shown in Table 2 and Figure 7[9].

Table 2: Source wise Installed capacity of Maharashtra in MW

Source Wise	2015	2016	2017	2018	2019	2020
Coal	21,416	23,629	25,090	26,746	29,015	30,019
Diesel	1,508	2,164	1,987	2,005	885	681
Hydro	3,075	3,075	2,897	2,897	3,068	3,068
Natural Gas	3,175	3,185	3,844	3,667	5,781	3,911
Nuclear	1,400	1,400	1,400	1,400	1,400	1,400
Renewables	5,706	6,477	7,724	8,677	9,884	10,382
Total	36,280	39,930	42,942	45,392	50,033	49,461

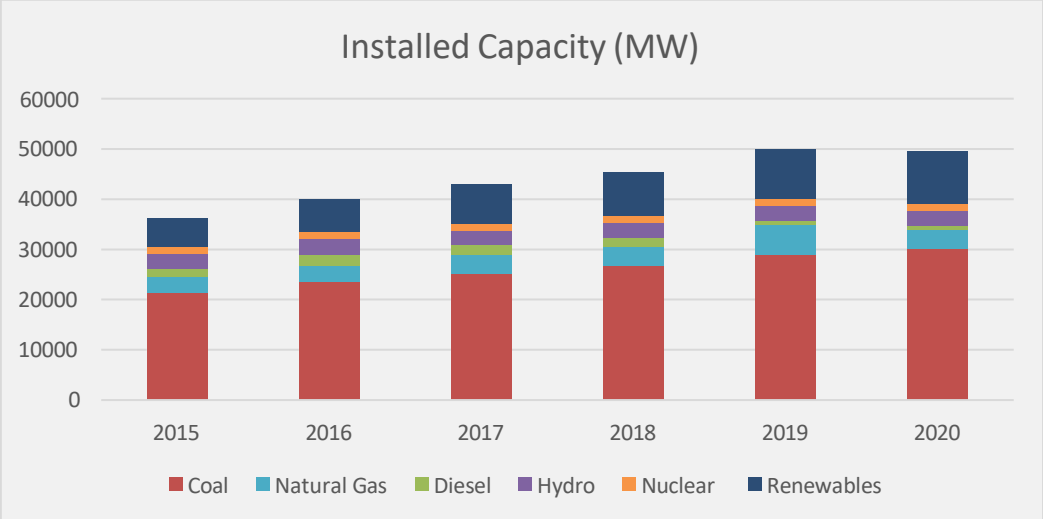


Figure 7: Installed capacity for electricity generation in Maharashtra

The ownership wise electricity energy generation (MU) of Maharashtra from FY 2015 to FY 2020 is shown in Table 3 and Figure 8[10].

Table 3: The ownership wise electricity energy generation (MU) of Maharashtra

Ownership	2015	2016	2017	2018	2019	2020
Utility	9,910	10,760	11,290	12,040	14,970	13,990
State	48,060	47,210	50,280	52,570	52,160	52,610

[9] https://www.niti.gov.in/edm/#elecCapacity

[10] https://www.niti.gov.in/edm/#elecGeneration

Private	46,670	56,530	48,450	51,150	55,970	52,780
Central	12,580	13,500	19,720	20,750	28,890	26,020
Captive	6,350	7,220	8,030	8,550	10,550	10,490
Total	1,25,585	1,37,236	1,39,787	1,47,078	1,64,559	1,57,910

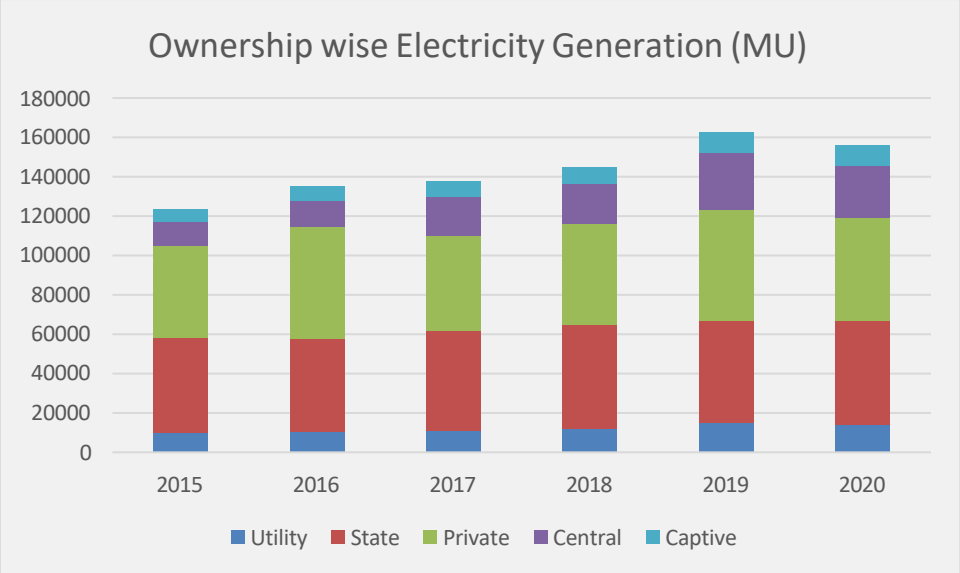


Figure 8: Ownership wise electricity generation (MU) of Maharashtra

The transmission capacity of MAHATRANSCO was about 1,31,981 Mega Volt Ampere (MVA) with the network of 49,604 circuit km transmission lines and 701 sub-stations till December 2021. The distribution network of MAHADISCOM had 3,953 sub-stations, 11,15,543 circuit km line length with 7,69,333 distribution transformers upto December 2021. Distribution network of MAHADISCOM is all over Maharashtra except Mumbai city. BEST has distribution network in Mumbai city whereas Tata Power Co. Ltd. and Adani Electricity Mumbai Ltd. have distribution network in Mumbai suburban. The contribution of MAHADISCOM to the distribution utilities in the State was 87.8 per cent followed by Adani Electricity (5.8 per cent), Tata Power (3.3 per cent) and BEST (3.1 per cent) during 2020-21[11].

Electricity consumption in 2020-21 has decreased at a rate of 0.6%, to 1,24,691 MU from 1,24,438 MU in 2019-20. In 2020-21, AT&C loss has decreased to 20.73 per cent from 21.33 per cent and transmission and distribution (T&D) loss came down to 18.22 per cent from 19.08 per cent. The average peak demand of the State in 2020-21 was 19,250 MW, indicating a slight increase from 19,103 MW in 2019-20.

The electricity consumption[12] in MU by the major sectors of Maharashtra for FY 2020 is given in Figure 9.

[11] Economic Survey of Maharashtra 2021-22
[12] Niti Ayog Energy India Dashboards

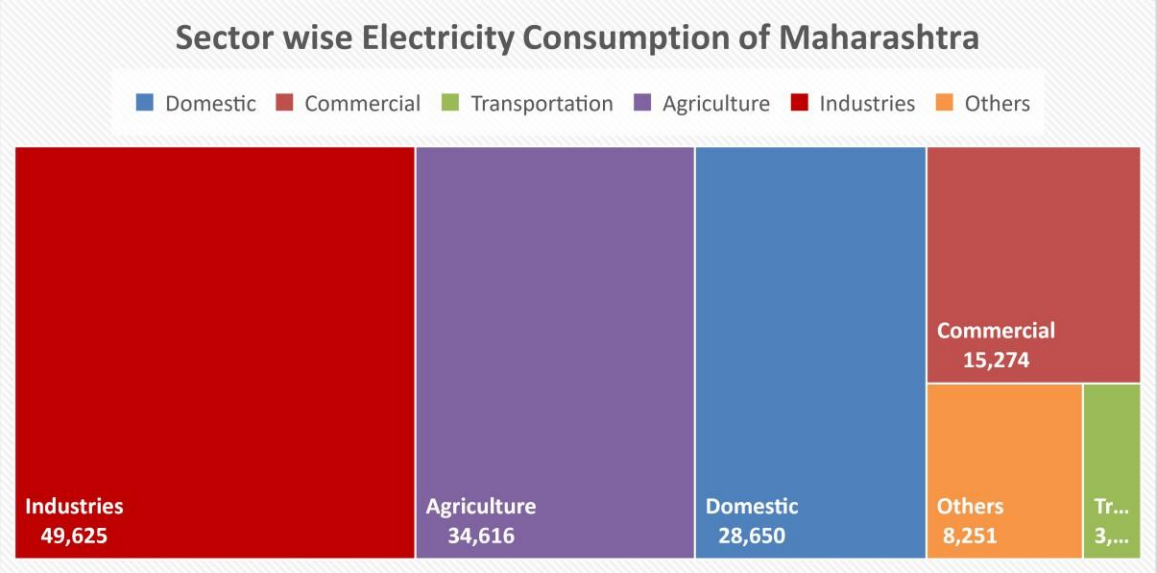


Figure 9: Sector wise Electricity Consumption of Maharashtra

The industrial sector is the most significant consumer of electricity and consumes about 36% of total electricity.

The agricultural sector comes second in electricity consumption and accounts for 25% of the total electricity consumption.

The domestic sector contributes for 20% of the total electricity consumption and the commercial sector accounts for 11% of the consumption.

Electricity Consumption Trend[13] of Maharashtra in MU for the period FY 2016 and FY 2020 is shown in Table 4 and Figure 10.

Table 4: Sector wise Electricity consumption trend of Maharashtra in MU

Category	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	CAGR
Domestic	25,207	27,927	26,870	27,947	28,650	**3.25**
Commercial	12,948	13,874	13,368	13,742	15,274	**4.22**
Transportation	2,442	2,495	2,298	2,500	3,070	**5.89**
Agriculture	26,633	28,397	28,202	30,307	34,616	**6.77**
Industries	40,967	40,094	40,628	46,477	49,625	**4.91**
Others	5,442	8,439	16,577	11,250	8,251	**10.97**
Total	1,13,639	1,21,226	1,27,943	1,32,223	1,39,486	**5.26**

[13] https://cea.nic.in/dashboard/?lang=en last accessed on 01/04/22

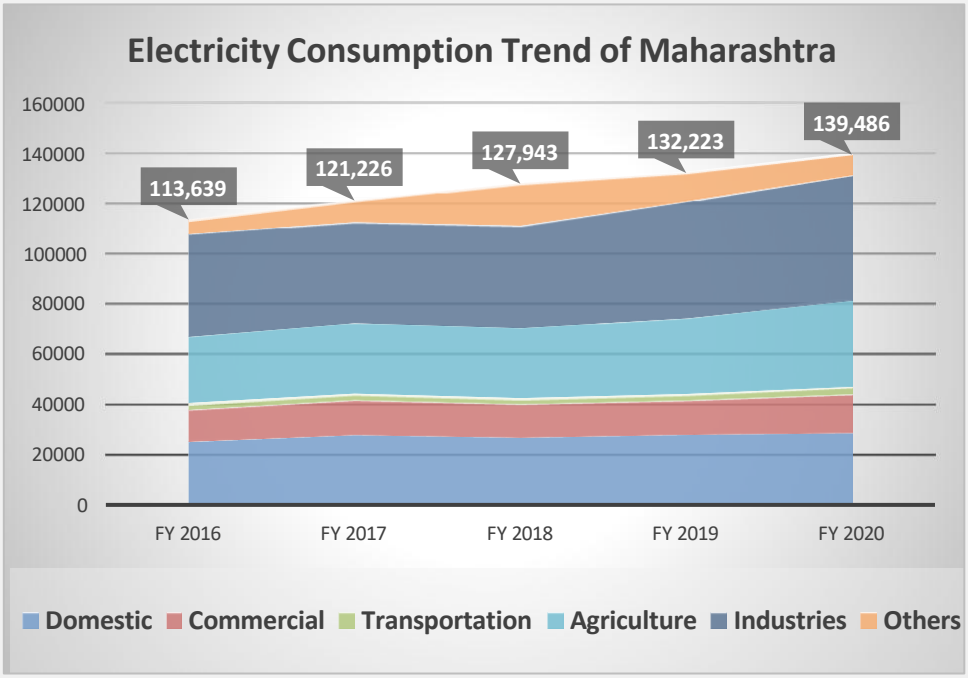


Figure 10: Electricity Consumption Trend of Maharashtra

The electricity consumption of Maharashtra has increased at a CAGR of 5.3% between FY 2016 and 2020. The largest contributor to electricity consumption, the industry sector has a CAGR of 5%. The domestic sector shows a CAGR growth of 4%, while the Commercial sector CAGR growth is 4.22%. The transportation sector, which includes the consumption of Traction, grew at a CAGR of 6%. Agricultural sector electricity consumption is grown by nearly 7%, primarily due to increase in electrical Agri pumps instead of diesel pumps.

1.4.1.1 Renewable Energy Scenario

The renewable power generating sources of Maharashtra are Wind, Bagasse co-generation, Solar, Hydel and Biomass. The installed capacity of RE from FY 2016 to FY 2020 is given in Table 5.

Table 5: The installed RE capacity of Maharashtra from FY 2016 to FY 2020

	2016	2017	2018	2019	2020
Wind	4,662	4,769	4,782	4,792	4,998
Bagasse Cogen	1,415	1,849	1,954	2,284	2,301
Small Hydro	302	304	336	366	370
Biomass	200	215	215	215	215
Urban solid waste	3	3	3	3	3
Industrial Waste	34	9	35	35	38
Solar	362	383	1,017	1,058	1,662
Total	6,978	7,532	8,342	8,753	9,587

The Figure 11 shows the state's total installed capacity as of 31 December 2021[14].

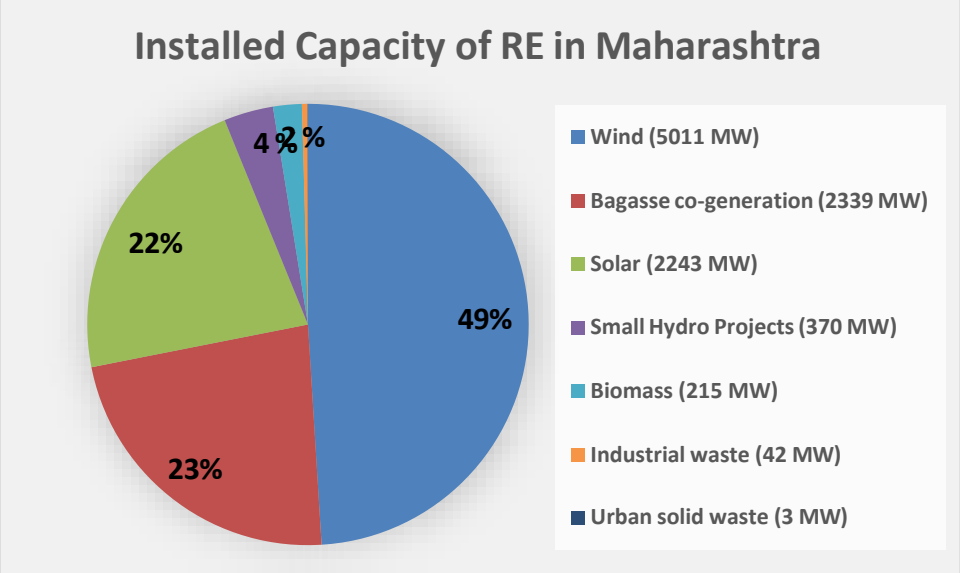


Figure 11: Installed Capacity of Power in Maharashtra

The State has adopted a policy for electricity generation from new and renewable energy sources, for transmission-linked projects and for non-transmission projects. The period of the policy is 31st December 2020 to 31st March 2025. Under this policy target is to set up non-conventional electricity generation project with a capacity of 17,385 MW. The policy envisages deployment of electricity generation projects from solar energy of capacity 12,930 MW, wind power projects of capacity 2,500 MW, bagasse based co-generation projects of capacity 1,350 MW, small hydro generation projects of capacity 380 MW, urban solid waste based power generation projects of capacity 200 MW and electricity generation projects based on advanced technology of capacity 25 MW. The State (9,846 MW) ranks fifth in India after Karnataka (15,463 MW), Tamil Nadu (15,225 MW), Gujarat (13,153 MW) and Rajasthan (10,205 MW) in terms of installed capacity of renewable energy.

1.4.2 Overview of the institutional framework – Energy

The Industries, Energy and Labour Department under the Government of Maharashtra is the apex authority in Maharashtra under which various agencies are working in tandem.

Maharashtra Electricity Regulatory Commission (MERC) was established on 5th August, 1999 and started working on 12th August, 1999. MERC is a 3-member Commission and one of the 3 members is Chairman. All the 3 Members of the Commission are full time Members and they are appointed by State Government. Chairman is the Chief Executive of the Commission. While discharging its functions under Electricity Act, 2003, the MERC is required to undertake various activities such as making Regulations, issuing Orders on Petitions for determination of tariff, Grant Licence etc.

The Electrical Inspectorate is a department under Government of Maharashtra, Industries, Energy and Labour Department. The main function of the department is to ensure safety of electrical installations as per the provisions of section 53 of Electricity Act 2003 & regulations made therein. Other important function of the department is to conduct inquiry of electrical accidents. All fatal and non-fatal electrical accidents are investigated by the field officers to find

[14] Economic survey of Maharashtra 2021-22

out the root cause of electrical accidents. The inquiry report is sent to the police for necessary action against the persons responsible for the electrical accident.

Maharashtra State Power Generation Co Ltd. (MSPGCL), also known as 'Mahagenco', has been incorporated under Indian Companies Act 1956 after reorganizing the erstwhile Maharashtra State Electricity Board (MSEB). Mahagenco has been incorporated on 31.5.2005 with the Registrar of Companies, Maharashtra, Mumbai and is engaged in the business of generation and supply of Electricity and has been vested with generation assets, interest in property, rights and liabilities of MSEB as per Gazette Notification dated 4th June 2005 issued by Industry, Energy and Labour Dept of Govt of Maharashtra pursuant to section 131 of Electricity Act 2003.

Maharashtra State Electricity Transmission Company limited (MSETCL) and Maharashtra State Electricity Distribution Company Limited (MSEDCL) are wholly owned corporate entities under the Maharashtra Government and were incorporated under the Companies Act on 2005, after restructuring the erstwhile Maharashtra State Electricity Board. MSETCL owns and operates most of Maharashtra's Electric Power Transmission System. This infrastructure constitutes most of the inter-regional as well as intra-regional electric power transmission system in the State. Today, MSETCL is the largest state transmission utility in the country. MSEDCL have the objectives of developing, operating and maintenance of distribution system for supplying electricity to the consumers in its area of supply. As a deemed distribution licensee under section 14 of the Electricity Act 2003, MSEDCL is carrying out the supply of power to the end users as well as maintaining the wire business for supply of such power.

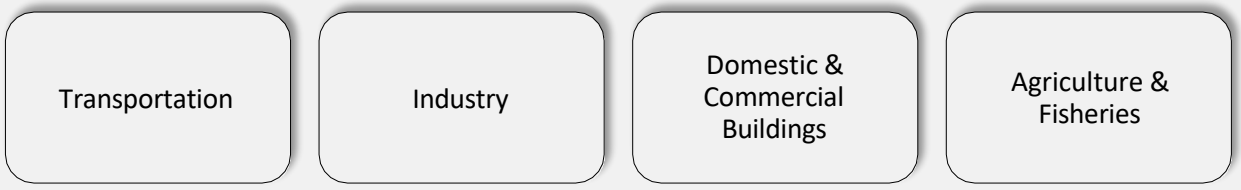
Maharashtra Energy Development Agency (MEDA) is registered as a society under Societies Registration Act, 1860 (in 1985) and Bombay Public Trust, 1950 (in 1987) under the aegis of MNRE, Govt. of India. It is the Designated Government agency or State Designated Agency (SDA) in Maharashtra to co-ordinate, regulate and enforce the provisions of the Energy Conservation Act 2001 (Central Act 52 of 2001). It is also the State Nodal Agency in renewable energy sector and assists state and central govt to promote and develop new and renewable sources of energy and technologies. MEDA is committed to explore the resources such as Wind, Bagasse Cogen, Hydro, Biomass, Geothermal, Wave which are clean and eco-friendly in nature.

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 Maharashtra.



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

3 PROJECTIONS AND FORECASTING

The Kaya identity is a useful equation for calculating the total amount of anthropogenic carbon dioxide (CO2) emissions. The equation, which is based on information that is easily accessible, can be used to calculate current emissions as well as how the important variables must evolve through time in relation to one another to achieve a target level of CO2 emissions in the future. The identity has been utilised and is still crucial in the discussion of international climate policy choices.

The Kaya identity states the total emission level of CO2 as the product of four factors:

$$F = P \times (G/P) \times (E/G) \times (F/E)$$

where: F = Global CO2 emissions from human sources

P = Global population

G = Global Gross Domestic Product (GDP)

E = Energy consumption

The equation identity was developed by Yoichi Kaya, the identity is a specific application of the I = PAT identity, which relates human impact on the environment (I) to the product of population (P), affluence (A) and technology (T). On first inspection, the Kaya identity may appear to be a frivolous equation given its construction as cancelling terms leaves you with F = F. In practice, however, it is commonly used to calculate an absolute value for global CO2 emissions from anthropogenic activities. It is also helpful in understanding how the four factors need to change relative to each other over time to reach a target level of CO2 emissions in future, and to understand how the four factors have changed in the past.

The expression simply states that emissions of greenhouse gases are the product of the population, GDP per person, energy efficiency, and emissions intensity.

KAYA Equation usages in Policy making:

The Kaya identity underlies the Intergovernmental Panel on Climate Change's (IPCC) analysis of emissions scenario literature. The analysis provided a basis for current assessments of greenhouse gas emissions and possible response strategies. In the context of policy-making, the Kaya identity is often expressed as:

Global CO2 emissions from human resources= Global population X Global GDP per capita X Energy Intensity X Carbon Intensity

The expression simply states that emissions of greenhouse gases are the product of the population, GDP per person, energy efficiency, and emissions intensity.

Energy Intensity – varies by country and region with underlying factors such as economic structure, climate, geography and energy efficiency policies.

Carbon Intensity – is driven by the prevailing form of energy generation. Measured on a total life cycle basis, renewable energy sources have a lower Carbon Intensity than fossil fuels.

The methodology employed for estimating the TFEC projection for Maharashtra involved analysing historical trends in final energy consumption and Gross State Domestic Product (GSDP) and growth of GSDP as per the state's vision. The historical trends of GSDP and TFEC are correlated to estimate the trend of energy intensity of the state.

The forecasting of TFEC is done based on the growth in state's gross domestic product. As per the state's vision, Maharashtra will become a 1 trillion-dollar economy by 2030. Based on this the state's growth of GSDP is calculated till FY 2030-31.

In a business-as-usual scenario it is considered that the energy intensity for next ten years would follow the same trajectory as the historical trend. Considering the historical energy intensity of the state, the CAGR of last five years is used to project the TFEC for next ten years up to 2031 in the business-as-usual scenario.

The TFEC (total final energy consumption) projected for FY 2030-31 is 114.98 MTOE for the state of Maharashtra from the actual TFEC of 42.86 MTOE in FY 2015-16.

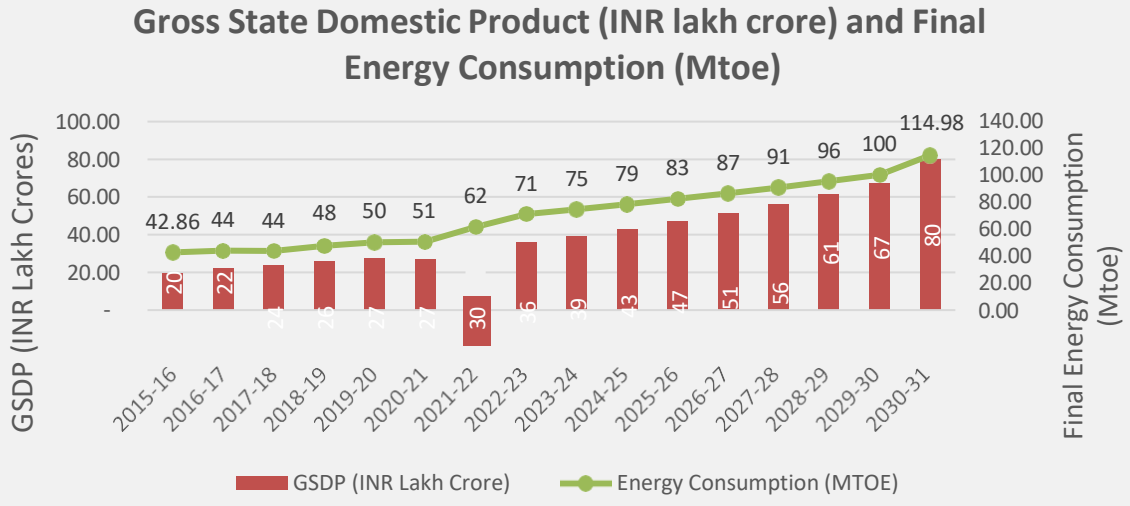


Figure 12 TFEC projection

4 FOCUS SECTOR 1: INDUSTRY

4.1 Overview

Maharashtra is one of the largest states in India with a diverse industrial sector. The state's industrial sector includes various industries such as cement, textiles, pharmaceuticals, agro - based industries, food processing, chemicals, and more. Industry sector in Maharashtra is the most energy intensive sector. It accounts to 39% of the total TFEC of the state at nearly 16.4 MTOE.

4.2 Energy efficiency strategies in the industry sector

4.2.1 Strategy: Deepening of PAT Scheme

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

The deepening of the PAT scheme can help Maharashtra achieve its energy efficiency and emission reduction targets by incentivizing industries to adopt energy-efficient practices and technologies. Energy consumption among the PAT DCs excluding the thermal power plants is shown in figure below.

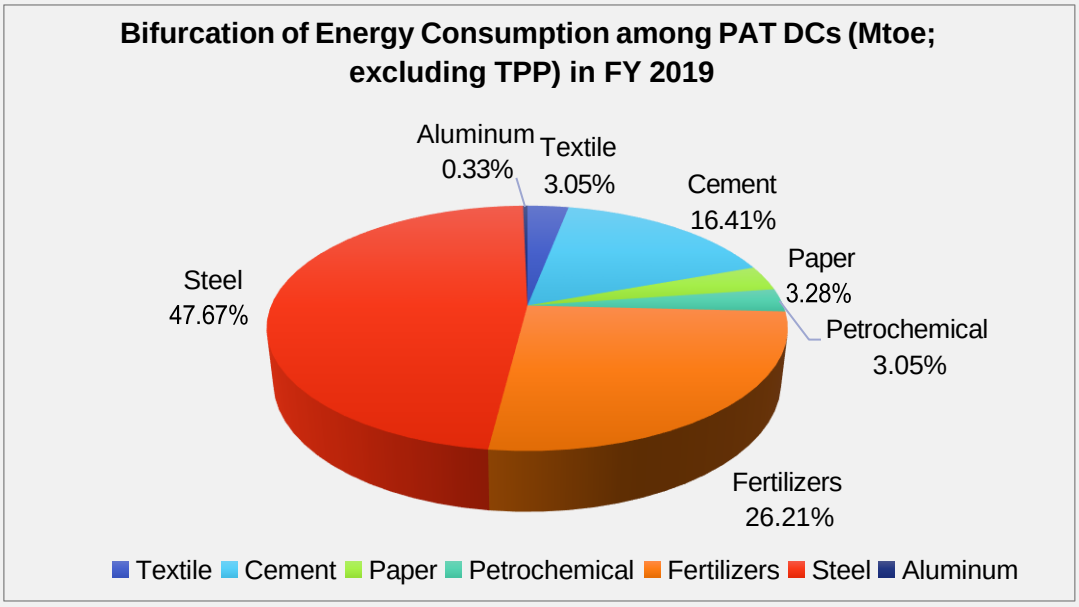


Figure 13 Bifurcation of Energy consumption among PAT DCs in FY 2019

By increasing the coverage of industries of above-mentioned sectors under the PAT scheme, Maharashtra can further unlock its potential for energy savings and emission reductions. This can not only contribute to meeting the state's climate change goals but also lead to cost savings for the industries involved. Therefore, the deepening of the PAT scheme can be an effective tool for sustainable industrial development in Maharashtra.

Scope Boundary

- Units in existing sectors under PAT namely Cement, Pulp & Paper and Sugar

Implementing Agency

- Bureau of Energy Efficiency(BEE) and MEDA

Current Policy In Place

- PAT Scheme

Energy Saving Potential

Energy saving potential is estimated by calculating SEC for moderate and ambitious scenarios based on the reduction in SEC that can be achieved through deepening of PAT.

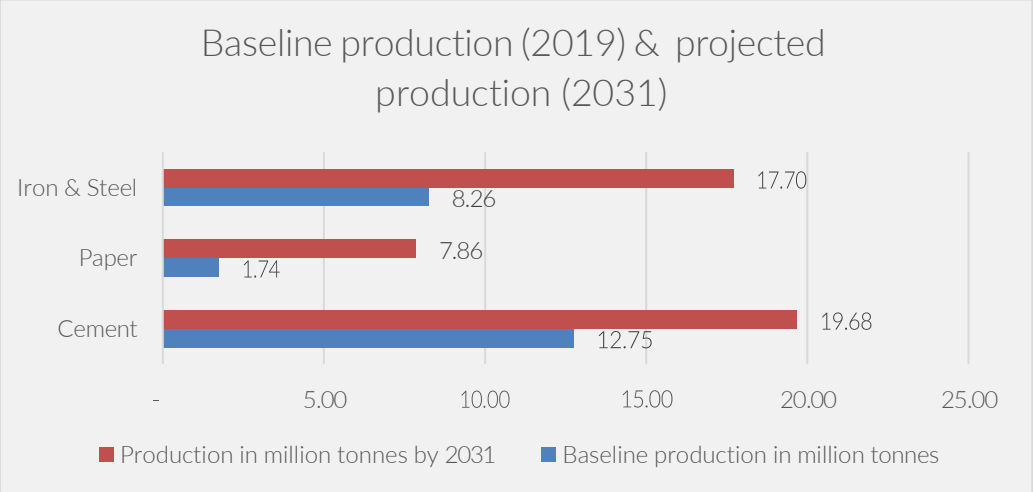


Figure 14 Production in PAT industries - Baseline and projected

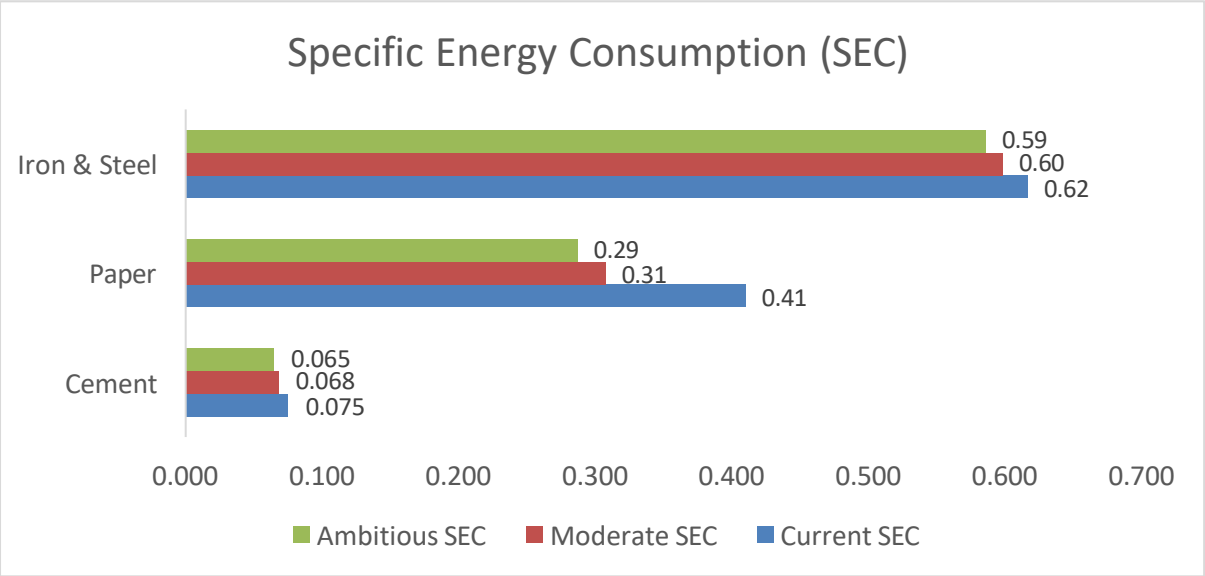


Figure 15 SEC of PAT Industries & projection for 2031 in moderate and ambitious scenarios

Table 6: Energy Saving Potential – Deepening of PAT scheme

Particulars	Moderate Scenario for 2031	Ambitious Scenario for 2031
Energy Saving Potential (MTOE)	1.27	1.72
GHG Emission Reduction Potential (MtCO2)	3.98	5.38

4.2.2 Strategy: Widening of PAT Scheme

By bringing more industries under the PAT scheme, the state can ensure that a larger number of energy-intensive industries are actively working towards improving their energy efficiency. This can help reduce the overall energy consumption of the state and reduce its carbon footprint.

Additionally, the incentives offered under the PAT scheme can encourage industries to invest in energy-efficient technologies and processes. This can lead to significant energy savings for the industries, which can translate into cost savings and improved competitiveness. It can also lead to the creation of new jobs in the energy efficiency sector, which can benefit the local economy.

Scope Boundary

- Sectors like Sugar, Automobile, Chemical, Pharma, Food processing, Tyre manufacturing, Glass and Ceramics are considered based on energy consumption patterns of the industries, their contribution to the state's economy, and their potential for energy efficiency improvements.

Implementing Agency

- Bureau of Energy Efficiency(BEE) and MEDA

Current Policy In Place

- PAT Scheme

Energy Saving Potential

Sugar, Automobile, Chemical, Pharma, Food processing, Tyre manufacturing, Glass and Ceramics are the major fuel consuming industries in Maharashtra.

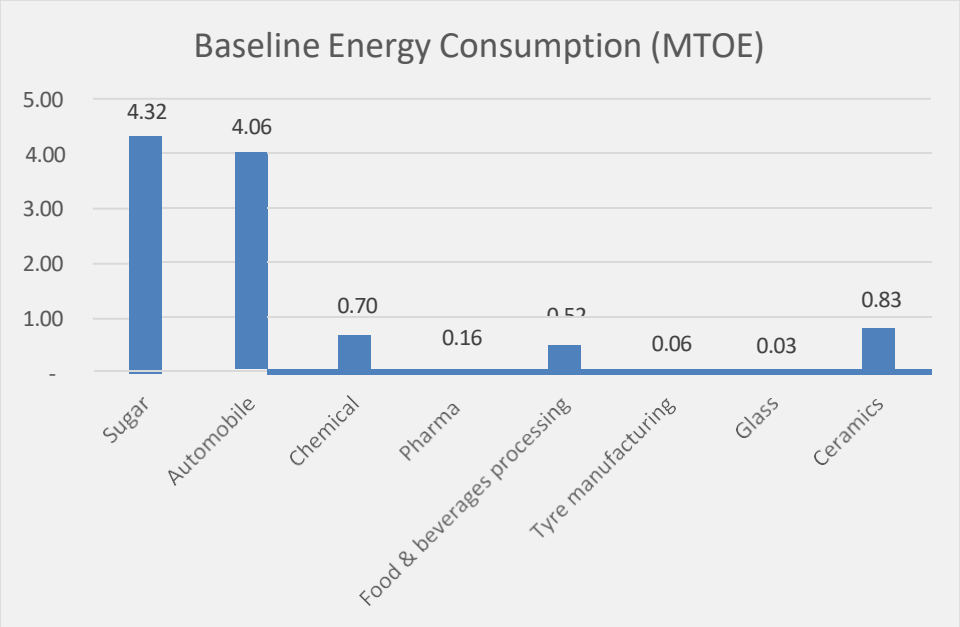


Figure 16 Baseline Energy Consumption

Among these major industries, the sugar sector in Maharashtra is major energy consuming followed by automobile sector.

Specific Energy Consumption (SEC) of these industries within the sector is calculated with the ratio of industry energy consumption and annual production. Table 7 shows the SEC of FY 2020 and estimated SECs for moderate and ambitious scenario. The SECs in moderate and ambitious scenarios are projected for year 2031 based on the trends of the targets given for the PAT industries.

Table 7 SEC Comparison Baseline (2020) Vs Moderate and Ambitious (2031)

Sector	Unit	Current SEC	Moderate SEC	Ambitious SEC
Sugar	TOE/ Ton	0.32	0.25	0.23
Automobile	TOE/ INR Lakh	1.79	1.40	1.33
Chemical	TOE/ INR Lakh	0.29	0.23	0.22
Pharma	TOE/ INR Lakh	0.10	0.07	0.07
Food & beverages processing	TOE/ INR Lakh	0.19	0.15	0.14
Tyre manufacturing	TOE/ INR Lakh	0.15	0.11	0.11
Glass	TOE/ INR Lakh	0.45	0.35	0.34
Ceramics	TOE/ INR Lakh	6.86	5.35	5.08

Based on the SECs of each sector, savings potential was derived for moderate scenario and ambitious scenario.

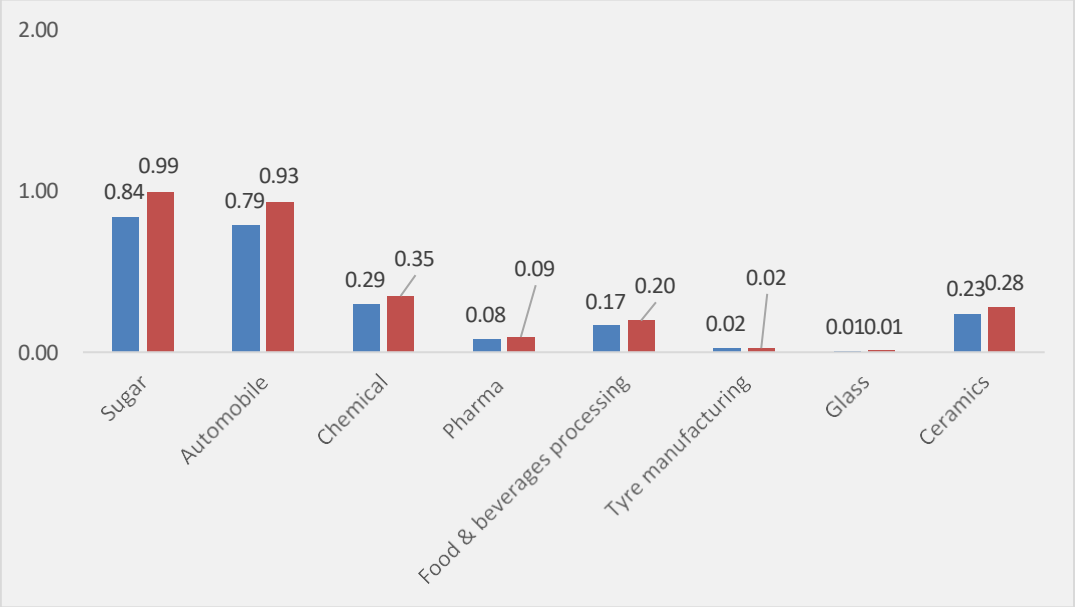


Figure 17 Energy Saving potential (MTOE) by sector

Table 8: Energy Saving Potential – Widening of PAT scheme

Particulars	Moderate Scenario for 2030	Ambitious Scenario for 2030
Energy Saving Potential (MTOE)	2.43	2.87
GHG Emission Reduction Potential ($MtCO_2$)	7.59	8.97

Action Plans - Deepening and Widening of PAT scheme

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

Table 9 Action Plan Deepening & Widening of PAT scheme

Policy Type	Action Plan	Timeline
Awareness & Capacity Building	Capacity Building of Energy Managers and Energy Auditors in PAT DCs and new probable sectors for compliance with scheme and new technologies.	Short Term
Technological Intervention	Feasibility Study of new probable sectors (Sugar, Automobile, Chemical, Pharma, Food processing, Tyre manufacturing, Glass and Ceramics to be included in PAT scheme	Short Term
	Benchmarking study and data collection	Long Term

4.2.3 Strategy: Decarbonising MSMEs through cluster approach

Maharashtra, a progressive state, wants to accelerate urbanisation and maintain industrialization. The demand for resources and energy will probably significantly increase because of these transitions. The achievement of this vision may be harmed by the depletion of resources like fossil fuels, land, and water, as well as the negative effects of air pollution, climate change, and transportation congestion on quality of life.

The state is home for several MSME clusters. These industry clusters include,

1. Pune forging cluster
2. Kolhapur foundry cluster
3. Pune rubber cluster
4. Pune aluminium cluster
5. Rabale chemicals & drugs cluster
6. Bhiwandi textile cluster
7. Solapur textile cluster
8. Bricks clusters of Maharashtra
9. Dairy cluster

A cluster-based strategy for benchmarking these industries and facilitating the energy efficiency interventions will have a high energy saving potential. Under the cluster approach, it is recommended to promote energy audit by mandating it among these clusters.

Table 10 Energy Saving Potential

Energy Saving Potential (MTOE) 2031		
Cluster name	**Moderate**	**Ambitious**
Dairy Cluster	0.014	0.017
Pune Forging Cluster	0.008	0.010
Kolhapur Foundry Cluster	0.066	0.088
Clay Fired Brick Making Clusters	0.872	0.969

Energy Saving Potential (MTOE) 2031		
Cluster name	**Moderate**	**Ambitious**
Pune Rubber Cluster	0.001	0.001
Pune Aluminium Cluster	0.023	0.030
Rabale chemicals & drugs cluster	0.006	0.009
Bhiwandi textile cluster	0.127	0.170
Solapur textile cluster	0.005	0.007
Total	1.12	1.29
CO2 Emission reduction (MnT CO2)	3.50	4.05

Energy Saving Potential

Considering the energy reduction in these MSME clusters by mandating energy audits and facilitating the energy efficiency interventions will result in potential savings of 1.12 MTOE and 1.29 MTOE in moderate and ambitious scenario respectively by FY 2031.

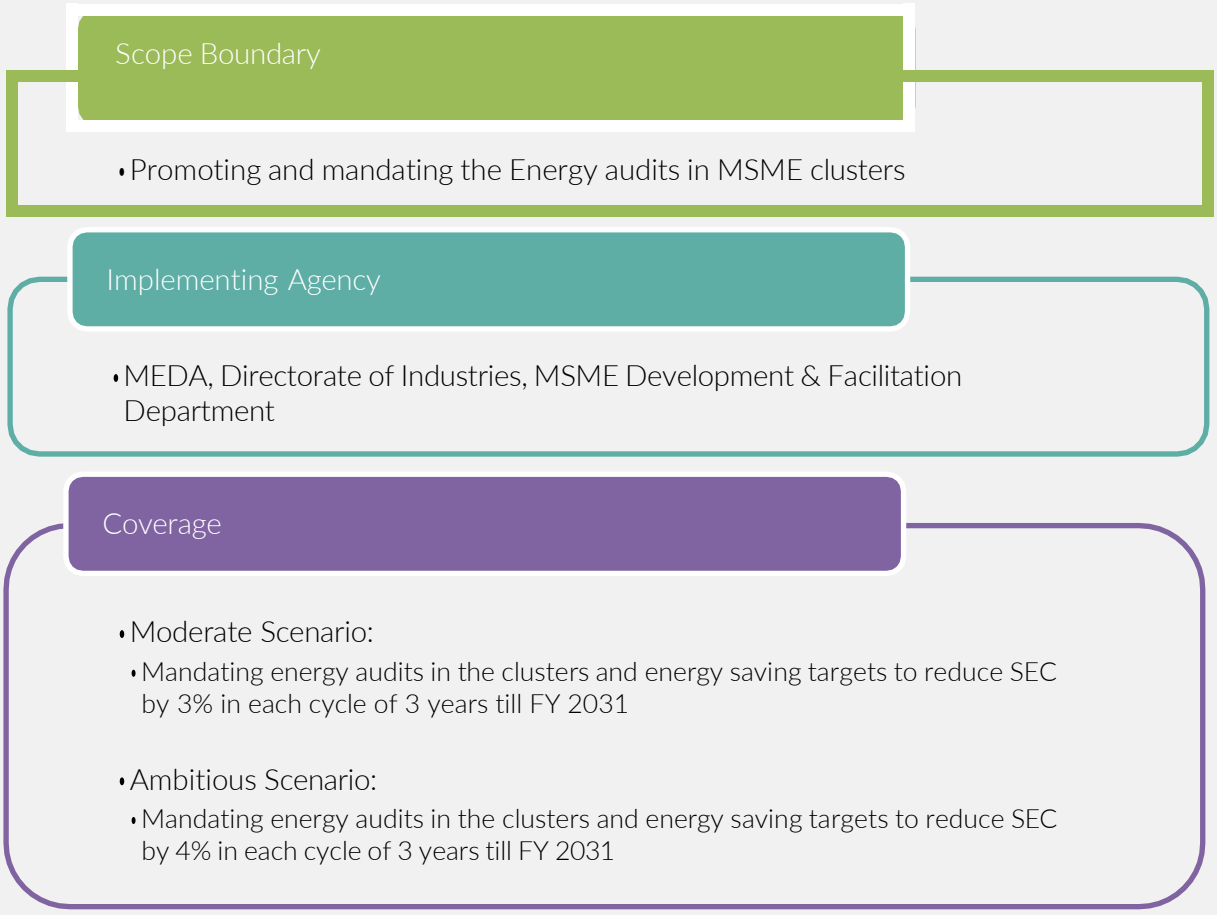


Table 11 Energy Saving Potential – Decarbonising MSMEs through cluster approach

Particulars	Moderate Scenario for FY 2031	Ambitious Scenario for FY 2031

Conventional Energy Offset Potential (MTOE)	1.12	1.29
GHG Emission Reduction Potential ($MtCO_2$)	3.50	4.05

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, and long-term period has been taken into consideration for actionable instruments.

Table 12 Action Plan for Decarbonising of MSMEs through Cluster approach

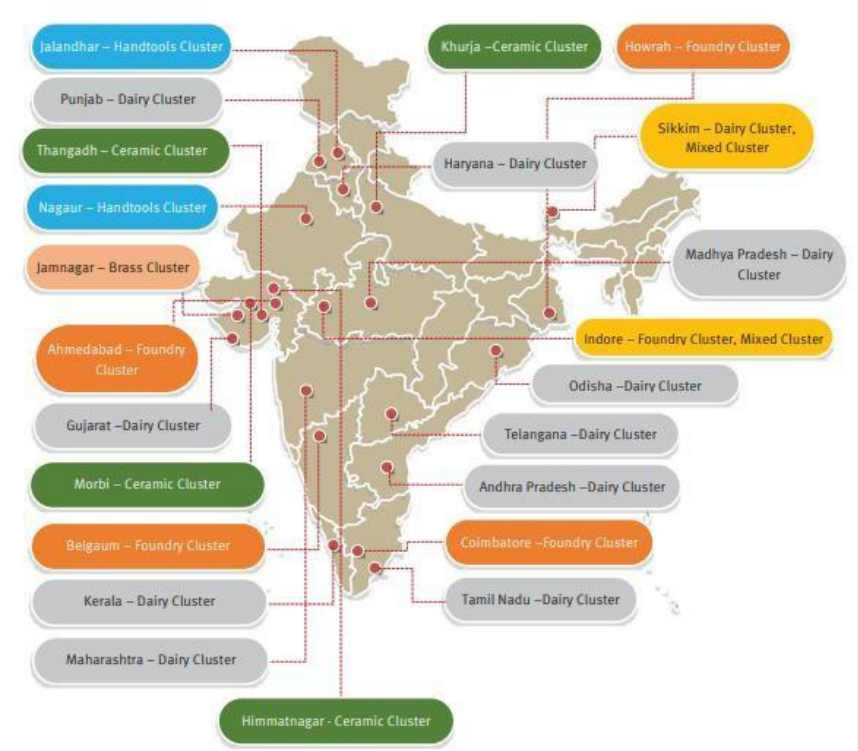
Sl. No.	Action Plans	Timeline
1	Sector-specific policy development for financial assistance on benchmarking the MSMEs within the clusters	Short Term
2	Subsidies for conducting energy audits and implementation of energy efficiency projects	Short Term
3	Promotion of Green Rating for Companies	Long Term
4	Incentives for electrification of MSME processes: • The MSME sector heavily relies on inefficient thermal equipment for various processes, but traditional process heating lacks energy efficiency. Critical MSME categories in Maharashtra like foundries and forging units may be incentivized to transition to more energy-efficient electric induction furnaces. Similarly, incentives may be provided to increase the uptake of efficient technologies, such as heat pumps and microwave heating among MSME units. Financing mechanisms such as soft loans to assist in initial capital investment, tariff subsidies to switch to electric processes may be explored. • Local manufacturing may be incentivized through schemes like PLI, capital subsidies for technology adoption, awareness campaigns and facilitation of local expertise and partnerships. • The State's Energy Conservation Fund may be leveraged to undertake demonstration projects in MSMEs	Short Term

Case Study: Promoting energy efficiency and renewable energy in selected micro, small and medium enterprises (MSME) clusters in India[15]

The UNIDO-BEE project named "Promoting EE/RE in selected MSME Clusters in India", is to provide support to the MSME units in implementing EE & RE technologies. The major activities undertaken in the project are,

1. Organizing awareness programs and identification of potential enterprises
2. Conducting walk-through audits
3. Preparing cluster-specific EE & RE-based technology compendium and
4. Implementation support to participating units.

Through this project, more than 1800 EE & RE projects were facilitated in the MSMEs which are worth INR 250 crore and have a potential for annual GHG emission reduction of about 140,000 tCO2 across more than 1500 participating units.



4.2.4 Strategy: Green Hydrogen

Green hydrogen is hydrogen produced by splitting water by electrolysis. This produces only hydrogen and oxygen. The hydrogen can be used while the oxygen can be released into the atmosphere with no negative impact.

[15] Promoting energy efficiency and renewable energy in selected micro, small and medium enterprises (MSME) clusters in India (isid4india.org)

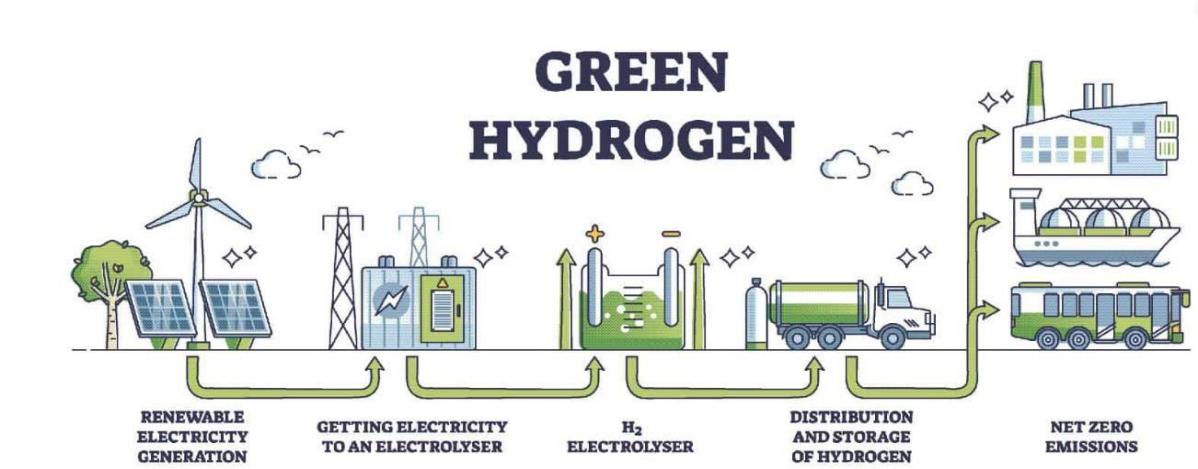


Figure 18 Green Hydrogen

A versatile energy source with numerous commercial and industrial uses is hydrogen. Additionally, it has a long storage life. The energy properties of hydrogen lead to both opportunities and difficulties. Green hydrogen is produced using electrolysis of water with electricity generated by renewable energy. The carbon intensity ultimately depends on the carbon neutrality of the source of electricity; in other words, the more renewable energy is used in the electricity, the more "green" the hydrogen generated. The electrolyser technology is essential to the environmentally friendly hydrogen production procedure. Alkaline and polymer electrolyte membrane (PEM) electrolysers are two commercially available technologies for green hydrogen production today. Advanced electrolyser technologies like solid oxide and anion exchange membrane nearing commercial deployment as well. There is a resurgence of interest in environmentally friendly hydrogen generation technology. This is due to the fact that hydrogen's potential applications are growing in a variety of fields, including power generation, manufacturing processes in the steel and cement industries, fuel cells for electric vehicles, heavy transportation like shipping, production of green ammonia for fertilisers[16] as shown in below figure;

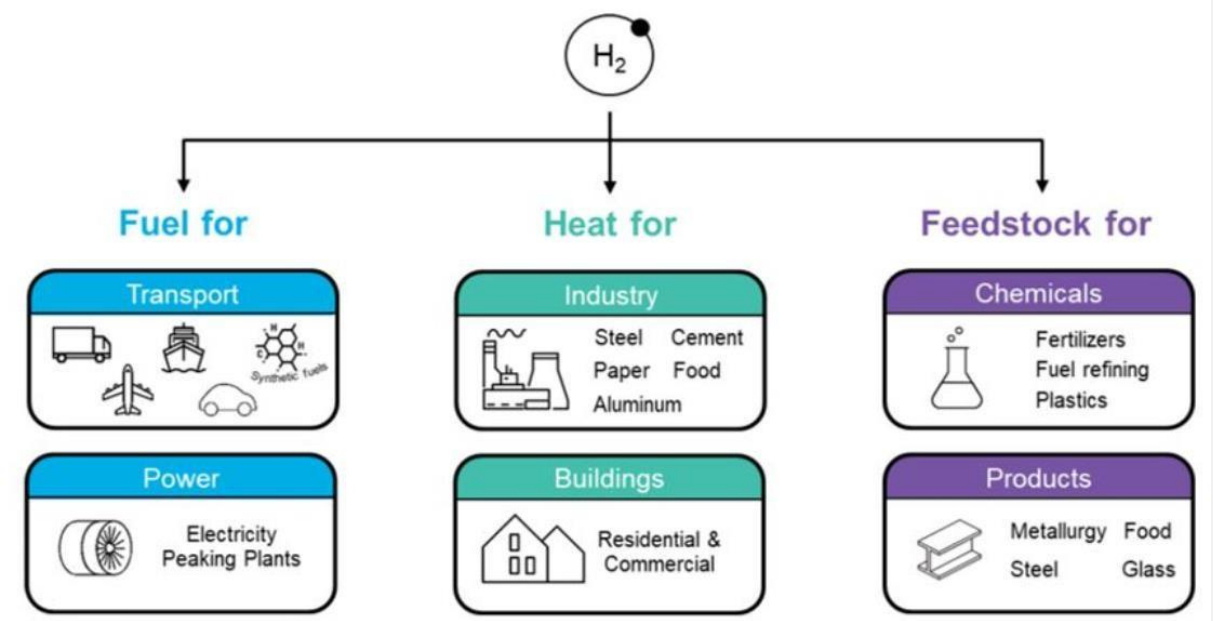


Figure 19 End use of H2

[16] https://blogs.worldbank.org/ppps/green-hydrogen-key-investment-energy-transition

Technology in use for Green H2 Production:

The most advanced hydrogen technologies are Alkaline Electrolysis (AE) and Proton Exchange Membrane (PEM), while Solid Oxide Electrolysis (SOE) and Anion Exchange Membrane (AEM) may yet have a future.

PEM Electrolysis:

In PEM water electrolysis, water is electrochemically split into hydrogen and oxygen at their respective electrodes such as hydrogen at the cathode and oxygen at the anode. PEM water electrolysis is accrued by pumping of water to the anode where it is spilt into oxygen (O2), protons (H+) and electrons (e−). These protons are travelled via proton conducting membrane to the cathode side. The electrons exit from the anode through the external power circuit, which provides the driving force (cell voltage) for the reaction. At the cathode side the protons and electrons re-combine to produce the hydrogen[17], the following mechanism as shown in below figure;

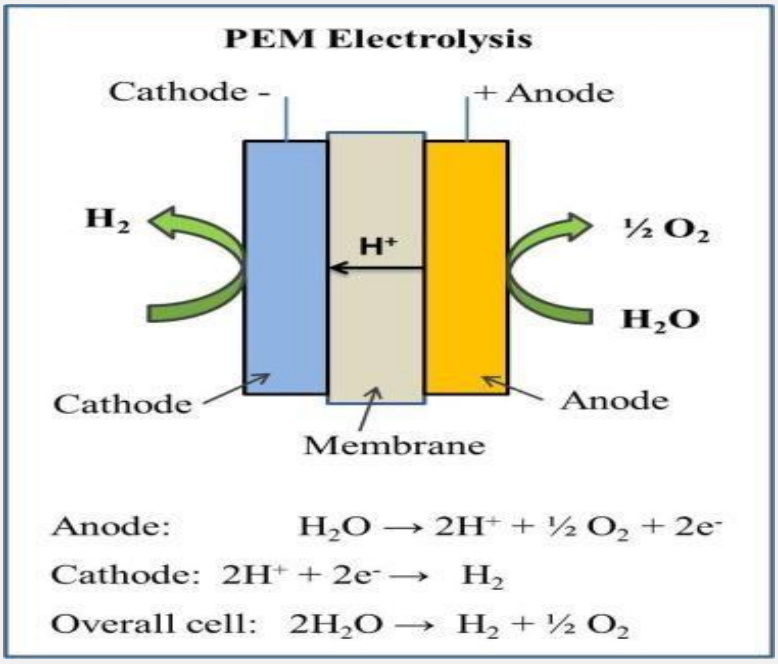


Figure 20 Schematic illustration of PEM water electrolysis

Alkaline water electrolysis

Hydrogen production by alkaline water electrolysis is well established technology up to the megawatt range for commercial level in worldwide. Alkaline water electrolysis process initially at the cathode side two molecules of alkaline solution (KOH/NaOH) were reduced to one molecule of hydrogen (H2) and two hydroxyl ions (OH−) are produced. The produced H2 eliminate from the cathode surface to recombine in a gaseous form and the hydroxyl ions (OH−) transfer under the influence of the electrical circuit between anode and cathode through the porous diaphragm to the anode, here in discharged to ½ molecule of oxygen (O2) and one molecule of water (H2O). The O2 recombined at the surface of electrode and escapes as hydrogen, the following mechanism as shown in below figure;

[17] Hydrogen production by PEM water electrolysis – A review, Materials Science for Energy Technologies Volume 2, Issue 3, December 2019, Pages 442-454, by S. Shiva Kumar and V. Himabandu https://www.sciencedirect.com/science/article/pii/S2589299119300035#:~:text=In%20PEM%20water%20electrolysis%2C%20water,and%20electrons%20(e%E2%88%92).

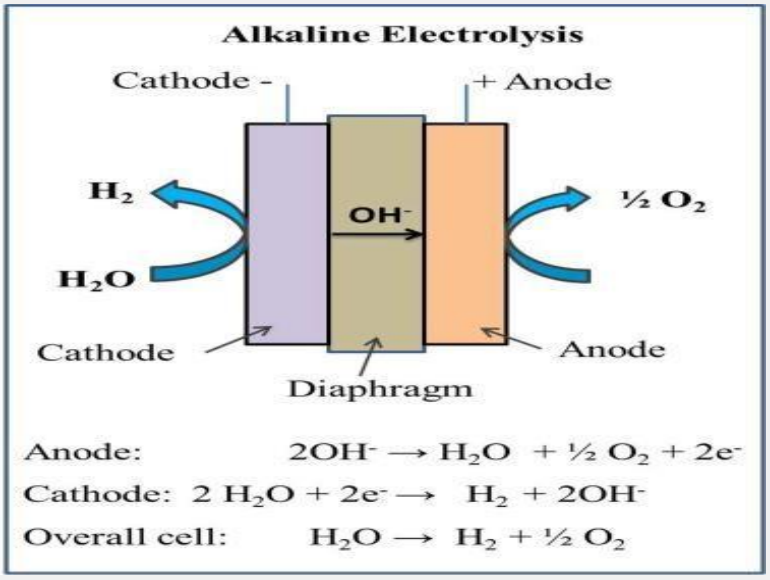


Figure 21 Schematic illustration of alkaline water electrolysis

At present, the National Green Hydrogen Mission has been released by the Government of India. And at the national level, a target has been set to produce about 5 million metric tons of green hydrogen per year by the year 2030. Internationally also the production capacity of green hydrogen is developing more rapidly. For this, it is necessary to set up green hydrogen production units so that the state of Maharashtra is also at the forefront of the production of green hydrogen.

Maharashtra state announced its green hydrogen policy to target the production of 500 kilo tonnes per annum by 2030. The state cabinet also sanctioned a budget of Rs 8,562 crore for the implementation of the policy by way of subsidies and benefits to companies generating the green hydrogen[18]. Projects that purchase renewable energy for self-consumption through open access from domestic or international power exchanges or distribution corporations will receive incentives under the policy. Some of the key benefits of the policy is as follows[19];

- Exemption of cross subsidy surcharge and additional surcharge in power bills for power procured for production of green hydrogen
- 50% exemption from intra state transmission charge and wheeling charge for projects for electricity procured from renewable energy plants
- 100% exemption from electricity duty

The strategy and its implementation are explained below.

[18] https://www.eqmagpro.com/maharashtra-pioneers-green-hydrogen-with-approved-policy-of-rs-8500-crore-investment-eq-mag/

[19] https://timesofindia.indiatimes.com/city/mumbai/state-takes-lead-in-announcing-green-hydrogen-policy-a-first-such-in-india/articleshow/101500660.cms

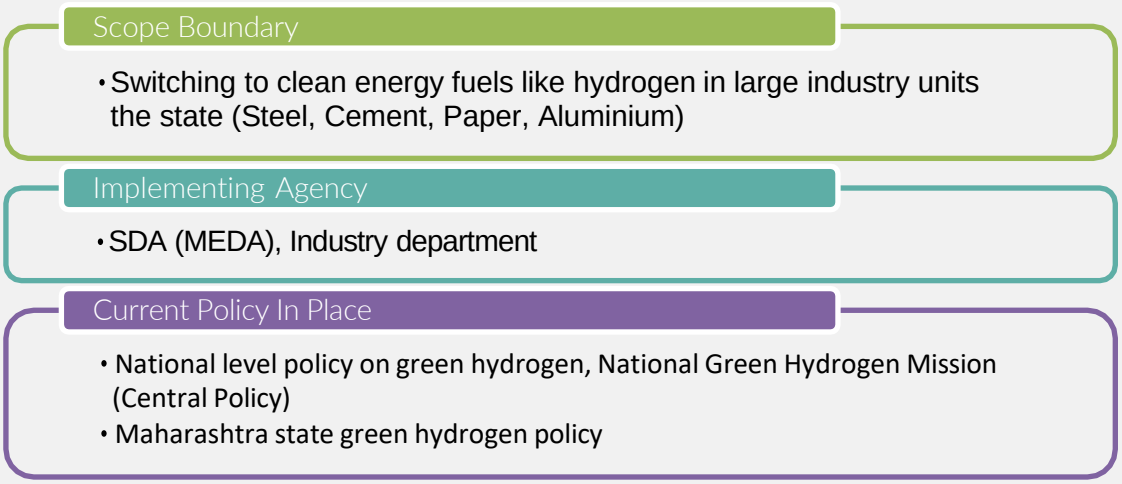


Figure 22 Green Hydrogen Projects: Scope Boundary, Implementing agency and policy

Energy Saving Potential

State policy target green hydrogen production of 500 KT per annum and this considered under moderate scenario and in ambitious scenario state may reach 600 KTPA by 2031

Table 13: Energy Saving Potential

Particulars	Moderate Scenario for 2031	Ambitious Scenario for 2031
Energy Saving Potential (MTOE)	1.69	2.03
GHG Emission Reduction Potential ($MtCO_2$)	5.30	6.36

Action Plans for Green H2

The following short term and long term action plan can be taken in the state.

Table 14 Action Plans for promoting green H2 Projects

Policy Type	Action Plan	Timeline
Incentive	1. The government can suggest specific regulations on hydrogen blending in current consumption sectors (steel and heavy-duty vehicles) as well as prospective future ones (refineries and ammonia). This will guarantee demand for early green hydrogen projects and promote market growth. The government can offer incentives for novel applications when the viability of employing green hydrogen is still in its infancy, such as a production linked incentive (PLI) plan for green steel aimed at export markets.	Short Term
R& D support	2. H2 technology is still evolving and not yet reached the economies of scale. Some initial support for R&D can help research, cost optimization and increasing technical capability of industries	Short Term

Green Hydrogen Policy	3. Formation of State policy on Green H2, however, to give push to green H2, state has land policy approved in April 2023.	Long Term

Example of supporting policies for green H2:

Table 15 Example of supporting policies for green H2

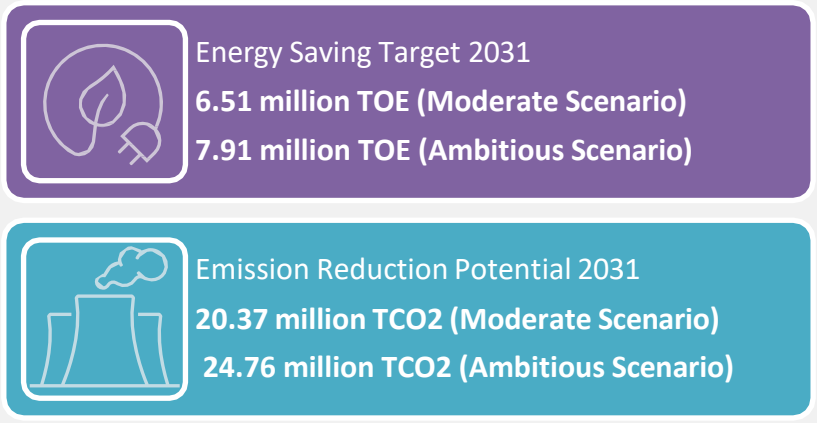
Policy	Area	Example of policies world wide
Policy Support for electrolysis	Setting target for electrolyser capacity	European Union's goal of increasing electrolyser capacity to 80 GW (40 GW in Europe, 40 GW in neighbouring countries) by 2030 (European Commission, 2020)
	Improving tax schemes for electrolysers	The cost of green hydrogen production could be lowered by reducing the taxes and fees on the electricity used by electrolysers
	Increasing support for research	Improve electrolyser efficiencies and to optimise and standardise designs for large-scale electrolysers to bring down electrolyser cost
Policy Support for Industrial application	Adapting Industrial policy for green H2	
	Planning phase-out of high emission technologies	Governments are able to create plans to shift industries gradually. By employing a growing percentage of green hydrogen in the existing blast furnaces, the steel industry might start decreasing emissions. However, it would need to move to fluidized bed furnaces in order for that percentage to reach 100%.

4.3 Energy saving targets & monitoring mechanism

Energy saving target of the industry sector is 4.60 MTOE and 5.87 MTOE for moderate and ambitious scenarios FY2031 respectively as seen from Table 16.

Table 16 Summary of energy saving from the strategies.

Strategy	Energy Saving Target (Moderate) 2031	Energy Saving (Ambitious) 2031	CO2 reduction potential (Moderate) 2031	CO2 reduction potential (Ambitious) 2031
1. Deepening of PAT	1.27	1.72	3.98	5.38
2. Widening of PAT	2.43	2.87	7.59	8.97
3. Decarbonizing MSMEs through cluster approach	1.12	1.29	3.50	4.05
4. Green Hydrogen Projects	1.69	2.03	5.30	6.36
Total	6.51	7.91	20.37	24.76



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

Table 17 Monitoring Mechanisms for strategies

Policy Type	Monitoring Mechanism
SDA (State Designated Agency)	The MEDA 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.

Industry associations	Industry associations can play a key role in monitoring energy policies for their members.

5 FOCUS SECTOR 2: TRANSPORT

5.1 Overview

In 2020, the Maharashtra state has a total energy consumption in transport sector of about 11.6 Mtoe which is 27% of overall energy consumption in the state. This includes energy consumption from road transport, railways and air transport. With majority of the energy coming from the fossil fuels, the corresponding emissions from the transport sector is about 36 $MtCO_2e$.

Maharashtra has vast network of road transport with 3.09 lakh kms in length. Of the total road network length, 48% is the village roads while the remaining 52% is from the district roads, state, and national highways[20].

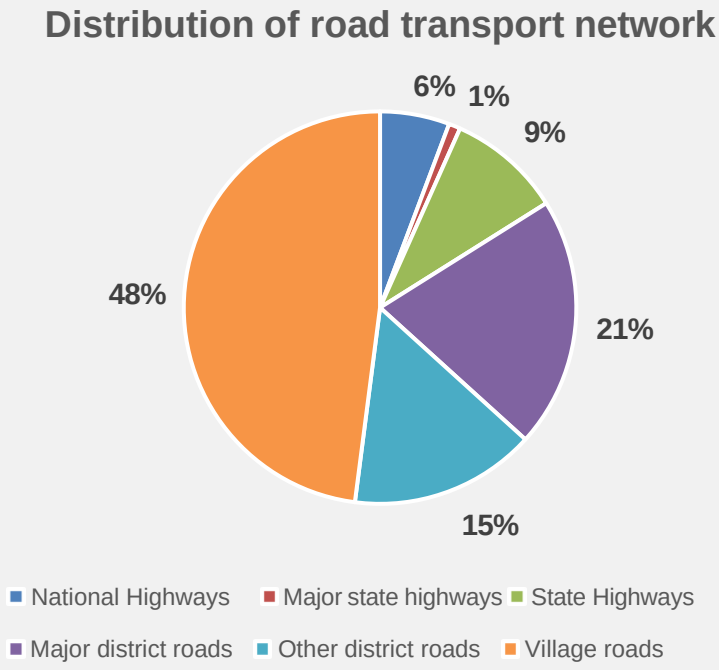


Figure 23 Distribution of road transport network

With the strong socio-economic growth in the state, there is a significant amount of road transport demand as well in the state. As of Sep 2022, the total registered vehicles in the state stands at 318 lakh[21].

[20] State Economic Survey 2020-21 (https://www.adb.org/sites/default/files/linked-documents/52298-002-ssa.pdf)
[21] Vahan Dashboard

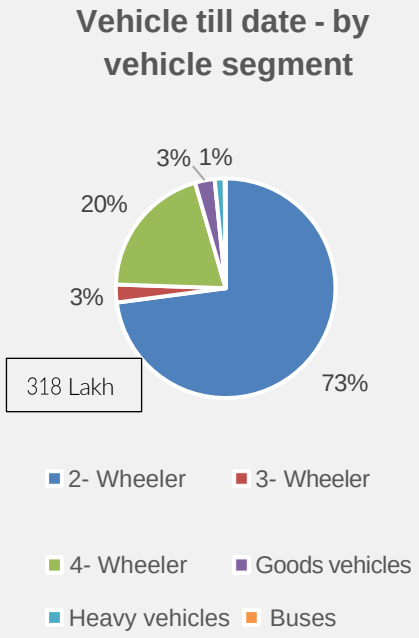


Figure 24 Vehicle till date- segment wise

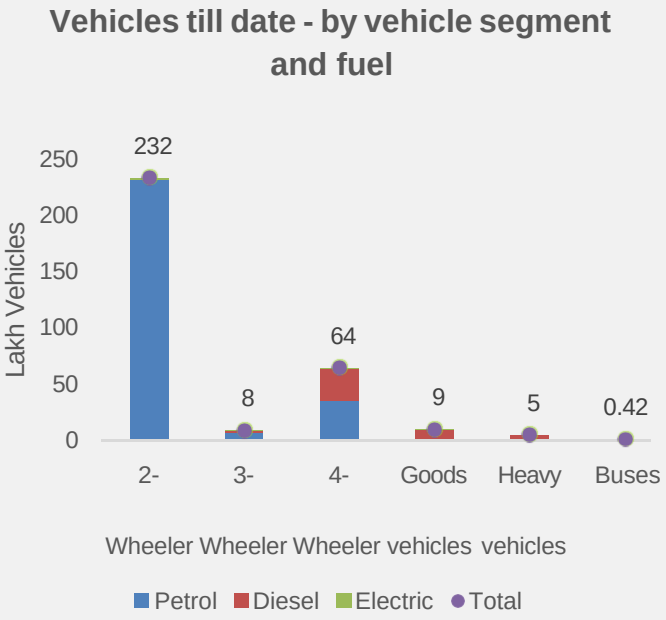


Figure 25 Vehicles till date – Fuel & Segment wise

5.2 Energy efficiency strategies in the transport sector

5.2.1 Strategy: Electrification of road transport

From an efficiency perspective, electric vehicles can covert around 60% of the electrical energy from the grid to power the wheels, but petrol or diesel cars can only convert 17%-21% of the energy stored in the fuel to the wheels. That is a waste of around 80%[22]. So, electrification of road transport is good way to reduce the energy consumption while also to reduce the emissions, as grid becomes greener with increased renewable share.

In Maharashtra out of the total registered vehicles, 0.4% are electric vehicles. Maharashtra is one of the fastest growing EV markets in the country with favourable demand side incentives offered through their EV policy. The state is also front runner in terms of setting up the charging infrastructure for EVs.

However, there is still a long way to go to make the transport sector transition from ICE vehicles to EVs. Creating awareness among the people and strengthening the charging infrastructure further will increase the adoption of EVs in the state.

[22] BENEFITS OF ELECTRIC VEHICLES (niti.gov.in)

Strategy: Electrification of road transport

- Promotion of EVs

Scope Boundary

- Road transport vehicles : 2-W, 3-W, 4-W, Goods Vehicles, Heavy Vehicles and Buses

Implementing agency

- State Transport Department
- Maharashtra State Electricity Distribution Company Limited

Current Policy In Place

- Maharashtra State Electric Vehicle Policy
- National Electric Mobility Mission Plan 2020 (NEMMP)

As listed in table below, in 2021-22 the sales of EVs as total vehicle sales for 3-wheelers has reached 20%. The same for 2-wheelers is about 3% and 1% for 4-wheelers. But with increase in penetration of new EVs in all segments, the share of EV sales is expected to improve in the state. So, considering the present EV penetration and EV penetration projections given by NITI Aayog[23], the below projections have been made for the state in moderate and ambitious scenarios.

Table 18 Present and future EV penetration in Maharashtra

Vehicle Category	2021-22	2025-26		2030-31	
		Moderate	Ambitious	Moderate	Ambitious
2- Wheeler	3%	15%	31%	50%	80%
3- Wheeler	20%	48%	48%	80%	100%
4- Wheeler	1%	6%	8%	30%	40%
Goods vehicles	0%	12%	18%	40%	60%
Heavy vehicles	0%	3%	3%	10%	10%
Buses	1%	5%	5%	30%	30%

[23] NITI Aayog and Rocky Mountain Institute (RMI). India's Electric Mobility Transformation: Progress to date and future opportunities. 2019

By achieving the above EV penetration levels by 2031, EVs in the vehicle stock of Maharashtra can reach up to 33.19 lakhs in ambitious scenario and 24.52 Lakhs in moderate scenario. This level of EVs in the vehicle stock would need 60,230 chargers in moderate scenario and 74,767 chargers in ambitious scenario.

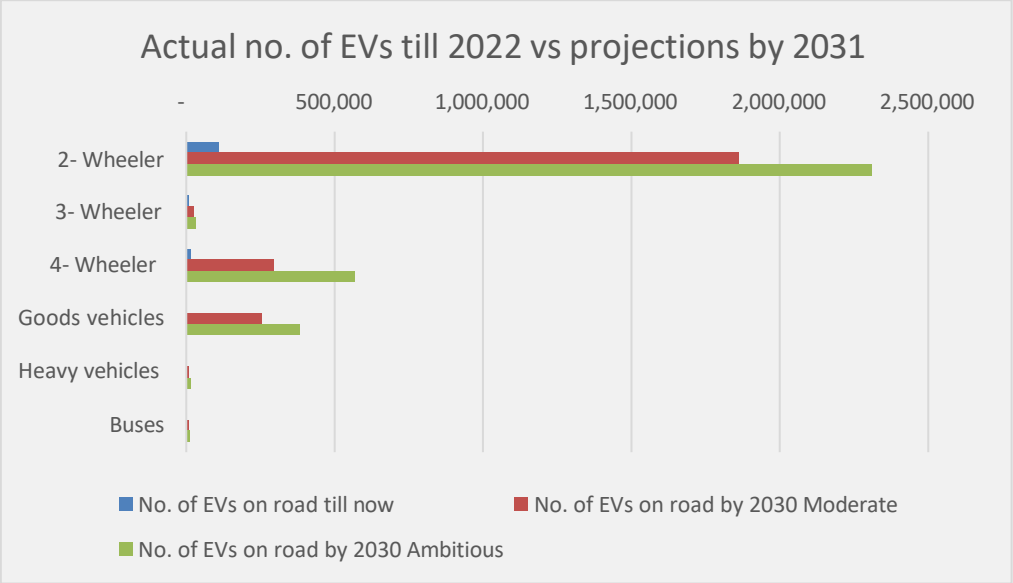


Figure 26 Actual no. of EVs 2022 v/s Projections 2030-31

By achieving the increased share of EVs and its charging infrastructure by policy push, it will result into energy saving of 4.91 MTOE by FY 2030-31 in ambitious scenario and 3.32 MTOE in moderate scenario.

Table 19 Saving potential - Electrification of road transport

Particulars	Moderate Scenario for 2030	Ambitious Scenario for 2030
Energy Saving Potential (MTOE)	2.00	2.97
GHG Emission Reduction Potential (MtCO2)	6.27	9.30

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.

Table 20 Action Plan for Electrification of Road Transport

Aspects	Strategic Area	Timeline
Awareness & Capacity Building	• Awareness on Energy Efficiency Program on High Energy Lithium-Ion Traction Battery Packs and Systems.	Short Term

Aspects	Strategic Area	Timeline
	• Mandatory Purchase of EVs in Govt departments	Short Term
Technology Intervention	• Combined Charging Systems (CCS Standard)	Short term
	• Charging stations based on open-access	Long Term
	• Pilot projects on Hydrogen Fuel Cell Vehicles	Long Term
	• Pilot projects on Battery Swapping stations for 2&3 wheelers	Long Term
	• Promotion of new sustainable battery chemistries like Zinc-ion, Al-air, Sodium ion etc.	Long Term
Retrofit programs	• To boost retrofitting of electric vehicles (EVs) and promote sustainability in transportation. Retrofitted EVs utilise the original vehicle's body frame, providing economic and environmental benefits comparable to new EVs while reducing automotive waste. While the current FAME II policy lacks incentives for retrofits, various state EV policies, like Telangana's, offer subsidies to support the adoption of retrofitted vehicles. • To accelerate adoption, Maharashtra may consider relaxing scrapping policies for retrofitted EVs that pass fitness tests, streamlining re-registration through Vahan integration.	Short Term

5.2.2 Strategy: Improving supply of ethanol for Ethanol Blended Petrol (EBP)

The ethanol blending policy of fuels can have a significant impact on the economy and environment of Maharashtra. By blending ethanol with petrol and diesel, 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 CO_2 emissions in 2020-21.

Moreover, Maharashtra is an agricultural state with a surplus production of sugarcane, which is a key feedstock for ethanol production. The state can leverage its agricultural resources to promote the production of ethanol and create new job opportunities. In fact, the central government has set a target of achieving 20% ethanol blending in petrol and 5% in diesel by 2025, which will create an additional demand of 1,000 crore litres of ethanol.

Saving Potential

The saving potential is estimated based on following assumptions.

Table 21 Savings Potential

	FY2 2025		FY 2030	
Blending of fuel	Moderate	Ambitious	Moderate	Ambitious
Utilization of Vehicles	80%	80%	80%	80%
Fuel Blending %age	20%	30%	20%	30%
Already Blending in Fuel%	10%	10%	10%	10%
Incremental Fuel Blending	10%	20%	10%	20%
Amount of fuel blended (Mn Lit)	854	1,709	1,118	2,236
GCV of Oil (Kcal/Kg)	10,350	10,350	10,350	10,350
Density (Kg/lit)	0.85	0.85	0.85	0.85
Energy Saved (MTOE)	0.80	1.60	1.05	2.09

Table 22: Energy Saving Potential – Ethanol Blended Petrol

Particulars	Moderate Scenario for 2030	Ambitious Scenario for 2030
Energy Saving Potential (MTOE)	1.05	2.09
GHG Emission Reduction Potential ($MtCO_2$)	3.27	6.54

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 and long-term period has been taken into consideration for actionable instruments.

Table 23 Action plan for improving supply of Ethanol

Policy Type	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.	Short 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

5.2.3 Strategy: Facilitating adequate public transport

According to the Ministry of Urban Development report[24] on Public Transit, cars and two-wheelers consume less than 50% of the total fuel consumption by all modes, however the total emission produced by these two modes is more than 60%. This is due to high level of congestion in the cities resulting in slow speeds and thus higher emissions. The public transport system is the most effective way to reduce the number of vehicles as well as the total emissions on the road. This is also the only way to a more equitable allocation of road space with people, rather than vehicles.

The study conducted in the report shows the impact of modal shift on the fuel consumption for about 30 cities of different population, terrain and geography. By correlating the results of similar cities, the study provides the fuel consumption data in cities based on the population.

Maharashtra has about 43 urban agglomerations which are listed in Annexure 13.1. These urban agglomerations are classified into various categories based on the corresponding populations as defined in the report. The same is shown in Table 24.

Table 24 Facilitating adequate public transportation

Fuel consumption (kL per day)					**Savings potential in State through facilitating adequate PT by FY 2031**	
Category	Population	No. of urban agglomerations	Without Adequate PT	With Adequate PT	kL/day	MTOE/year
Cat-1	<5 Lakhs	18	18	17	18	0.01
Cat-2	5-10 Lakhs	5	559	502	285	0.10
Cat-3	10-20 Lakhs	2	2617	2112	1010	0.35
Cat-4	20-40 Lakhs	0	2802	2099	0	0.00

[24] https://mohua.gov.in/upload/uploadfiles/files/final_Report.pdf

Cat-5	40-80 Lakhs	0	37164	38395	0	0.00
Cat-6	>80 Lakhs	1	38395	37163	1232	0.43

Based on the findings of the report (i.e., the savings in the fuel consumed when adequate public transportation is available in the state), the saving potential is calculated for the state of Maharashtra. The saving potential is about 1.06 MTOE.

By considering 70% of the total saving potential and 100% of the saving potential respectively for moderate and ambitious scenarios, the resulted savings are 0.88 MTOE and 1.06 MTOE. The savings in the energy consumption will further result in the emissions saving potential of 2.77 and 3.32 MTCO2 respectively in moderate and ambitious scenarios.

Table 25 Energy Saving Potential – Facilitating adequate public transportation

Particulars	Moderate Scenario	Ambitious Scenario
Energy Saving Potential (MTOE)	0.88	1.06
GHG Emission Reduction Potential ($MtCO_2$)	2.77	3.32

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

Table 26 Action plan for facilitating adequate public transport

Policy Type/Scheme	Action Plan	Timeline
Capacity Building	Mandate major urban agglomerates to have a Comprehensive Mobility Plan (CMP)	Long Term
	Conduct integrated public transport studies for major urban agglomerates	Long Term
	Incentivize regular travelers for using public transport	Short Term

Subsidies & Technology intervention	Facilitate last mile public transport through e-rikshaws and electric 3-wheelers	Short Term
	Improving the fuel efficiency of oil-based existing public transport fleets. Establishing guidelines for fuel efficiency, capacity building for drivers and focusing on regular hardware checks can be some recommended activities for improving fuel efficiency.	Short Term

Case Study: Electrification of first and last mile public transport

The Faster Adoption and Manufacturing of Electric Vehicles (FAME-II) scheme was aimed to transit 5,00,000 three-wheelers within the span of three years. However, in the initial stages the growth of EVs was slower because of a lack of charging infrastructure, limited vehicle models and limited financing options.

RAAHI (Rejuvenation of Auto-Rickshaw in Amritsar through Holistic Intervention) project is initiated by ASCL, to electrify Amritsar streets with a three-wheelers-based paratransit system. To do so they started rationalizing their areas of operation for improving integration with formal public transport. And coming to financial support, the state bank of India is facilitating low-interest rate loans for people, for replacing old Baharat stage (BS) III emission standard diesel three-wheelers and financial support from ASCL in vehicle cost subsidy. To promote the project's aim to electrify as quickly as possible, they started giving training to female drivers as an initiative for transitions.

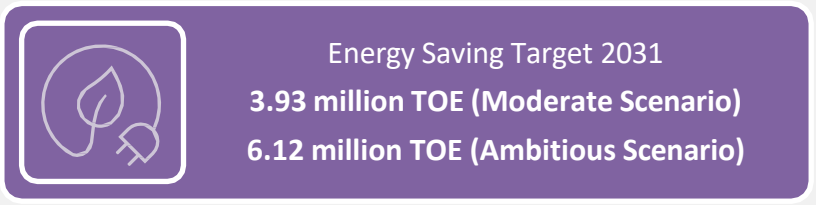
5.3 Energy saving targets & monitoring mechanism

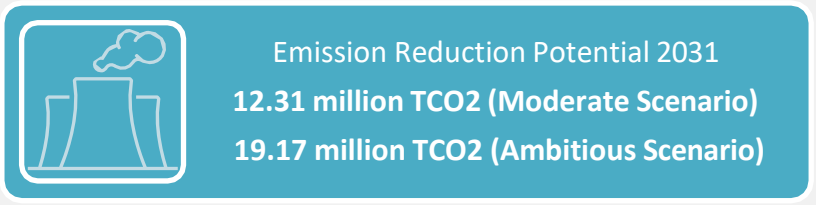
Energy saving target of the transport sector is 5.39 MTOE and 8.10 MTOE for moderate and ambitious scenarios by FY2031 respectively as seen from Table 16.

Table 27 Summary of energy saving from the strategies.

Strategy	Energy Saving Target (Moderate) MTOE	Energy Saving (Ambitious) MTOE	CO2 Reduction Potential MnTCO2	CO2 Reduction Potential MnTCO2

Electrification of Road Transport	2.00	2.97	6.27	9.30
Ethanol blending	1.05	2.09	3.27	6.54
Facilitating adequate public transportation	0.88	1.06	2.77	3.32
Total	3.93	6.12	12.31	19.17





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

Table 28 Monitoring mechanism to track progress of policies

Policy Type	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 Maharashtra, the residential sector consumed 6.56 MTOE in FY 2020 and the commercial sector consumed 1.55 MTOE. Combinedly, the building sector has accounted for about 19% of total energy consumption in the state during FY2020. The adoption of energy-efficient building practices is critical for reducing energy consumption and greenhouse gas emissions in Maharashtra. Despite the slow adoption of ECSBC standards in the state, there is a significant potential for energy savings through various strategies such as building envelope improvements, energy-efficient lighting systems, high-efficiency HVAC systems, and the use of renewable energy sources. The implementation of these strategies requires strong government support, stakeholder engagement, and effective policies to incentivize energy-efficient building practices.

6.2 Energy efficiency strategies in the buildings sector

The buildings sector likely provides the single largest opportunity for reductions in energy consumption and GHG emissions. Currently, India's buildings account for around one-fifth of total CO2 emissions and nearly 33 percent of the nation's energy use. The buildings sector is also one of the largest consumers of natural resources. In the absence of peremptory energy efficiency improvements and policy measures, the buildings sector is projected to emit seven times more CO2 by 2050, as compared with 2005 levels. Meanwhile, the residential sector's overall energy use could increase eightfold.

According to building census 2011[25], the total no. of houses in the state were around 335 Lakhs. These houses are majorly used for residence, commercial purposes like school, office, hotel, lodge, workshop, factory and other uses like hospital, dispensary etc. The breakup of the houses by its use is shown in below figure.

[25] State of Housing in India: A Statistical Compendium

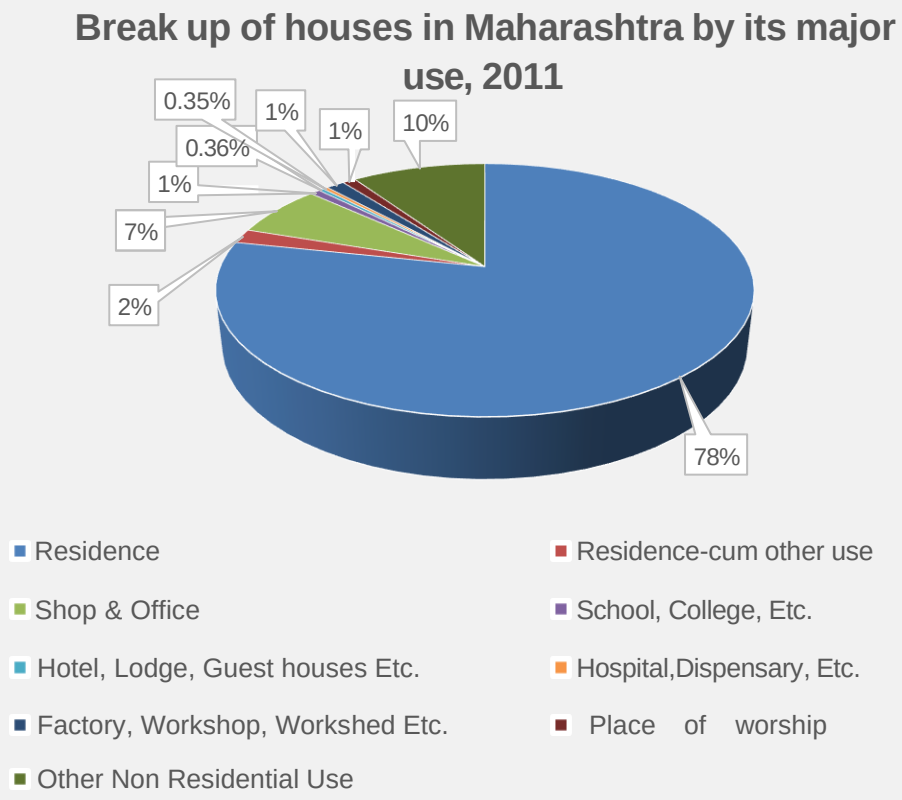


Figure 27 Break up of houses in Maharashtra by its major use

Looking at the historical growth in the economic development in the state and the growth of Gross Value Addition from the building and construction sector[26], the houses in the state are expected to have grown by 3% CAGR till 2021 and expected to grow at a similar rate till 2031. Therefore, the no. of houses by 2031 is expected to reach 600 Lakh houses by 2031.

6.2.1 Strategy: Implementation of ECSBC in commercial buildings

ECSBC (earlier refereed as ECBC) is not yet mandatory in Maharashtra. To begin with, ECSBC (Earlier ECBC 2017) should be made mandatory for buildings or building complexes that have a connected load of 100 kW or greater, or a contract demand of 120 kVA or greater and are intended to be used for commercial purposes.

The successful implementation of the ECSBC guidelines would result in energy savings in the building sector and will in turn help in reducing the GHG emissions in the state. The implementation of the strategy is explained below:

[26] Economic Survey of Maharashtra 2017

Scope Boundary

- Upcoming new commercial buildings and retrofit of existing buildings

Implementing agency

- Bureau of Energy Efficiency; SDA MEDA; Town and country planning department, Urban Deveoplemnt Department (UDD)

Current Policy In Place

- ECSBC (by BEE), State has submitted draft of ECSBC but not yet notified in the state

Projected no of commercial buildings till 2031 is shown in below figure;

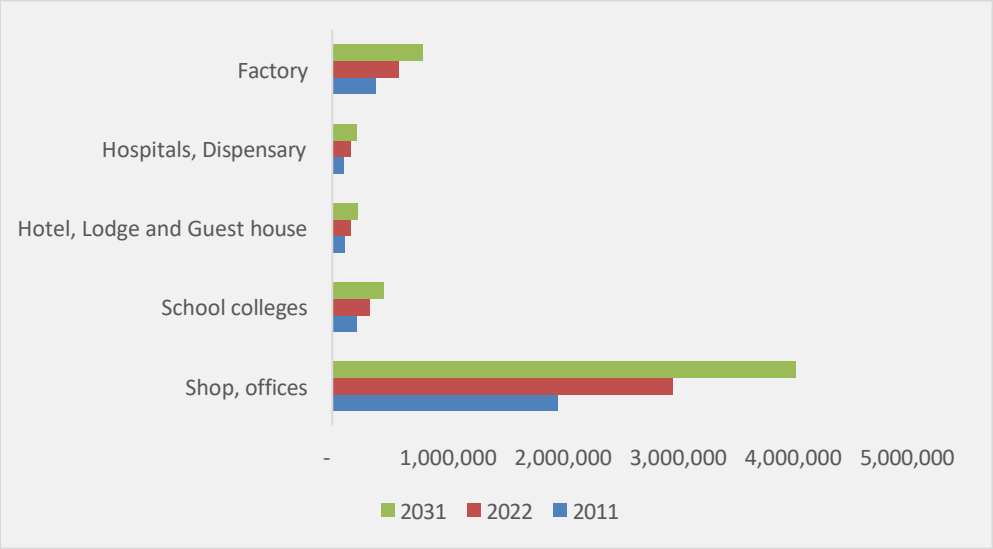


Figure 28 Projected no of commercial buildings by 2031

Energy Saving Potential

The saving potential estimated for Commercial sector is 0.16 MTOE in moderate scenario and 0.35 MTOE in ambitious scenario which is estimated by calculating energy saving by establishment type such as; Shop, offices, School colleges, Hotel, Lodge and Guest house, Hospitals, Dispensary and Factory (kWh/commercial connection) which is then multiplied with the projected no of commercial buildings for FY2031 for both moderate and ambitious scenarios. Similarly, the GHG saving potential for this strategy is 1.10 $MtCO_2$ in ambitious scenario by 2031.

Table 29: Energy Saving Potential

Particulars	Moderate Scenario for 2031	Ambitious Scenario for 2031
Energy Saving Potential (MTOE)	**0.63**	**0.97**
GHG Emission Reduction Potential ($MtCO_2$)	**1.99**	3.03

Action Plans for ECSBC

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.

Table 30 Action Plan for implementation of ECSBC

Policy Type	Action Plan	Timeline
Awareness & Capacity Building	1. Market Outreach for ECSBC compliant products, radio jingles, social media awareness. 2. Encourage green education	Short Term
	3. Energy Auditor Training for auditing commercial	Short Term
Subsidy/Incentives	4. Compliance structure and rebates on energy savings for first few residential projects. 5. Policy measures to encourage green, net zero energy buildings 6. Encourage PWD to adopt eco-friendly certified products by implementing a Sustainable Procurement Policy 7. Additional FAR, reduction in stamp duty and faster environmental clearance for upcoming green-rated building projects	Short Term
Technology Intervention	8. Development and maintenance of ECSBC compliance portal.	Short Term
	9. Pilot project investment for ECSBC as case studies.	Long Term

6.2.2 Strategy: Implementation of Eco Niwas Samhita for urban residential houses

Eco Niwas Samitha (ENS) is a program launched by the Indian government 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 is major contributor to climate change. The ENS covers various aspects of building design and construction such as,

i. Building Envelope: orientation, insulation, Glazing, roof

ii. Electro-mechanical aspects such as lighting, controls, ventilation, air conditioning and renewable energy systems.

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.

Strategy: Implementation of ENS

- Eco Niwas Samhita" is an energy conservation building code launched by the Bureau of Energy Efficiency (BEE) in 2018. The code provides guidelines for energy-efficient design and construction of residential buildings and is aimed at reducing energy consumption, promoting energy efficiency, and reducing greenhouse gas emissions from buildings.

Scope Boundary

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

Implementing agency

- MEDA

Current Policy In Place

- Draft policy prepared

Of the total houses mentioned in the housing census 2011, 48% of them are in urban agglomerations. If the similar share of houses is considered for projected houses by 2031 in the state, the new urban residential houses added by 2026 would be around 21 lakhs and 52 lakhs by 2031.

Considering implementation of ENS in the state for the new urban houses will have a saving potential of 0.19 Mtoe by 2030 in ambitious scenario and 0.10 in case of moderate scenario. Similarly, the GHG saving potential for this strategy is 0.59 $MtCO_2$ in ambitious scenario and 0.33 $MtCO_2$ in moderate scenario.

Table 31: Energy Saving Potential – ENS for residential houses

Particulars	Moderate Scenario for 2030	Ambitious Scenario for 2030
Energy Saving Potential (MTOE)	0.10	0.19
GHG Emission Reduction Potential ($MtCO_2$)	0.33	0.59

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.

Table 32 Action plan for implementation of ENS

Policy Type	Action Plan	Implementation
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	1. 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

In Maharashtra, a total of 591 projects have been registered and certified in the IGBC green building rating system. The cumulative certified area spans 2480 lakh square feet. Among these, private projects contribute 2.383 lakh square feet of certified built area, while government projects account for 96 lakh square feet. The substantial number of certified projects signifies a positive trend in promoting environmentally sustainable construction practices. However, there is room for further growth, and it is encouraged that more buildings undergo green building certification through IGBC to advance sustainable development in the region.

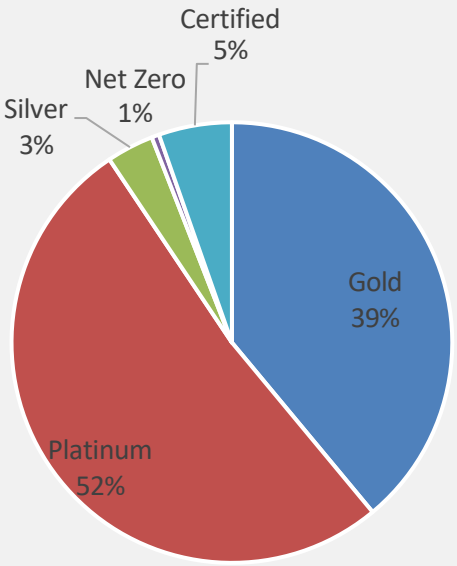


Figure 29 Certified building-built area: Private: 2,383 lakh sq.

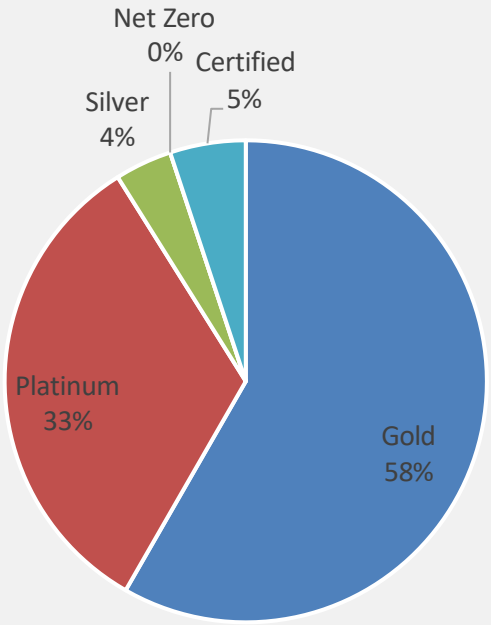


Figure 30 Certified building-built area: Government: 96 lakh sq. feet

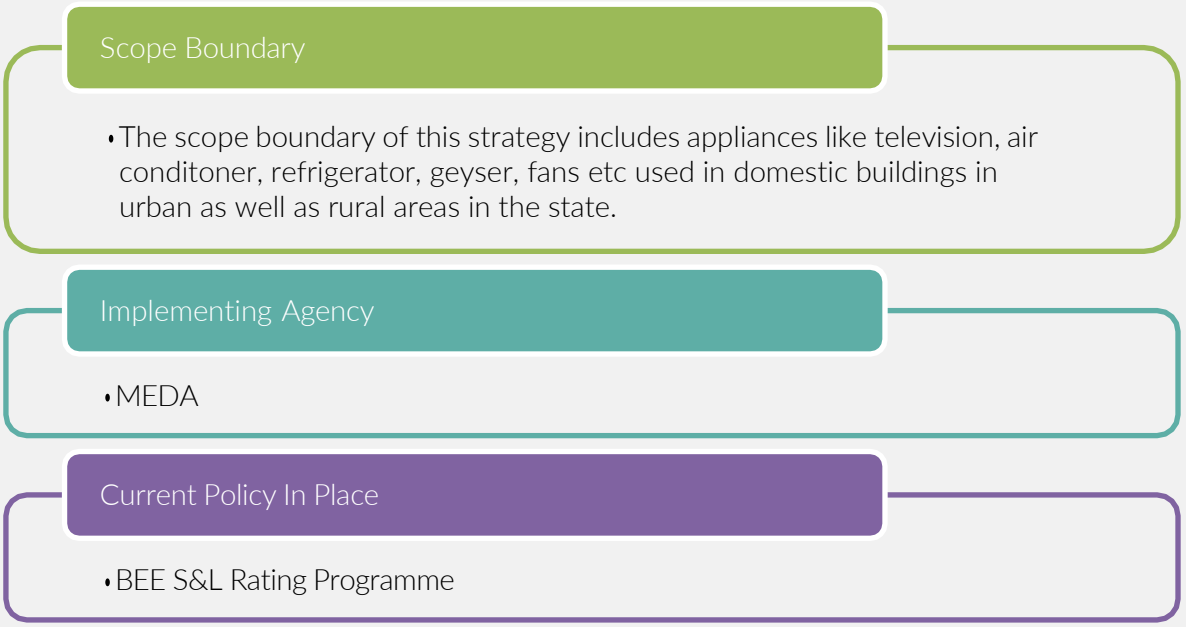
6.2.3 Strategy: Improving adoption of Energy Efficient appliances

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 other building equipment/systems.

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:



Energy Saving Potential

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

Table 33: Energy Saving Potential – Improving adoption of standards & labelling program

Particulars	Moderate Scenario for 2030	Ambitious Scenario for 2030
Energy Saving Potential (MTOE)	**0.60**	**0.75**
GHG Emission Reduction Potential ($MtCO_2$)	**1.87**	**2.34**

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-term, medium-term, and long-term period has been taken into consideration for actionable instruments.

Table 34 Action Plan for improving adoption of energy efficient technology

Policy Type	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 etc	Long Term
	4. Production Linked Incentives (PLI) scheme for energy efficient appliance manufacturing	Long Term

Case Study: Energy Efficient Air Conditioners in India by BEE and CLASP[27]

India is a developing country with a rising disposable income for a growing middle-class family. Low prices of ACs and availability and financing have grown rapidly over two decades.

The government of India expects that 300 million ACs will be purchased in India. Awareness of energy-efficient schemes and intervention campaigns will be key to purchase decisions.

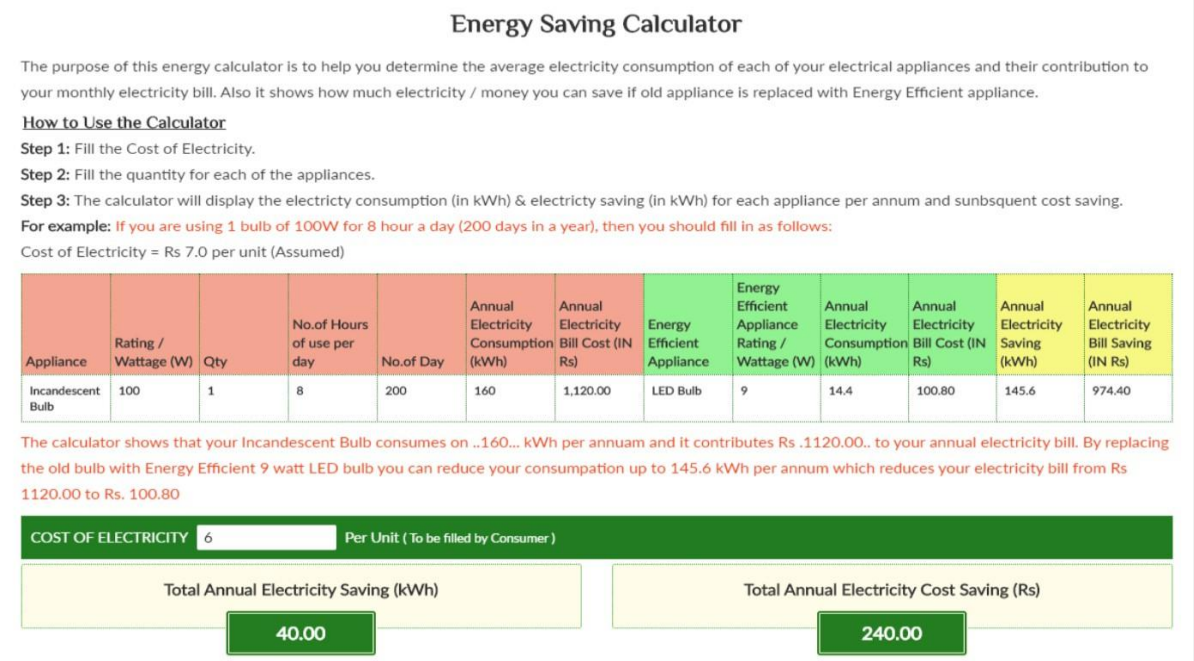
CLASP collaborated closely with BEE by providing technical and institutional support to accelerate access to ACs in India. Efficiency policies play a crucial role in energy efficiency and high-quality and affordable products. Standards and labelling programs help consumers to take correct decisions at the time of purchasing to save money and time. AC efficiency policies were launched in 2006 in India, seeing an increase in energy efficiency by 47%. The introduction of Minimum Energy Performance Standards (MEPS) and revised star rating plan are some policies by BEE with the support of CLASP.

Over the past 15 years, India has manufactured more than 63 million efficient AC units that reduced the country's electricity consumption by 85 TWh. Efficient ACs have also lowered electricity bills by an estimated USD 5.6 billion

[27] Increasing Access to Air Conditioners in a Heating India - CLASP

Case Study: Uttar Pradesh State Development Authority's campaign for conserving energy

In a notable case study, the adoption of energy-efficient technology is showcased as a means to save both energy and money. The initiative centers around a web portal designed to enhance consumer awareness regarding energy conservation and validate the energy efficiency of appliances. A prime example of this is the web portal developed by the Uttar Pradesh Government. This platform empowers end-users by enabling them to calculate the potential energy and monetary savings achievable through the purchase of energy-efficient appliances compared to their older counterparts. The case study underscores the importance of leveraging technology to inform and incentivize consumers towards making energy- conscious choices, contributing to both environmental sustainability and financial savings.



Energy Saving Calculator

The purpose of this energy calculator is to help you determine the average electricity consumption of each of your electrical appliances and their contribution to your monthly electricity bill. Also it shows how much electricity / money you can save if old appliance is replaced with Energy Efficient appliance.

How to Use the Calculator

Step 1: Fill the Cost of Electricity.

Step 2: Fill the quantity for each of the appliances.

Step 3: The calculator will display the electricty consumption (in kWh) & electricty saving (in kWh) for each appliance per annum and sunbsquent cost saving.

For example: If you are using 1 bulb of 100W for 8 hour a day (200 days in a year), then you should fill in as follows:

Cost of Electricity = Rs 7.0 per unit (Assumed)

Appliance	Rating / Wattage (W)	Qty	No.of Hours of use per day	No.of Day	Annual Electricity Consumption (kWh)	Annual Electricity Bill Cost (IN Rs)	Energy Efficient Appliance	Energy Efficient Appliance Rating / Wattage (W)	Annual Electricity Consumption (kWh)	Annual Electricity Bill Cost (IN Rs)	Annual Electricity Saving (kWh)	Annual Electricity Bill Saving (IN Rs)
Incandescent Bulb	100	1	8	200	160	1,120.00	LED Bulb	9	14.4	100.80	145.6	974.40

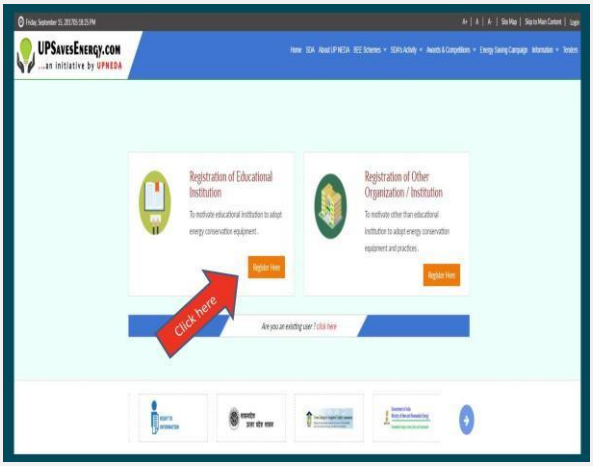
The calculator shows that your Incandescent Bulb consumes on ..160... kWh per annuam and it contributes Rs .1120.00.. to your annual electricity bill. By replacing the old bulb with Energy Efficient 9 watt LED bulb you can reduce your consumpation up to 145.6 kWh per annum which reduces your electricity bill from Rs 1120.00 to Rs. 100.80

COST OF ELECTRICITY 6 Per Unit (To be filled by Consumer)

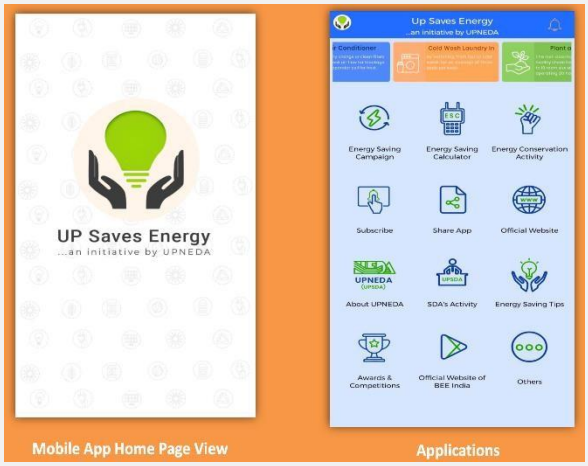
Total Annual Electricity Saving (kWh) 40.00

Total Annual Electricity Cost Saving (Rs) 240.00

Energy saving calculator by UP SDA



Website



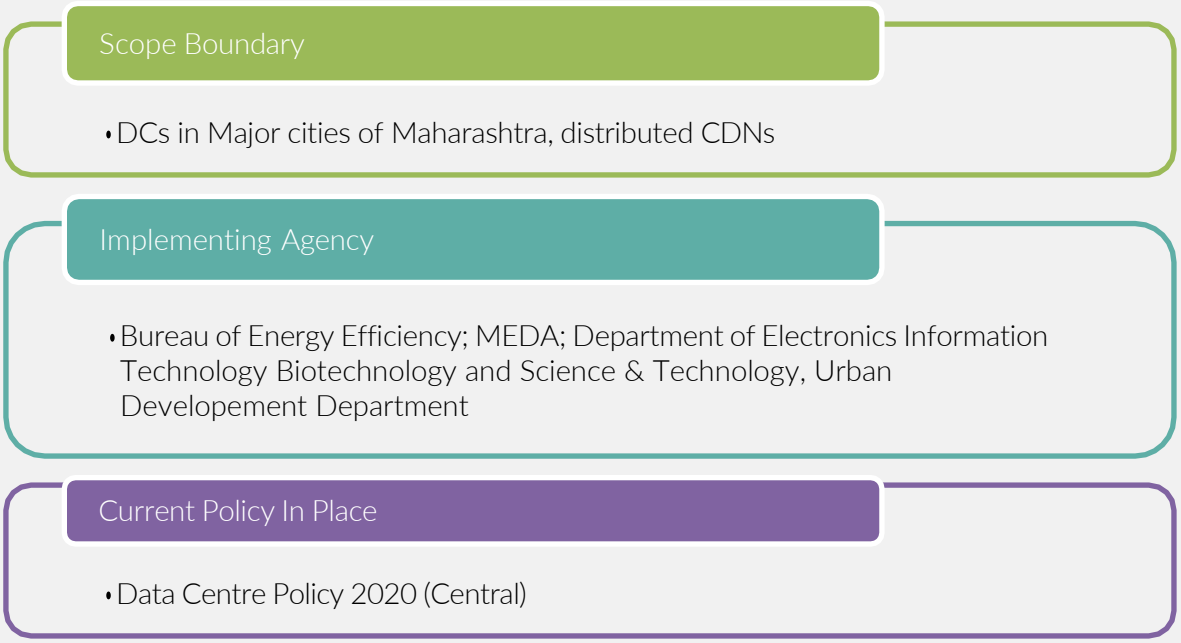
Mobile App

6.2.4 Strategy: Promotion of energy efficient data centres

Maharashtra has the highest share of data centers in the country. More than 50% of the investments in data centers that have been done in India are in state of Maharashtra. Within Maharashtra most of the data centers are in Mumbai. This is because of the inherent advantage of dense wet cable ecosystem with nine internet cable landings. So, the growth of data centers in the state is only expected to grow. As per various market studies, the data centers are expected to double by 2025 as compared to 2021 numbers and about 75% of the new installations would be in Maharashtra and Tamil Nadu.

With such a growth expected in the state, the state govt is also envisaging preparing a state data center policy. The guidelines for data centers should also focus on creating efficient distributed Content Delivery Networks (CDNs) through

- Incentivizing the energy efficient data centers
- Fast tracking environment clearance
- Reduced building taxes
- Financial assistance at concessional rates



Large financial institutions and telecom firms are likely to build captive Data centres to host their expanding data storage needs, but data centre service providers are expected to invest significantly to multiply their capacities in order to meet the demand arising from small and midsize users.

Data centres use a lot of electricity. It is obvious that operational costs will rise as the cost of electricity grows. Reduced energy use is therefore required to balance out rising operational costs and keep up with the competition. As a result, for sustained expansion, India's data centres must adopt "Green IT" principles and incorporate novel designs for energy efficiency.

To attain operational excellence, existing data centres must follow best practises in design, operation, and maintenance. The energy efficiency methods must be incorporated into new data centre designs.

Along with operation and maintenance, the three main parts of a data centre that reduce carbon emissions are,

Electrical system/Power:

A crucial strategy for lowering Total Cost of Ownership (TCO) and improving return on investment for infrastructure expenditures is power management. The fine-tuning of UPS loading, transformer loading, and harmonic filter installation all present chances for energy savings. There are also emerging technologies like Rotary UPS systems, Modular UPS systems, and LED illumination.

Critical cooling system:

As processor densities have increased over time, cooling power and intensity have also increased. This is pushing the data centre sector towards cutting-edge cooling methods that can control the excess heat produced by higher processor densities. There are numerous methods and technologies that can assist a data centre achieve maximum cooling effectiveness, including thermal storage systems, water cooling systems, and emerging technologies like cooling system economizers.

IT peripherals:

Data centre managers are increasingly searching for solutions that are more intelligent in order to achieve energy efficiency and manage crucial resources as the complexity of deploying IT solutions rises. Numerous advantages of virtualization in data centres include better resource utilisation, less energy and cooling use, quicker provisioning, and reduced space requirements. The potential for energy savings through the use of high-density servers, virtualization of network and server components, optimum storage utilisation, and increased infrastructure efficiency in a virtual environment

Operation and Maintenance:

Due to how heavily businesses rely on IT infrastructure, network outages have a negative effect on operations. As a result, the Datacentre's ongoing functioning has become crucial. A datacentre's downtime can be decreased by using best practises for operation and maintenance.

The minimal amount of energy that can be saved by implementing the newest technologies in a standard datacentre with an operating Power Usage Effectiveness (PUE) of 2.0 is typically between 25% and 30%.

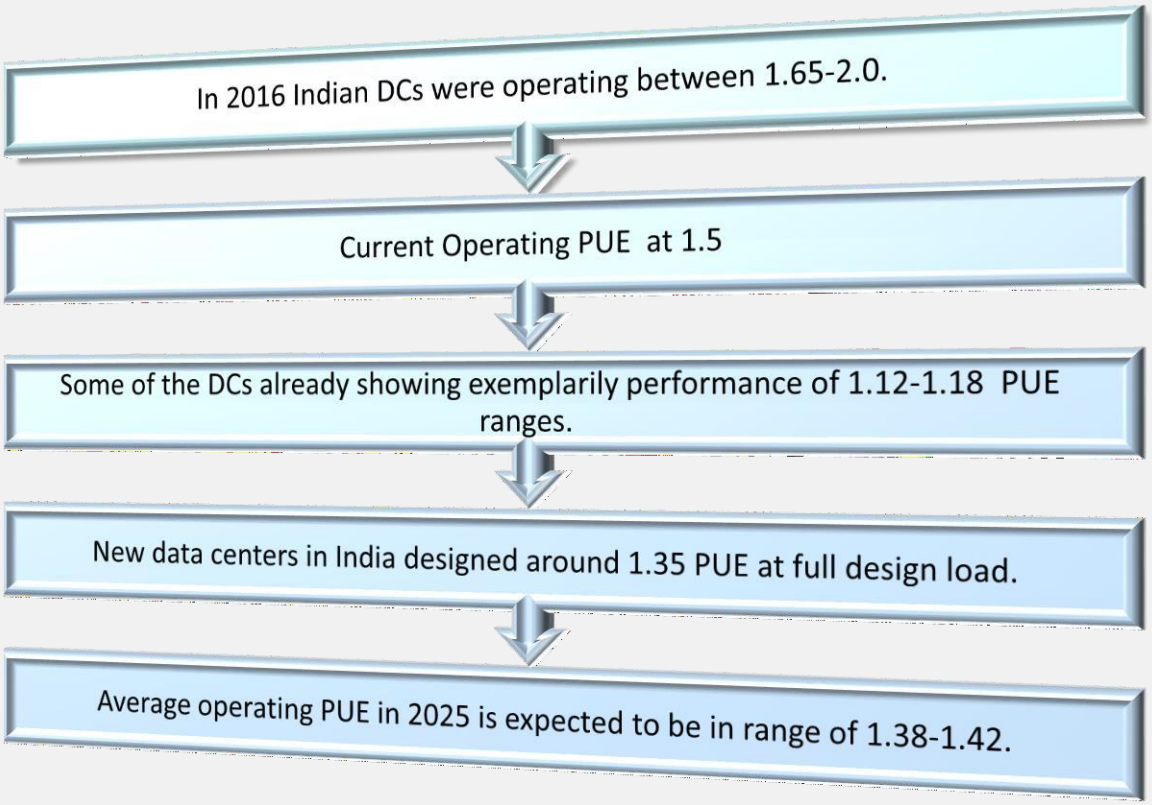
Apart from improving the operational efficiency of the data centres, the sourcing of power from renewable sources can also reduce the use of conventional fossil fuels and reduce the emissions. Solar and wind are the go-to options for renewable power generation and same has been drafted in the national data centre policy. However, since the data centres are expected to come in the cities where area will be a constraint, other cleaner fuels also need to be looked at such as liquified natural gas.

Energy Saving Potential

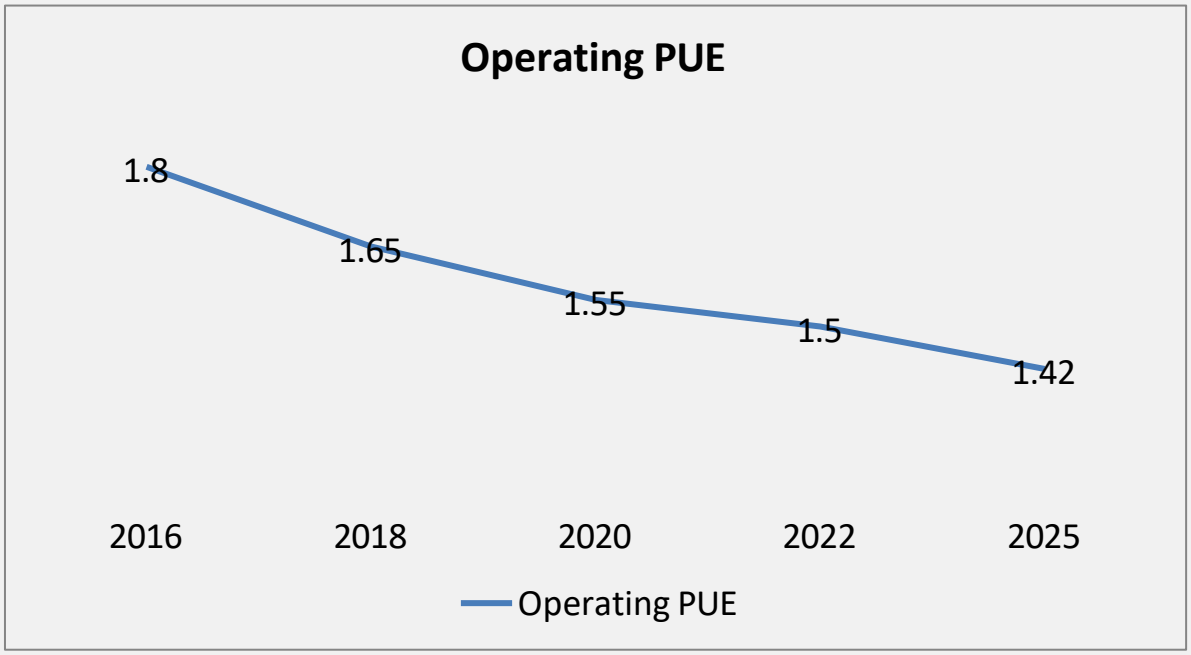
In BAU, the PUE for targeted data centers is assumed to be 2.0. While in moderate and ambitious scenarios, the PUE is assumed to reduce to 1.5 and 1.2 respectively.

By considering this strategy, 0.21 & 0.33 MTOE saving potential can be achieved in moderate and ambitious scenario.

The study is grounded on the outlined focus points and trend analysis, indicating a downward trend in the trend line. This observation suggests that IT equipment is becoming more energy efficient. This trend serves as the foundational principle for the proposed action plan.



Initiatives by Indian Green DCs PUE Trend



Source : IGBC certified Green Data Centers Data Base

Table 35 Energy Saving Potential – Promotion of energy efficient data centres

Particulars	Moderate Scenario for FY 2031	Ambitious Scenario for FY 2031
Energy Saving Potential (MTOE)	0.85	0.98
GHG Emission Reduction Potential ($MtCO_2$)	2.66	3.08

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 and long-term period has been taken into consideration for actionable instruments.

Table 36 Action plan for promotion of energy efficient data centres

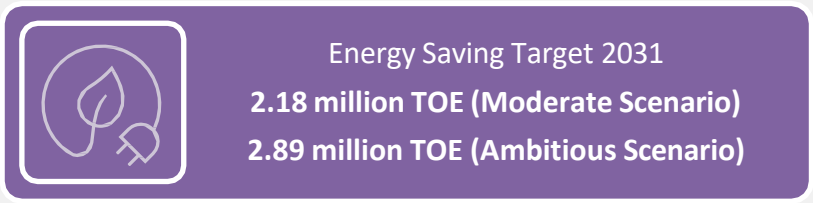
Policy Type	Action Plan	Timeline
Environment	1. Fast tracking environment clearance	Short Term
Subsidy	1. Concession in state GST for procuring energy intensive equipment such as chillers, transformers and UPS systems. 2. Reduction in property tax and concessional power tariff 3. Exempt, green-rated data centers for wheeling green power – there should be no restriction on usage of on-site and off-site green power (i.e. green power procurement within and outside the state). 4. Promotion of use of LNG for data centres	Long Term

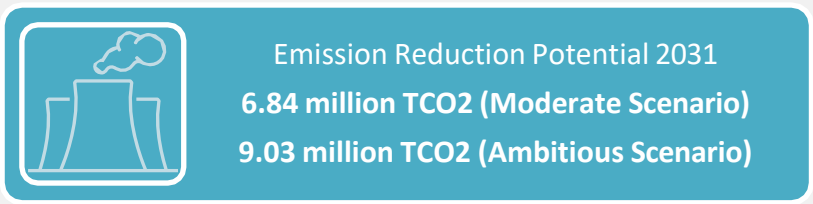
6.3 Energy saving targets & monitoring mechanism

Energy saving target of the building sector is 0.43 MTOE and 0.64 MTOE for moderate and ambitious scenarios FY2031 respectively as seen from Table 37.

Table 37 Summary of energy saving from the strategies.

Strategy	Energy Saving Target (Moderate)	Energy Saving (Ambitious)	CO2 reduction Target (Moderate)	CO2 reduction Target (Ambitious)
1. Implementation of ECSBC-Commercial buildings	0.63	0.97	1.99	3.03
2. Implementation of ENS-Residential buildings	0.10	0.19	0.33	0.59
3. Deepening of S&L in domestic buildings	0.60	0.75	1.87	2.34
4. Promotion of energy efficient data centres	0.85	0.98	2.66	3.08
Total	2.18	2.89	6.84	9.03





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

Table 38 Monitoring mechanism for tracking progress of policies in transport sector

Policy Type	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.

6.4 Recommendation by India Green Building Council (IGBC) for building sector in Maharashtra State:

- ECSBC is not mandatory yet in Maharashtra. To begin with, ECSBC 2017 (Previously ECSBC) should be made mandatory for buildings or building complexes that have a connected load of 100 kW or greater, or a contract demand of 120 kVA or greater and are intended to be used for commercial purposes.
- Green-rated Buildings comply with ECSBC and are at least 20 - 30% more energy efficient than conventional buildings.
- Incentives for green buildings have been declared in the state in 2020.
    - Urban Development Department offers an additional FAR of 3%, 5% and 7% for Green Buildings rated by IGBC as Silver, Gold and Platinum respectively.
    - As per UDCPR 2020, the Urban Development Department has mandated that the buildings in Integrated Township Project have at least Silver Rating from IGBC.

- Incentives to green buildings, wherever possible, should be extended if the green certification is renewed. This would ensure sustained superior performance over the years.
- To have a holistic impact, Government Policy should be framed in a manner which encourages green buildings as a whole rather than few select measures such rainwater harvesting, solar PV, organic waste treatment, etc.

CII's Recommendations for wider adoption of Green and Net Zero Buildings and Built Environment:

- Encourage renovation and retrofitting of existing buildings to Green Buildings through Rebate in property tax for green-rated Existing Building Projects.
    - With suitable retrofitting, the existing building stock can contribute to significant reduction in both energy and water consumption. In many cases, over a period of time, the performance level of existing buildings goes below optimum efficiency levels. If these buildings can also improve their indoor air quality and manage waste better, it will vastly optimise resource usage thereby resulting in significant benefits to the state. Greening of existing building offers immense untapped opportunities.
    - This incentive will encourage buyers to live and work out of green buildings and create demand for such projects.
- Reduction in stamp duty and faster environmental clearance for upcoming green-rated building projects
    - A green-rated building project requires additional investment on the part of the project owner. However, the benefits in terms of lower resource consumption during the

building's life cycle, far outweigh the conventional buildings. Hence, the recommendation to encourage through additional FAR and other suitable incentives.

- Incentives and Policy support to encourage Net Zero Energy Buildings
  - Reduce / Waive off fee related to electrical infrastructure or development for such projects
  - Charge customers a small CO2 tax per unit consumption and use this to install Cleaner Power plants / offsetting revenues
  - Encourage open-access and remove the limit on purchase of green power for buildings and built environment aspiring to achieve Net Zero Energy Status. There should be no restriction on on-site and off-site green power. 100% procurement of green power through wheeling within and outside the state should be allowed.
  - Remove the cap on installed capacity of onsite renewable power generation system (roof top, Building Integrated Photovoltaic system or any other RE installation) in buildings and built environment projects
  - Encourage net metering or in case of gross metering, the power purchase tariff to be set in a way that Return on Investment (ROI) is not more than 2 - 3 years

- Promoting Sustainable Industrial Infrastructure

  Few of the proposed incentives for green-rated logistics parks, warehouses and factory buildings are as follows:
  - Allow higher ground coverage
  - Enable Single window faster clearance
  - Subsidy on capital investment for implementing key sustainability measures - STP, ETP, RWH, LED lighting, RE systems, etc
  - Provide Power at concessional rate
  - Concession in stamp duty and registration fee
  - Exemption in payment of development charges
  - Road tax exemption or concession in vehicle registration fees for e-vehicles and other low-emitting service vehicles
  - Facilitate green loans

- Required policy support for development of green-rated Tourism Facilities (Hotels and Resorts)
  - Suitable concession in power tariff and water charges
  - Exemption from luxury and entertainment tax

- Required policy support for development of green-rated Data Centers
  - Concession in state GST for procuring energy intensive equipment such as chillers, transformers and UPS systems
  - Reduction in property tax and concessional power tariff
  - Exempt green-rated data centers for wheeling green power – there should be no restriction on usage of on-site and off-site green power (i.e. green power procurement within and outside the state).

- Miscellaneous Policy measures to encourage green, net zero energy buildings

  - Development of infrastructure in a green village and / or providing the necessary requirements in a green school should also be considered as part of CSR while granting Environment Clearance.
  - All upcoming Airports, Metro and Rapid Rail Network, Industrial Parks, SEZs, Sports Stadiums and other similar infrastructure projects which are high-impact developments should be mandatorily developed as green-rated projects

- Encourage PWD to adopt eco-friendly certified products by implementing a Sustainable Procurement Policy
  - Certified Green Product enables the end users of the building sector and manufacturing sector to choose sustainable products, materials and technologies for reducing the environment impacts during the construction, operation and maintenance of their buildings and factories.
  - A certified green product has lower environment impact and contributes significantly for enhancing the performance of Green Buildings and Green Companies.

- Encouraging Green Education
  - Architectural and Engineering colleges should offer specialised courses on green buildings, energy efficiency and the students should be encouraged to get professionally accredited on these subjects. This would create industry- ready professionals who can be involved in green and net zero energy projects in the future.
  - Similarly, officials from PWD, Urban Development, Town and Country Planning and other concerned departments must be encouraged to get trained and accredited by professional agencies on green and net zero energy buildings and built environment.

7 FOCUS SECTOR 4: AGRICULTURE & FISHERIES

7.1 Overview Agriculture Sector

With close to 43.6 lakh agriculture consumers in 2019, Maharashtra has the largest share (~20%) of electric pump-sets in the country.

The Maharashtra State Electricity Distribution Company Limited (MSEDCL) has provided electricity connection to 1,70,263 agricultural pumps in the financial year 2022 -'23[28] which is the highest progress achieved in last 10 years. Total pump sets energized in the State are 47,56,094 up to Mar-2023. MSEDCL has achieved a double feat by providing the highest number of power connections to agricultural pumps in 10 years as well as reducing the number of pending connections to the lowest ever. MSEDCL planned to provide electricity connection to agricultural pumps on priority basis. In FY 2019-'20, electricity connection was given to 96,327 agricultural pumps, 1,17,304 in FY 2020-21 and 1,45,867 in FY 2021-'22. According to All India Agriculture Input Survey 2016-17, total No. of Diesel Pumps is 3,93,300 and total no of Standalone Solar Pumps installed till 30.06.2022 is 17,137.

Table 39 Agricultural Pump statistics

Year	Agricultural pumps statistics		
	Electric Pumps	Diesel Pumps	Total Pumps
2020	43,60,000	3,93,300	47,53,300
2031 (Projected)	47,56,094	4,32,777	51,88,871

7.1.1 Strategy: i) Conversion of Diesel pumps to solar powered pumps

No of diesel pumps is considered as 4,32,777 by 2031 and assumed 75% pumps are operational i.e. 3,24,583. It is further assumed that out of total no of pumps i.e., 3,24,583, 80% diesel pumps will be electrified under moderate scenario and 90% in ambitious scenario.

Energy saving under this strategy is:

Table 40 Energy Savings Potential

Saving	Moderate	Ambitious
Energy saving (MTOE)	0.11	0.12
CO2 saving (MnTCO2)	0.33	0.37

7.1.2 Strategy: ii) Transition of electric pumps to solar powered pumps

By 2031, projected no of electric pump is 4,32,777. Under this strategy 50% pumps and 75% pumps considered for transition from electric to solar powered pumps.

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[28] https://indianexpress.com/article/cities/mumbai/msedcl-provides-1-7-lakh-agricultural-pump-power-connections-in-2022-23-8567928/

Table 41 Energy Savings Potential

Particular	Moderate	Ambitious
No. of pumps (Lakhs)	3.56	5.35
Energy saving (MTOE)	0.13	0.20
CO2 saving (MnTCO2)	0.41	0.62

7.1.3 Strategy: iii) Transition of electric pumps to BEE Star rated pump

In moderate scenario 3.56 Lakhs pumps and in ambitious scenario 5.35 Lakhs pumps are considered for transition from electric pumps to star rated pumps by 2031.

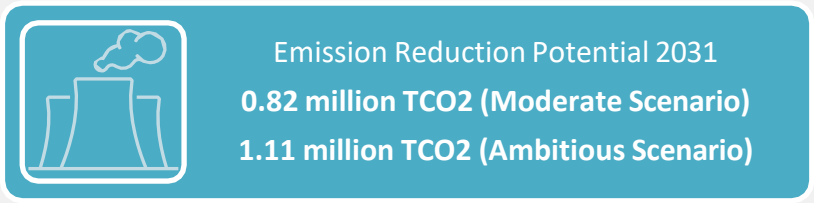
Table 42 Energy Savings Potential

Particular	Moderate	Ambitious
No of pumps (in Lakhs)	3.56	5.35
Energy saving (MTOE)	0.02	0.04
CO2 saving (MnTCO2)	0.07	0.11

7.1.4 Overall energy saving in Agriculture sector

Table 43: Energy Saving Potential

Particulars	Energy Moderate Scenario for 2031	Energy Ambitious Scenario for 2031	CO2 reduction Moderate Scenario for 2031	CO2 reduction Moderate Scenario for 2031
Conversion of diesel pumps to electric pumps	0.11	0.12	0.33	0.37
Transition of electric pumps to solar powered pumps	0.13	0.20	0.41	0.62
Transition of electric pumps to BEE star rated pumps	0.02	0.04	0.07	0.11
Total	0.26	0.35	0.82	1.11



Action Plans

This section describes several short-, medium-, and long-term action plans that can be implemented across the agriculture sector.

Table 44 Action plan for efficiency in Agriculture sector

Policy/Scheme	Action Plan	Term
Solarization of pumps and replacement of inefficient pumps	• Survey of agriculture pumps and replacement programs in association with EESL • Retrofitting conventional pumps with energy efficient pumps • mandatory BEE 4-star-rated pumps, and sprinkler system installation to promote and enhance awareness about EE in the agriculture sector.	Long-Term
Awareness Programs	• Educating farmers about the benefits of energy efficiency and providing training on energy-saving practices and maintenance of pumps that can help increase adoption rates and improve the effectiveness of energy efficiency practices.	Long-Term
Micro Irrigation Project promotion subsidy	Micro irrigation has benefit of energy and water saving. State can promote such projects through initial subsidy. Example: The Telangana Horticulture Department has introduced the Telangana Micro Irrigation Project for small and marginal farmers. Under this programme, all small and marginal farmers, irrespective of economic status, are eligible for a subsidy for drip irrigation/micro-irrigation systems for up to 12.5 acres of land. Effective water utilisation through micro-irrigation is crucial to improve crop productivity, cost of production, and the living standards of small and marginal farmers. This is achieved through enhanced water-use efficiency through micro-irrigation, resulting in less energy used	Short-Term

	for pumping. This unique programme is being implemented in 32 districts in Telangana[29]	
Sustainable Cold Chain Initiative for horticulture	Sustainable cold chain initiative for horticulture to optimize energy efficiency and reduce operational costs and environmental impact. The programme will encompass several key activities including equipment selection, design optimization, temperature management, load management, logistics streamlining, energy management systems, and regular maintenance.	Short Term

7.2 Overview Fisheries sector

The fisheries sector is an important contributor to the economy of the state of Maharashtra, located on the western coast of India. The state has a long coastline of around 720 kilometres and several major rivers, making it well-suited for fishery activities.

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

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

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

7.3 Energy efficiency strategies in the agriculture and fisheries sector

7.3.1 Strategy: Energy efficiency across value chain of fisheries

According to Handbook on Fisheries Statistics 2020 by Department of Fisheries, Maharashtra produced 1.18 lakh inland fishes and 4.43 lakh marine fishes in FY 2020 as shown in figure below.

29 https://horticulturedept.telangana.gov.in/Horticultureteleangana/(S(gpkyvbhhvdwuwjypwpu0vrbe))/MIP_Aboutus.aspx

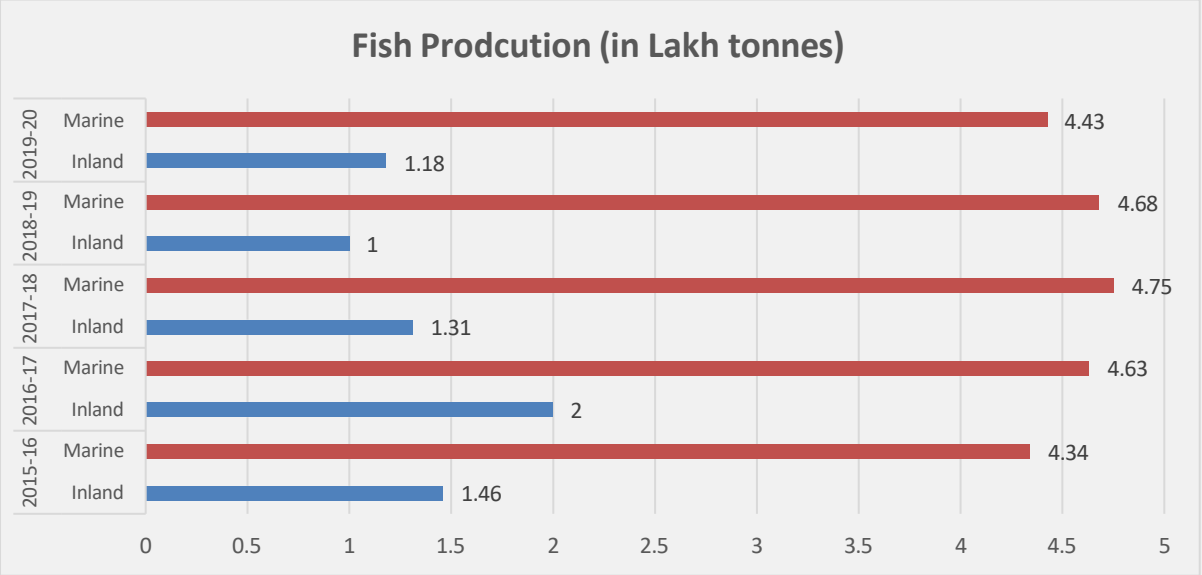
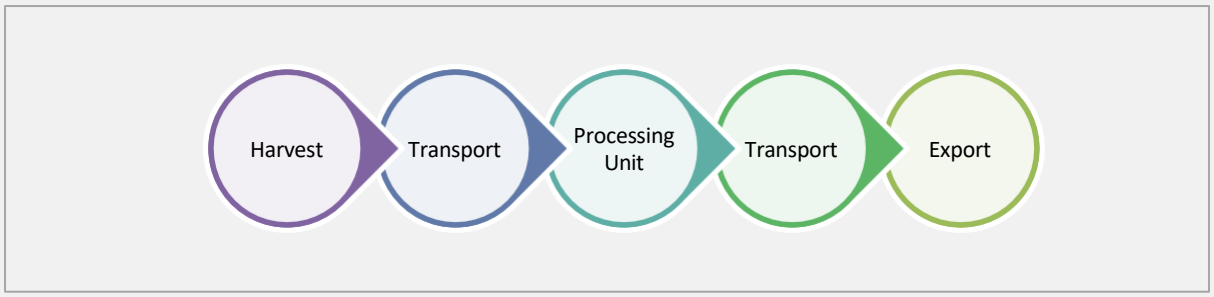


Figure 31 Fish production in Maharashtra

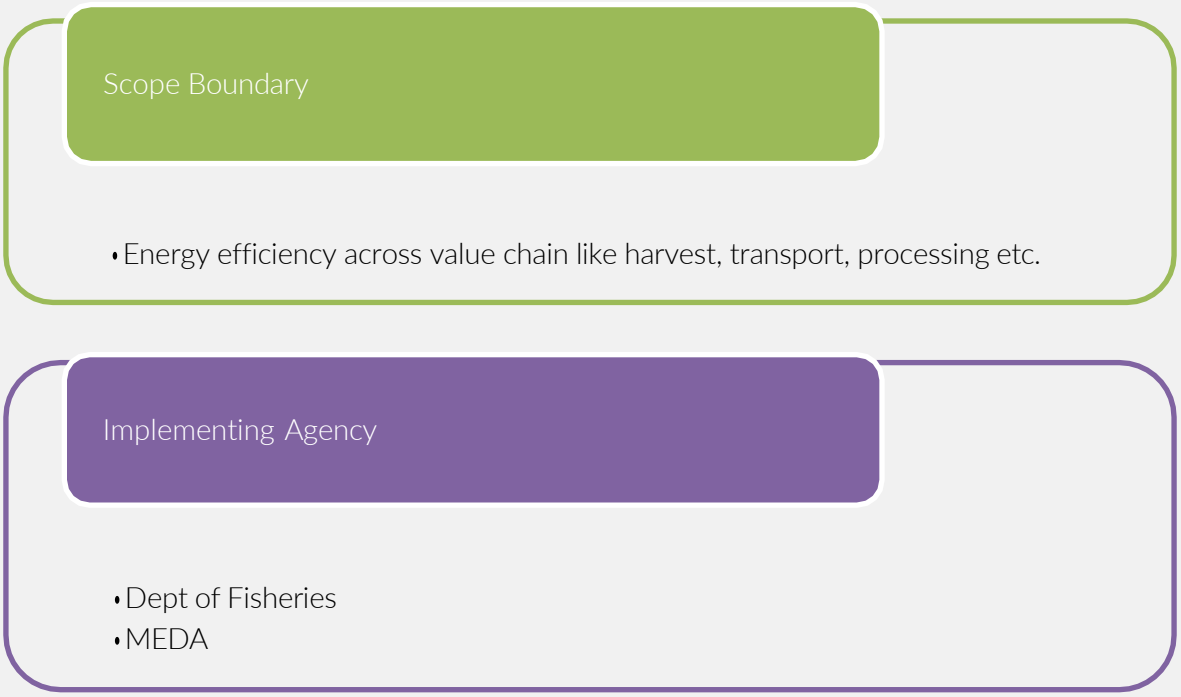
The fisheries sector in India encompasses a wide range of activities, from fishing to processing, marketing, and distribution of fish and fish products. Improving energy efficiency across all value chains in the fisheries sector can lead to significant environmental and economic benefits, including reduced 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.



Saving Potential

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

Table 45: Energy Saving Potential – Energy Efficiency in fisheries value chain

Particulars	Moderate Scenario for 2031	Ambitious Scenario for 2031
Energy Saving Potential (MTOE)	0.14	0.19
GHG Emission Reduction Potential ($MtCO_2$)	0.44	0.59

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.

Table 46 Action plan for implementing energy efficiency strategies in Fisheries sector

Policy Type	Action Plan	Timeline
Awareness & Capacity Building	1. Provides skill development support. 2. Creating awareness Resource efficiency and cleaner refrigerant	Short Term
	Energy-efficient fishing vessels: By adopting energy-efficient engines and reducing vessel weight, fuel consumption can be	Long Term

Technological Interventions	reduced. According to a study conducted by the Indian Council of Agricultural Research (ICAR), the use of energy-efficient engines in fishing vessels can reduce fuel consumption by up to 40%.	
	Efficient fish processing: By using energy-efficient equipment, optimizing cooling systems, and using renewable energy sources, energy consumption in fish processing can be reduced. According to a study conducted by the Ministry of New and Renewable Energy (MNRE), the use of energy-efficient fish processing equipment can reduce energy consumption by up to 30%.	Long Term
	Energy-efficient cold storage: By using energy-efficient cooling systems, insulation, and efficient lighting, energy consumption in cold storage can be reduced. According to a study conducted by the ICAR, the use of energy-efficient cold storage equipment can reduce energy consumption by up to 25%.	Long Term
	Renewable energy sources: By using solar-powered boats for fishing and solar-powered cold storages, energy consumption in the fisheries sector can be reduced.	Long Term
	Retrofitting of boats: The following two activities may be considered for this. Firstly, modernizing fishing boats by integrating on-board active refrigeration systems. This involves the use of absorption/adsorption-based refrigeration systems that are driven by engine exhaust heat or solar thermal energy. Working in collaboration with fisher societies, this initiative will ensure that fishing boats are equipped with energy-efficient refrigeration technologies, enabling better preservation of catch and reducing energy consumption during storage and transportation. Secondly, targeting EE retrofitting of inefficient or old refrigeration plants used in seafood processing. These refrigeration plants may additionally be upgraded with low Global Warming Potential (GWP) refrigerants, leading to significant energy savings and a reduction in the sector's carbon footprint.	Long Term

7.3.2 Transforming the Fisheries Sector

As part of our commitment to sustainable practices and resource efficiency, the State Energy Efficiency Action Plan outlines several measures aimed at enhancing energy efficiency in the fisheries sector. The implementation of these initiatives not only aligns with environmental stewardship but also contributes to cost savings and long-term viability.

Table 47 Resource efficiency measures in Fisheries sector

Resource efficiency measures	Marine catch	Farm	Transport	Processing	Transport (Reefer truck)
Replacement of existing blower motor with energy efficient motor				√	
Replacement of inefficient pumps		√		√	
Periodic maintenance of air blower				√	
Replacement of metal blade with FRP blade in cooling tower				√	
Waste heat recovery condensate				√	
Replacement of old inefficient motor with IE3 motor		√		√	
Installation of solar streetlights		√		√	
Installation of solar PV for power generation		√		√	
Installation of Chiller management system				√	
Installation of IOT system in farming pond		√			
Usages of phase change material boxes to reduce ice usages	√	√	√	√	√
Installation of portable oxygen generator		√			
Fuel switch to solar-battery hybrid (OBM Boats)	√				
Fuel switch to diesel to LNG (IBM Trawling boats)	√				
Replacement of diesel fired boiler with electric boilers				√	
Installation of RTEMS				√	
Steam pressure reduction				√	

Case studies illustrating the successful implementation of initiatives to enhance energy efficiency-

- Solar powered boats- Solar powered boats harness energy from the sun through electric motors and storage batteries charged by solar panels and photovoltaic cells, offering a sustainable alternative to traditional fuel-powered vessels. With no fuel costs, zero emissions from combustion, and a reduced carbon footprint, these boats

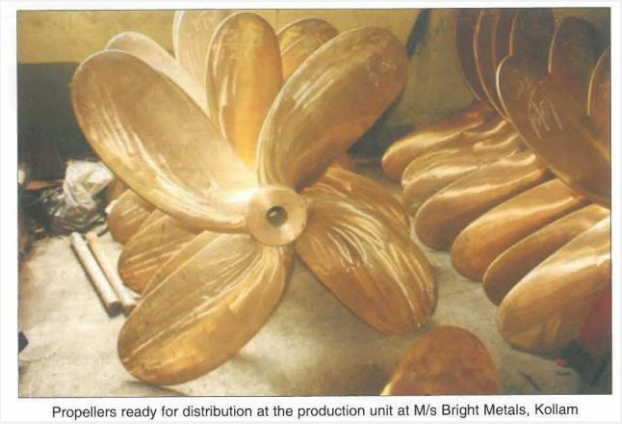
boast environmental benefits. Their clean fiberglass-reinforced plastic (FRP) surface, wider design, and minimal noise pollution make them ideal for eco-conscious boating. Additionally, the absence of sound pollution, suitability for shallow waters, and increased deck area enhance their appeal for various maritime activities, such as fishing, while contributing to a greener and more sustainable watercraft industry.

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

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

Source: https://www.newindianexpress.com/cities/kochi/2022/nov/22/srav-the-worlds-first-solar-fishing-vessel-bags-global-award-2520957.html

- Use of fuel-efficient propellers- Enhancements in the blade element design of propellers have led to significant fuel savings in ring seiners, ranging from 18- 21%. This improvement translates to an average minimum reduction of 750 litres of diesel consumption per month per boat during fishing operations. The optimized propellers contribute not only to substantial cost savings but also to a more sustainable and efficient utilization of resources in the maritime industry.



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

Source: https://krishi.icar.gov.in/jspui/bitstream/123456789/7502/1/fuel%20efficient%20propeller.pdf

- Energy-efficient fishing vessel- The Sagar Haritha vessel, crafted at the Goa Shipyard through a public-private partnership with CIFT, showcases innovative features aimed at enhancing efficiency and sustainability. Its hull, fabricated from marine-grade steel, not only reduces weight but also enhances carrying capacity. The vessel is

equipped with a 400HP engine, providing 20% lower power consumption compared to conventional vessels. Furthering its eco-friendly design, a 600-watt solar panel is incorporated for lighting, minimizing the reliance on conventional power sources. The inclusion of a bulbous bow is noteworthy, as it diminishes wave resistance at sea, thereby improving overall energy efficiency for a more environmentally conscious maritime operation.

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

- LNG powered fishing vessels - A marine LNG engine operates as a dual fuel system, utilizing both natural gas and bunker fuel to convert chemical energy into mechanical energy. The natural gas is stored in a liquid state (LNG), and any boil-off gas is directed to dual fuel engines. This technology offers significant advantages that position LNG as a promising innovation in the shipping industry. Firstly, the use of LNG as ship fuel results in an impressive 90-95% reduction in sulphur oxide (SOx) emissions, contributing to cleaner air quality. Secondly, the lower carbon content in LNG compared to traditional ship fuels facilitates a noteworthy 20-25% reduction in carbon dioxide (CO2) emissions, aligning with sustainability goals and environmental regulations. These combined benefits underscore the potential of LNG as an environmentally friendly and efficient solution for maritime propulsion.

Case Study: Energy Efficiency in fisheries value chain[30]

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

Project activities:

[30] PowerPoint Presentation (unep.org)

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

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

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

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

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

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

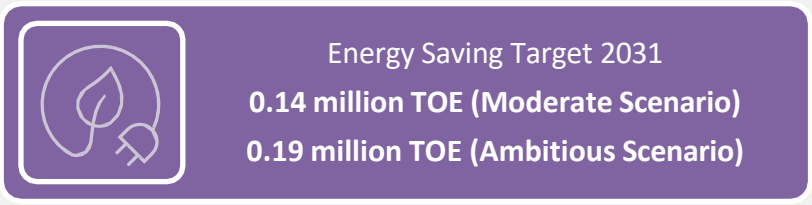
1. Develop a compendium for investment potential & highlight current best practices in the fisheries sector that can be created across different supply chains and value chains
2. Organise B-to-B workshops and Matchmaking for the fisheries sector along with financing institutions
3. Implement pilot projects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

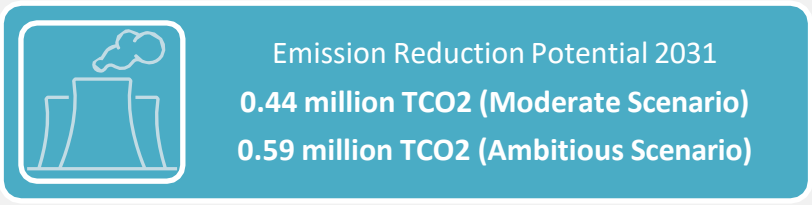
7.4 Energy saving targets & monitoring mechanism

Energy saving target of the fisheries sector is 0.14 MTOE and 0.19 MTOE for moderate and ambitious scenarios FY2031 respectively as seen from Table 16.

Table 48 Summary of energy saving from the strategies.

Strategy	Energy Saving Target (Moderate)	Energy Saving (Ambitious)
Energy efficiency across all value chain in fisheries sector	0.14	0.19
Emission Reduction Potential (MtCO2)	0.44	0.59





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

Table 49 Monitoring mechanism to track progress in fisheries sector

Policy Type	Monitoring Mechanism

Awareness Programs and skilling of manpower (fisherman)	• There is a need for awareness in the new innovations arising in the cold chain that can aid to reduce the overall GHG emissions of the sector like PCM (Phase change material) looks to be a promising technology to reduce emissions of the cold chain sector and aid in the productivity of the sector. • Awareness creation through capacity building programs amongst fishery cold chain supply and operations staffs on best practices and available technologies along with implementation methodologies • Improving awareness and skill levels • Leverage existing boat associations to raise awareness on productivity using available technologies

8 MUNICIPAL SECTOR

8.1.1 Strategy: EE in street lighting and water pumping systems

The street lighting and water pumping are the major energy consuming loads in municipal sector. State has already taken steps to reduce the energy consumption thereby decreasing the emissions through scheme for installation of energy saving devices in Street lighting and water pumping systems of Municipal Councils/ Municipal Corporations / Maharashtra Jeevan Pradhikaran.

Under this scheme financial assistance is up to Rs. 20 lakhs is provided for installation of energy efficient equipment/monitoring system in street lights and Rs. 5.00 lakh for installation of monitoring system. Under this programme total 40 nos. of Municipal Councils / Corporations are covered up to March, 2023. Around 206 TOE per year energy savings have been achieved through this intervention.

There are total 409 Urban local government bodies in 35 districts of Maharashtra. The Nagpur district has highest no. of ULBs in Maharashtra having 22 ULBs and Mumbai district has lowest no. of ULBs in Maharashtra having 1 ULBs.

Table 50 No. of ULBs District wise

Sl. No.	District Name	No. of ULBs
1	Ahmednagar	17
2	Akola	7
3	Amravati	15
4	Aurangabad	10
5	Beed	11
6	Bhandara	7
7	Buldhana	13
8	Chandrapur	17
9	Dhule	5
10	Gadchiroli	11
11	Gondia	8

Sl. No.	District Name	No. of ULBs
12	Hingoli	5
13	Jalgaon	19
14	Jalna	8
15	Kolhapur	15
16	Latur	10
17	Mumbai	1
18	Nagpur	22
19	Nanded	17
20	Nandurbar	5
21	Nashik	18
22	Osmanabad	10
23	Palghar	8
24	Parbhani	9
25	Pune	21
26	Raigad	17
27	Ratnagiri	9
28	Sangli	11
29	Satara	17
30	Sindhudurg	8
31	Solapur	14
32	Thane	11
33	Wardha	10
34	Washim	6
35	Yavatmal	17

State has taken significant initiative so far for energy efficiency in municipal sector lightings. Example: The street lights project has been successfully completed in Amaravati where 35,922 streetlights across the city of Amaravati were replaced by LED lamps. The power consumption after replacement came down to 1,673 KW as against the previous 3,900 KW. The annual energy consumption of Amaravati reduced to 7.33 MU from 17.08 MU- saving a whopping 9.75 MU annually. Prior to the implementation of the pilot project, the annual energy bill along with maintenance stood at INR 123.34 crore, which came down to INR 42.65 crore with LED streetlights. The overall cumulative savings for the Amravati ULB for the project period of 7 years stands at INR 28.85 crore[31].

As per CEA forecast, load forecast in Maharashtra state is as follows;

Table 51 Energy load forecast

Energy Consumption-MUs	2021-22	2029-30	2030-31	2031-32
Domestic	32984	45267	47354	49284
Commercial	15199	19763	20601	21396
Public lighting	2047	2490	2540	2589
Public water works	3164	3833	3909	3983
Irrigation	33879	46650	48142	49630

[31] https://www.energetica-india.net/news/twenty-lakh-led-lamps-to-light-up-streets-in-maharashtra

LT Industries	6751	8828	8944	9022
HT Industries	34556	61624	62606	63415
Railway Traction	3744	10481	11053	11491
Bulk Supply	6809	9354	9691	10030
Others	5284	7088	7241	7390
	144417	215378	222081	228230

The Agriculture Demand Side Management (AgDSM) and Municipal Demand Side Management (MuDSM) schemes were initiated during the XI plan and are being implemented in many states presently. The objective of the program is to reduce the energy intensity of agriculture pumping sector (AgDSM) and municipal pumping sector (MuDSM) by carrying out efficiency up gradation of pump sets. Studies reveal that about 30%-40% energy savings is possible in by adoption of Energy Efficient Star Labelled Pump Sets.

Sector	Subsector	Impact
Municipal and Gram Panchayat	Pumping	Replacement of pumps used for water supply and sewage will improve the energy efficiency of municipal bodies and gram Panchayats

Energy Saving Potential

Table 52 Energy Savings Potential

Energy Consumption-MUs	Unit	2030-31 Moderate Scenario	2030-31 Ambitious Scenario
Public lighting	MUs	2540	2540
Public water works	MUs	3909	3909
Energy saving- Public lighting	%	30%	40%
Energy saving-Public water works	%	15%	20%
Energy saving- Public lighting	MTOE	0.07	0.09
Energy saving-Public water works	MTOE	0.05	0.07
Overall energy saving in Municipal	MTOE	0.12	0.15
Emission reduction- Public lighting	MnTCO2	0.21	0.27
Emission reduction -Public water works	MnTCO2	0.16	0.21
Overall CO2 reduction in Municipal	MnTCO2	0.36	0.48

Action Plans

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

Table 53 Strategy to implement EE measures in street lighting & water pumping

Policy Type	Action Plan	Timeline
Data collection	1. Electrical distribution single line diagram of the distribution networks and the lighting details. 2. Layout the transformers indicating their sizes, capacities, connected loads, etc. 3. Sketch the distribution system indicating the type of lamps, approximate distance between two poles, type of poles, conductor material and size	Short Term
Technology intervention	4. The proper auto On/Off control like timer/sensor/radio frequency based/any other smart control systems shall be provided in the street light circuits to avoid un-necessary burning of street lights. o Installation of radio frequency-based street lights with centralised control and monitoring system in the major cities; o Installation of street light with Supervisory Control and data acquisition.	Long term
Localised plan	o To enhance the effectiveness of energy efficiency initiatives, it is recommended to transition from a schematic approach to a strategic program-based approach. In this approach, municipalities can adopt localized plans that prioritize energy efficiency within their jurisdictions. By identifying the priority sectors and establishing specific programs, municipalities can streamline efforts and allocate resources accordingly.	

In addition to above action plans Maharashtra can undertake a District Cooling (DC) Programme to expedite the adoption of energy-efficient district cooling solutions in urban areas. The main objective would be to enhance cooling sustainability, reduce energy consumption, and mitigate the urban heat island effect. The programme may encompass conducting feasibility studies, implementing pilot projects, offering infrastructure grants, promoting public-private partnerships, and developing a supportive regulatory framework. Key

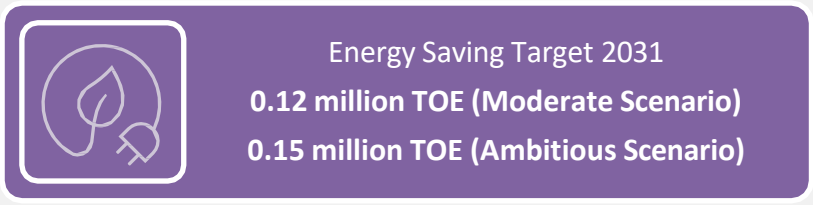
actions can include designating DC as a utility and treating it on par with other public utilities such as PNG, electricity, and water in terms of tax and incentives, ensuring fairness and transparency in DC tariffs for cooling as a service (CaaS) through concrete guidelines, offering competitive electricity and water tariffs for DC systems, and laying out policy mandates to recognise sustainable cooling as a basic necessity in large infrastructural developments and residential projects.

8.2 Energy saving potential & monitoring mechanism

Energy saving potential of the municipal sector is 0.12 MTOE and 0.15 MTOE for moderate and ambitious scenarios FY2031 respectively as seen from Table 54.

Table 54 Summary of energy saving from the strategies – Municipal sector

Action Plan	Energy Savings in FY 2031 under moderate scenario (Mtoe)	Energy Savings in FY 2031 under ambitious scenario (Mtoe)
Replacement of conventional streetlights with energy efficient LED lighting and energy efficiency of water pumps	0.12	0.15
CO2 Reduction Potential (MtCO2)	0.36	0.48



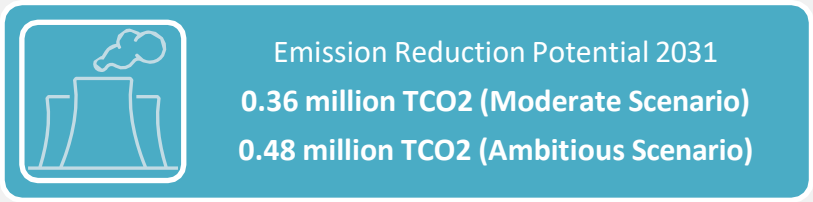


Table 55 Monitoring mechanism to track progress of policies in municipal sector

Policy Type/Scheme	Monitoring Mechanism
Data collection	• SDA to coordinate with DISCOMs and monitor the data collection of Electrical distribution single line diagram of the distribution networks and the lighting details

Implementation	• SDA to coordinate with the ESCO like EESL for continued monitoring of the replacement of streetlights against the set targets

9 CROSS-SECTOR RECOMMENDATION

Promoting end-use level energy data tracking at the consumer level: Enhancing the tracking of end-use energy consumption, particularly in energy-intensive buildings and industries, can yield numerous benefits. Data insights will strengthen decision making, enabling planners to optimise energy use, deploy efficient technologies, and promote energy-efficient behaviour.

Capacity development plan

- Inclusive Workshops and Trainings: To ensure continuous learning and upskilling in the dynamic field of energy efficiency, it is recommended to include regular workshops and trainings on energy efficiency concepts, tools, and methodologies as an integral part of the SEEAP. Training and capacity building will enable a diverse range of stakeholders to deepen their understanding of energy-efficient policies, solutions, practices, and their practical implementation. The topics covered can encompass energy management systems, audits, efficient technologies, building design and retrofitting, policy frameworks, procurement, financing mechanisms, and behaviour change strategies.
- Targeted Trainings for Specific Groups or Sectors: In addition to workshops, state may also design targeted training programs tailored to specific groups group like policy makers, MSMEs, industry associations, architects and builders, end-users or sectors. The content may address sector-specific challenges and opportunities related to energy efficiency. By providing specialised knowledge and skills, these trainings have the potential to empower participants to effectively integrate energy efficiency elements into their decision-making processes.
- Monitoring and Evaluation: Monitoring the number of participants and evaluating the outcomes of these capacity development initiatives will provide valuable insights into the effectiveness of such programmes and identify areas for improvement.
- Collaboration with Expert Partners: To ensure the quality and effectiveness of capacity development initiatives, state may consider partnering with reputable academic institutions, research organizations, or think tanks. The partners can help the local institutes to develop the course curriculum, deliver training programs, and provide expertise and specialized knowledge in energy efficiency. The training institutes in the state such as Yashwantrao Chavan Academy of Development Administration (YASHADA) could be capacitated to lead such capacity building programs.

10 FINANCING MODELS FOR ENERGY EFFICIENCY

Energy efficiency is one the most effective strategies to meet rising energy demand, reduce green house gas emissions and provide socio-economic benefits. Unlocking the potential of energy efficiency requires investments which can spur the technology availability in the market and adoption of energy efficiency among the end consumers. Many developed country has unlocked energy efficiency financing potential through innovative financing models and some of such models are also being explored in India such as the Energy Service Companies (ESCOs) model. The present study analysed few popular financing models which can be helpful in commercial, residential as well as Industrial sector. Few financing strategy which are generally common in India are as given below;

- Financial Institutions (Credit, leasing)
- Microfinance Institutions (Credit)
- Dealer finance
- Financial Incentive (rebate/subsidy programs)

However, there are few other financing strategies which are being used world-wide and adopted in foreign countries are.

1. On Bill Financing Model
2. ESCOs
3. Leasing Model
4. Bulk Procurement

10.1 On bill financing model

On-bill financing can aid in increasing the household sector's adoption of climate-friendly and energy-efficient appliances (such as lighting, air conditioners, and refrigerators). Because it lowers monthly electricity costs and hence boosts purchasing power, it provides homes with a host of important advantages.

It has been demonstrated that basic energy efficiency measures like insulation, air sealing, heat pumps, and lighting upgrades produce an average energy savings of 25%. Through on-bill initiatives, an electric company or a third-party financier can cover the initial cost of energy-saving upgrades and equipment. Ratepayers can use a percentage of the savings realised as a consequence of the upgrades to pay down the cost of these investments through a monthly payment on their electric bill. On-bill financing makes energy-saving upgrades more accessible and affordable for consumers of all sorts and income levels by moving the initial costs to the utility.

Figure 32 Major common energy consuming appliances and equipment in Building sector

Energy efficiency is frequently the fastest-acting alternative to reduce the consumption of fossil fuels. The plan of delivering EE appliances to consumers may be more significant in order to offer them significant benefits. With the OBF model, consumers won't be put at a financial disadvantage because the payback is mostly funded by savings on electricity costs. The only party having an interest in the suggested model for using energy-efficient equipment will be the consumer.

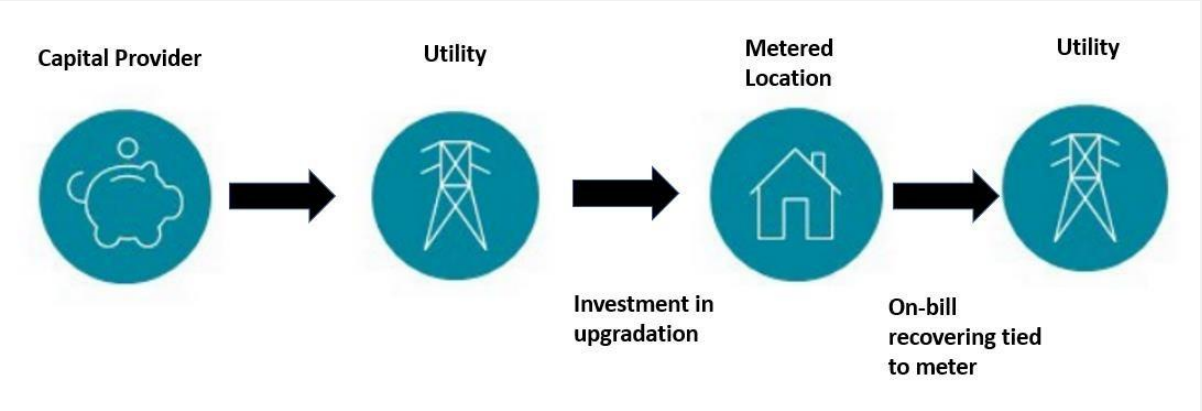


Figure 33 Modality of financing energy efficiency projects through on bill financing model

Improvements in efficiency of houses and buildings are treated by tariffed on-bill programmes as an investment in system dependability and as the creation of less expensive distributed energy resources. The utility makes investments and seeks cost recovery through tariffs using its recognised authority while utilising the current systems for sending bills and collecting money. The investment in energy savings is linked to the location rather than a specific customer up until the point at which the utility's investment is recouped. A tariffed investment does not increase the owner's debt profile the same way a bank loan would.

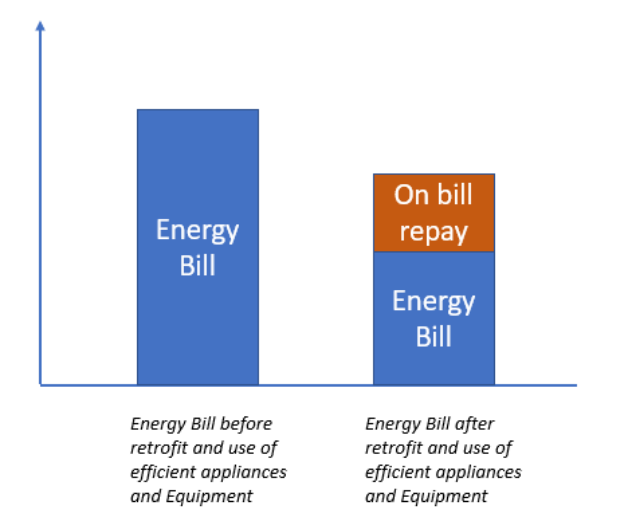


Figure 34 On bill financing structure

With adjustment of cost of appliances in monthly payment of electricity bills, this business model enables clients to access a wider choice of energy services, including demand response, electrification of transportation and heating systems, and efficiency enhancements.

Case Study: ECOFRIDGE-On bill financing

The government of Senegal (in 2020), in association with African Development Bank, United4Effciency, Renewable Energy and Energy Efficiency (ECREEE) &BASE offered efficient refrigerator and cooling product on EMI basis which was repaid through utility bills. The credit assessment of customer was done through their track record of payment of utility bill. As of Nov 2022, ECOFRIDGE GO model has achieved;

- Selling of 2527 new energy efficient ACs and emission reduction of 18824 MTCO2
- Total energy of 22,836 MWh energy saving
- Financing of 1 million USD

10.2 Energy service companies (ESCOs) Model of financing

Energy service companies (ESCOs) design, plan, construct, and secure funding for initiatives that lower energy use, energy expenditures, and maintenance and operations expenses at their clients' facilities. A project's technical and performance risks are typically assumed by ESCOs, who also serve as project developers for a wide variety of energy conservation measures (ECMs) (Energy Efficiency and Renewable Energy, n.d). Due to the fact that they employ the performance-based contracting model, ESCOs set themselves apart from other businesses that provide energy-efficiency solutions. The payment made to an ESCO for a project is closely correlated with the real energy cost savings.

The utility might be able to reach economies of scale that would further reduce costs with strong user acceptance and bundling that offers a kind of "mass customisation." To guarantee programme success, the utility would keep handling billing, quality control, monitoring, and reporting. Customers' invoices would show the improvement measures' net energy cost

reductions versus service fees. Customers may think about upgrading for extra services like new windows or a refrigerator when the initiative started to show benefits.

- ESCO in Industry

Energy service companies (ESCOs) are becoming one of the most popular off-balance-sheet methods of financing in the energy efficiency sector. Depending on the needs of the client, ESCOs engage in a variety of activities, including, but not limited to, conducting energy audits of existing facilities, designing and implementing energy efficiency projects, locating opportunities to save energy, outsourcing energy infrastructure and technology, and directly funding or arranging the financing of energy projects (Ablaza 2019c).

Ownership of the energy asset or infrastructure may lie with the ESCO (or even a third party) rather than the energy end user, depending on the contracting arrangement. Energy performance contracting (EPC), which aids in reducing the financial and performance risk associated with energy efficiency projects, is being used by an increasing number of ESCOs. Although an equipment replacement or retrofit tries to lower total energy consumption, the energy savings that the end user actually experiences may differ from what was anticipated or promised for a variety of technical reasons.

In an EPC, the ESCO guarantees energy savings as long as predetermined operational and maintenance guidelines are followed. Processes for measurement and verification are also put in place to make it easier to calculate the actual energy savings. The ESCO reimburses the energy end user with an amount equal to the gap if the project doesn't achieve the guaranteed energy savings. Because utility rate volatility is a market-based risk that should be managed separately from the energy efficiency project, performance guarantees are usually linked to energy savings (e.g., kWh) rather than monetary savings. There are two models in Energy Efficiency.

- Guaranteed Saving Model of ESCO

The energy savings promised by the ESCOs carrying out the projects equate to cost savings. The host facility's owner pays the ESCO a predetermined amount based on the guaranteed energy savings from the project.

The ESCO covers the shortfall if savings fall short of the guarantee. The ESCO may receive (but is not guaranteed) a bonus payment if the savings are greater. The M&V protocol and the ESCO's payment terms will be laid forth in the ESPC. According to this concept, the host facility or facility owner may raise equity capital, and the FI will cancel the ESCO's debt. The host facility or facility owner then offers a loan. The facility owner/host facility then uses its savings to pay the FI's interest and loan repayments.

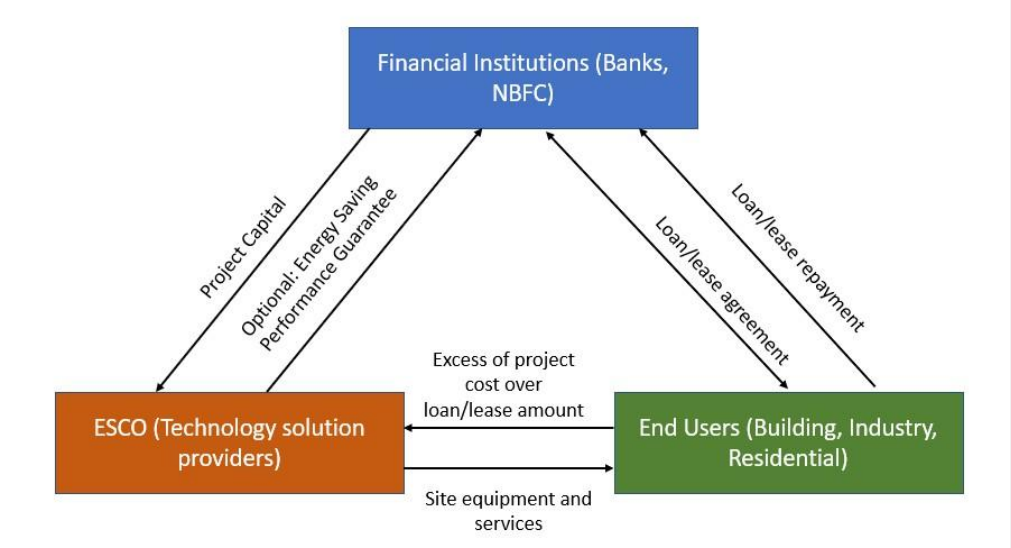


Figure 35 Guaranteed Saving Model

- Shared Saving Model of ESCO

Energy services companies deploy the Energy Savings Performance Contracting (ESPC) strategy in a turnkey manner. Design, engineering, construction, installation, commissioning, measurement, and verification are all part of ESCO services. Additionally, ESCOs handle training, financing, and operations and maintenance. The main criterion in this situation is to share the value of the energy savings, and this is what makes up the ESCOs' revenue stream. Beyond the duration of the contract, any savings are retained by the facility owner/host facility.

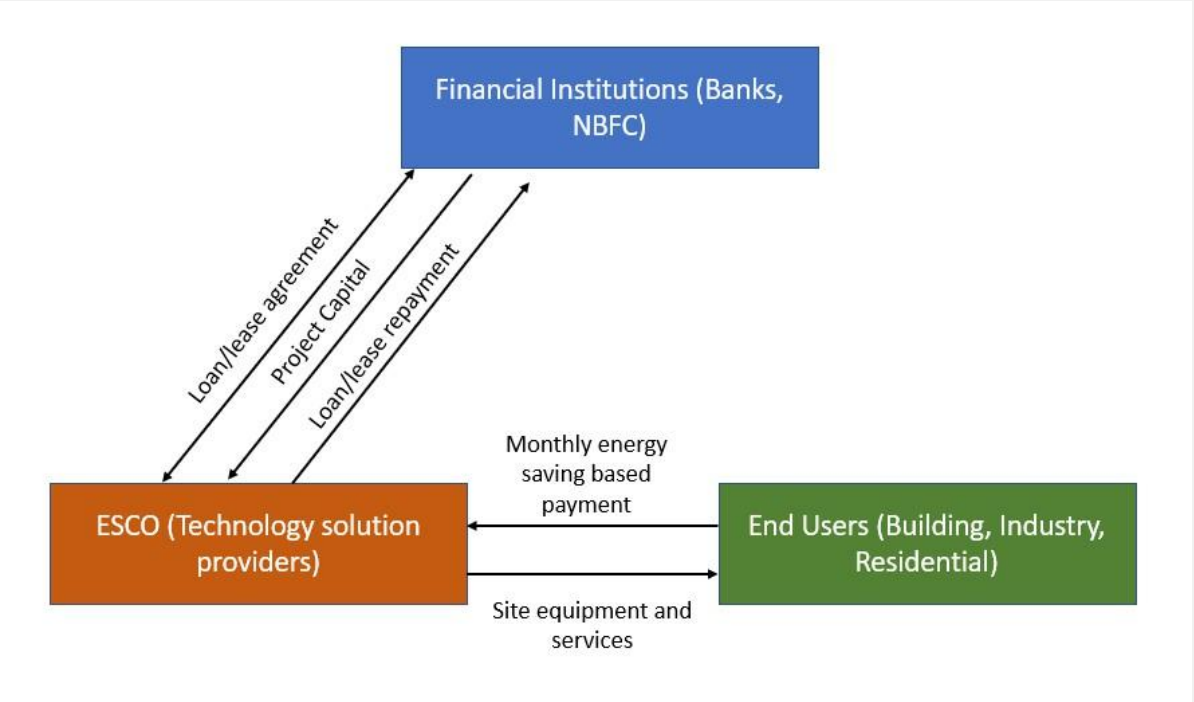


Figure 36 Shared ESCO saving Model

Various risk have been identified in the ESCO model through one of the research papers (Muhammad Ery Wijaya, et.al., 2021)

Table 56 Various Risk in ESCOs Models

Risk category	Impact	Likelihood
Economic and Financial	High	Medium
Finance resources	High	Medium
Operational and Behavioural	Medium	Low
Awareness	Medium	Medium
Measurement and verification	Medium	Medium
Technical solution and services	Medium	Medium
Technology	Medium	Low
Regulatory	High	Medium

Source: Climate Policy Initiative, 2021

10.3 Dealer or retailer financing model

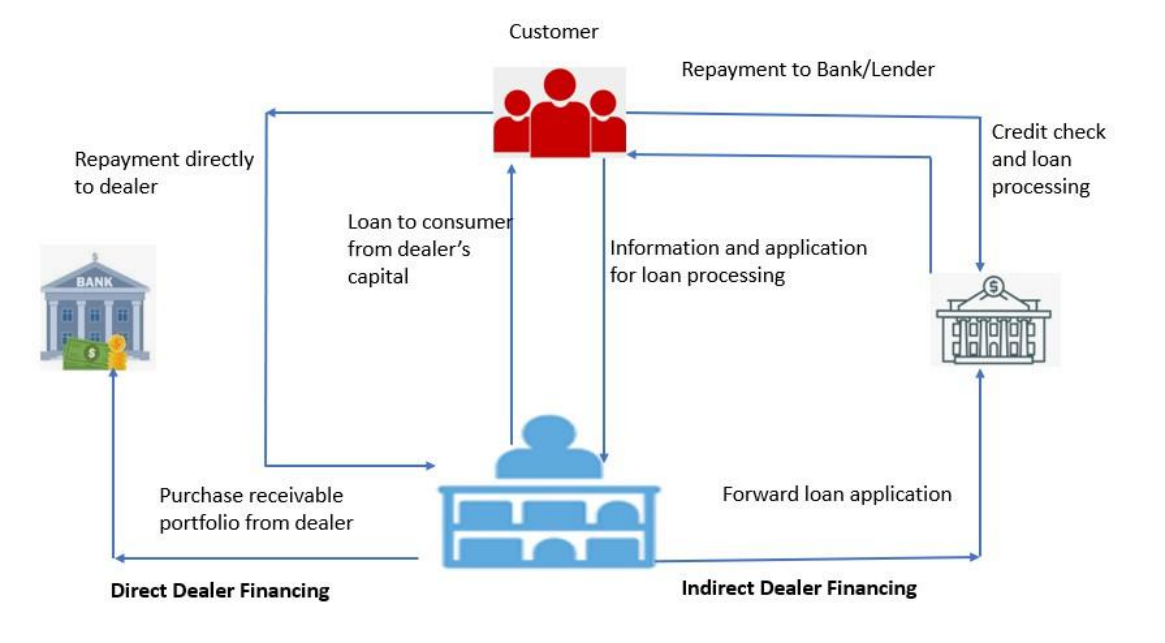


Figure 37 Dealer and retailer financing model

In direct dealer financing dealer directly provide loan to consumer or through partnership with third party financing institutions. Dealer can get access to finance by selling its purchase

receivable portfolio to Bank. In indirect financing arrangement, dealer forward the consumer loan application form and other information to bank and bank access the credit worthiness of consumer before processing the loan. Consumer's repayment is directly to Bank and Dealer works as intermediary or facilitator.

Dealer financing lowers the cost of loan for consumers and easier access to credit facility. Dealer also helps the consumer to do all paper work, credit risk assessments etc. Dealer can negotiate with multiple finance provider for lending at discounted interest rates.

Case study: ECO-Financing Model by Enervee

Los Angeles based Enervee company, a provider of energy efficient appliances through online market place announced the ECO-Financing model for making energy efficient appliances affordable. The program was launched in collaboration with lenders Southern California Gas Company & the Sate of California. Enervee also partnered with best buy to provide end to end consumer services such delivery and installation. ECO-Financing model provided consumer favourable loan terms, low cost EMI, no down payment facility and instant rebate. Consumer could buy the product upto $ 5000. Initially it was targeted to reach 5.7 million consumers of SOCalGas and expansion later. Under this program consumer could purchase Clothes washers/dryers, dishwashers, kitchen appliances etc.

10.4 Leasing financing model

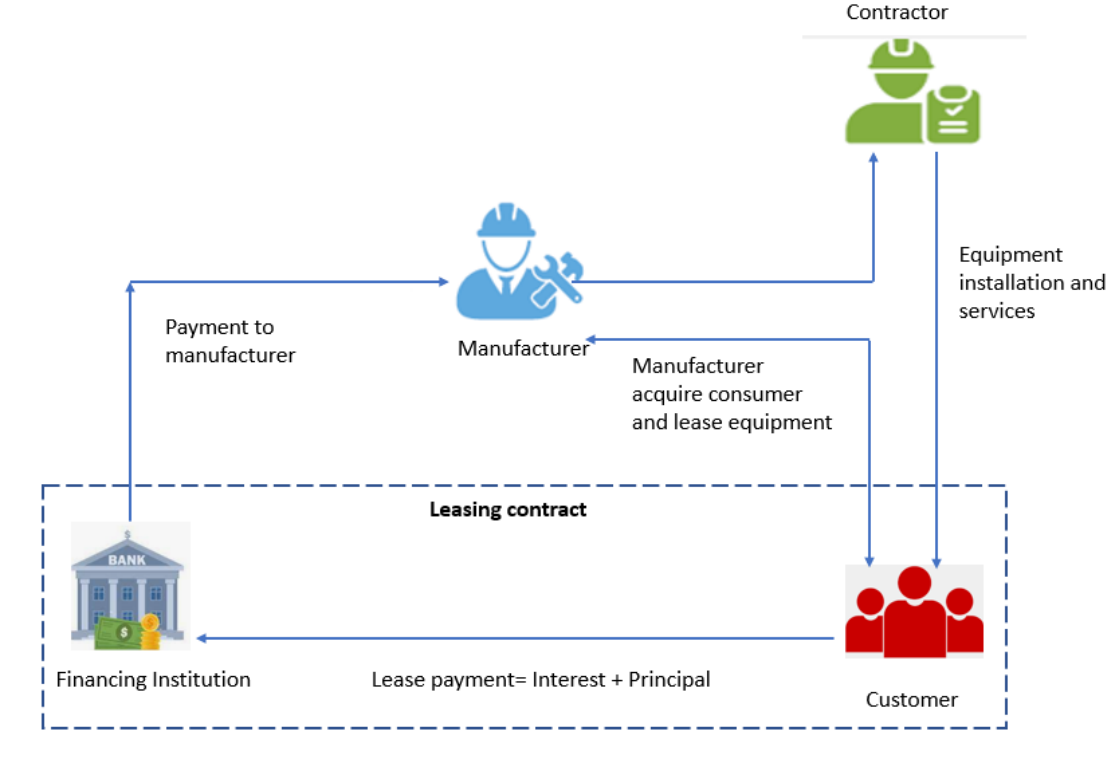


Figure 38 Leasing financing model

Leasing an asset-based financing where the financier (lessor) finances its assets to customer (lessee) for a fixed period of time through an agreement between lessor and lessee (IFC, 2009). In such model leasing is managed by partnership between financing institution, technology provider and contractor or service vendor. Manufacturer install equipment through contractor or service provider at the customer end. Equipment is financed by banking or financing institution where the customer pays fixed monthly instalment to Bank and Bank pays fixed monthly payment to manufacturer. Manufacturer takes liability for services, maintenance.

Case Study: Ultimate Home Comfort by York: A leasing model by Johnson Control

Johnson Control, provides smart and sustainable cooling and heating solutions for building. It launched a 10 years leasing program for HVAC system for residential buildings under its brand YORK. This industry led program provided owners a new, energy efficient system with no down payment and service warranty for 10 years and even at low monthly payment. It provided stress free cooling and heating services to homeowners with 53% saving in energy. Financing was provided by third party- Fundient Capital LLC and YORK covered its cost from customer through fixed monthly payment. York initially piloted leasing program in United State for three years and made many contractor its partners which increased its profit. At the expiry of the contract the customer had following options;

- Lease to own and pay balance pending amount of loan to financier
- No-renew and handover the equipment to financier

- New 10 year lease with new equipment
- Extension of lease for 2 years without maintenance and parts facilities

10.5 Utilization of green finance

Any structured financial activity that is intent to improve environmental outcome and enhance the access of finance for environmental benefit can be referred to as a green finance (World Economic Forum, 2020). Green finance directly linked with Environment Social and Governance (ESG) factor. Green finance benefits the broader context of the business rather than traditional source of finance which look at the profitability and cashflow. Grant is also a part of green finance generally provided by either Government or Internationally established institutions (Non-profit). Example: Government Environmental Facility (GEF) fund. GEF is an independent operating financing organization that provides grants for projects under climate change, biodiversity, land degradation etc. Grants has big role for enhancing energy efficiency adoption at large scale.

Case Study: CII's Dairy Project- Promoting Energy Efficiency and Renewable Energy in Selected MSME Clusters in India" initiated by GEF, BEE and UNIDO

In 2020 dairy cluster received grants for promotion of energy efficient technology under a program-"Promoting Energy Efficiency and Renewable Energy in Selected MSME Clusters in India" initiated by GEF, BEE and UNIDO.

The main objective of the project was to facilitate the implementation of energy efficient and renewable energy technologies in Rajasthan dairy clusters of India. The project of scaling up and expanding activities in Rajasthan dairy cluster had four major components:

- Component 1: Increasing capacity of suppliers in the category of Renewable and Energy efficient products.
- Component 2: Facilitate the implementation of energy efficient and Renewable energy technologies, best practices in MSMEs cluster of India.
- Component 3: Scaling up the project at national level.
- Component 4: Strengthening of policy, Institutional and decision making frameworks.

And key outcome of the project is as given below;

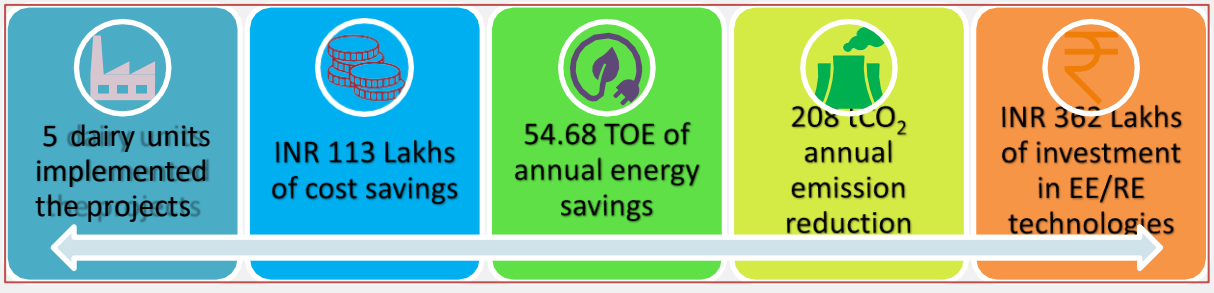


Figure 39 Key outcome of GEF funded Dairy Project

10.6 Bulk Procurement model

Procurement of appliances and equipment in large volume helps in achieving economies of scale and bulk procurement bring down the cost significantly and make it more affordable to end consumer. Bulk procurement model brings buyer and seller at a common platform where the manufacturer is able to generate profit through large volume and consumer gets product at lower price than market. Bulk procurement model providers negotiate with manufacturer and brings down the product price in multiple bidding round. The procurement costs are also down because of elimination of middle parties for selling the product in the market.

Bulk procurement model does not cover the financing requirements of consumer for purchasing the product rather brings down cost of the product.

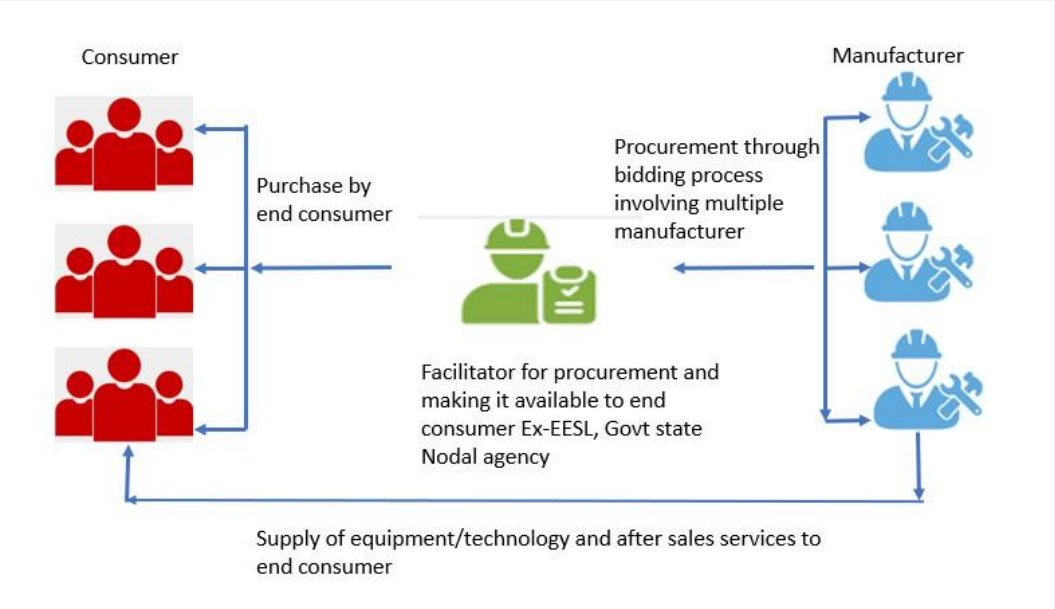


Figure 40 Bulk procurement model

Case study: Bulk Procurement model of EESL

Energy Efficiency Services Ltd. (EESL), targeted a program for replacement of standard motors with energy efficient motors for end consumers (PAT Industries and SMEs). The additional benefit of such bulk procurement model through EESL was the extend warranty of motors, Motor price reduction, information sharing on best practices and training to industries on operation and maintenance.

As shown in below table EESL, procured IE-3 motors, in bulk at price less than the market price and helped industries to save energy consumption and money.

Table 57 Bulk Procurement model by EESL

Motor specification (IE-3)	No of motors procured. (Nos Lakh)	Market price of Motor (Rs Lakh)	EESL Procured price (Rs Lakh)
1.10	0.15	0.08	0.05
1.50	0.15	0.08	0.06
2.20	0.15	0.11	0.07
3.70	0.15	0.14	0.09
5.50	0.15	0.20	0.13
7.50	0.15	0.23	0.16
11	0.10	0.47	0.25
15	0.10	0.49	0.31
22	0.10	0.65	0.40

11 INVESTMENT POTENTIAL

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

Table 58 Sectoral Investment Potential

Sector	Emissions Reduction (MtCO2) - FY2031		Energy Consumption Reduction (Mtoe) - FY2031		Investment Potential[32]
	Moderate	Ambitious	Moderate	Ambitious	
	MtCO2 reduction	MtCO2 reduction	Mtoe Reduction	Mtoe Reduction	INR Crores
Industry	20.38	24.76	6.51	7.91	14,275
Buildings	6.84	9.03	2.18	2.89	5,207
Transport	12.31	19.17	3.93	6.12	11,049
Agriculture	0.82	1.11	0.26	0.35	637
Fisheries	0.44	0.59	0.14	0.19	342
Municipal	0.36	0.48	0.12	0.15	279
Total	41.16	55.15	13.15	17.62	31,789

The energy saving investment potential of the state is estimated to be ₹ 31,789 crores by the year 2031, under the ambitious savings scenario, with the transport sector constituting highest energy saving investment potential followed by industry sector.

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

12 WAY FORWARD

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

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

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

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

13 ANNEXURES

13.1 List of urban agglomeration in Maharashtra

Table 59 Urban agglomeration in Maharashtra and population

Rank	Name	District	Population
1	Mumbai	Mumbai City and Mumbai Suburban	1,24,42,373
2	Pune	Pune	31,24,458
3	Nagpur	Nagpur	24,05,665
4	Thane	Thane	18,41,488
5	Pimpri-Chinchwad	Pune	17,27,692
6	Nashik	Nashik	14,86,053
7	Kalyan-Dombivli	Thane	12,47,327
8	Vasai-Virar	Palghar	12,22,390
9	Chhatrapati Sambhajinagar	Chhatrapati Sambhajinagar	11,75,116
10	Navi Mumbai	Thane	11,20,547
11	Solapur	Solapur	9,51,558
12	Mira-Bhayandar	Thane	8,09,378
13	Bhiwandi-Nizampur	Thane	7,09,665
14	Amravati	Amravati	6,47,057
15	Nanded-Waghala	Nanded	5,50,439
16	Kolhapur	Kolhapur	5,49,236
17	Ulhasnagar	Thane	5,06,098
18	Sangli-Miraj-Kupwad	Sangli	5,02,793
19	Malegaon	Nashik	4,81,228
20	Jalgaon	Jalgaon	4,60,228
21	Akola	Akola	4,27,146
22	Latur	Latur	3,82,940
23	Dhule	Dhule	3,75,559
24	Ahmednagar	Ahmednagar	3,50,859
25	Chandrapur	Chandrapur	3,20,379
26	Parbhani	Parbhani	3,07,170
27	Ichalkaranji	Kolhapur	2,87,353
28	Jalna	Jalna	2,85,577
29	Ambarnath	Thane	2,53,475
30	Panvel	Raigad	1,95,373
31	Bhusawal	Jalgaon	1,87,421
32	Badlapur	Thane	1,74,226
33	Beed	Beed	1,46,709
34	Gondia	Gondia	1,32,813
35	Satara	Satara	1,20,195
36	Barshi	Solapur	1,18,722

37	Yavatmal	Yavatmal	1,16,551
38	Achalpur	Amravati	1,12,311
39	Dharashiv	Dharashiv	1,11,825
40	Nandurbar	Nandurbar	1,11,037
41	Wardha	Wardha	1,06,444
42	Udgir	Latur	1,03,550
43	Hinganghat	Wardha	1,01,805

13.2 List of data centres in Maharashtra

Data Centres in Maharashtra
ESDS Software Solution Pvt. Ltd. Nashik Maharashtra, India
MILESWEB NASHIK. Nashik Maharashtra, India
WEB WERKS NAVI MUMBAI DATA CENTER Thane Maharashtra, India
CYQUATOR TECHNOLOGIES Mumbai, Maharashtra, India
SIFY TECHNOLOGIES PVT LTD Mumbai Maharashtra, India
RELIANCE DATA CENTER Mumbai Maharashtra, India
WEB WERKS INDIA Pune Maharashtra, India
Bharti Airtel Ltd. Pune Maharashtra, India
HOSTIN SERVICES PRIVATE LIMITED Pune Maharashtra, India
LEAPSWITCH NETWORKS PRIVATE LIMITED Baner Maharashtra, India
NET4 DATA CENTER PUNE Pune Maharashtra, India
TATA COMMUNICATIONS Pune Maharashtra, India
DATAGALAXY Pune Maharashtra, India
SAY DATA SOLUTIONS Pune Maharashtra, India
Web Werks India Pvt. Ltd. Mumbai, India
NETMAGIC SOLUTIONS Mumbai Maharashtra, India
STT GLOBAL DATA CENTRES Mumbai Maharashtra, India
NETMAGIC SOLUTIONS Andheri (E) Maharashtra, India
NETMAGIC SOLUTIONS Vikhroli (W) Maharashtra, India
STT GLOBAL DATA CENTRES Andheri, Maharashtra, India
STRAD SOLUTIONS Mumbai Maharashtra, India
NET4 DATA CENTER MUMBAI Maharashtra, India
SIFY TECHNOLOGIES Rabale, Maharashtra, India
CYBER FUTURISTICS INDIA Mumbai Maharashtra, India
STT GLOBAL DATA CENTRES Bandra Maharashtra, India
ESDS MUMBAI DC Maharashtra, India
GO4HOSTING MUMBAI Mumbai Maharashtra, India
TATA COMMUNICATIONS DATA CENTER MUMBAI Mumbai Maharashtra, India
BSNL IDC MTNL Mumbai Maharashtra, India
HONESTY NET SOLUTIONS , Mumbai India
RELIANCE DATA CENTER Mumbai Maharashtra, India
SIFY TECHNOLOGIES PVT LTD Mumbai Maharashtra, India

TATA COMMUNICATIONS	Mumbai Maharashtra, India
RICOH DATA CENTER IN MUMBAI	Mumbai Maharashtra, India

13.3 List of GreenCo rated companies in Maharashtra

Sl. No.	Company	Sector	Category	Location	State	Rating Level
1	Acropolis Industries	Engineering	SME	Aurangabad	Maharashtra	Gold
2	Ajay Poly Pvt Limited	Engineering	SME	Satara	Maharashtra	Gold
3	Align Components Pvt. Ltd.	Engineering	SME	Pune	Maharashtra	Silver
4	Amber Enterprises India Pvt Ltd	Engineering	SME	Pune	Maharashtra	Gold
5	Apcotex Industries	Chemical	SME	Mumbai	Maharashtra	Bronze
6	Atharva Corrugations Pvt Ltd	Engineering	SME	Pune	Maharashtra	Bronze
7	Atharva Poly Plast Pvt. Ltd	Engineering	SME	Khandala	Maharashtra	Gold
8	Bharat Petroleum Corporation Limited(BPCL), Refinery	refinery		Mumbai	Maharashtra	Silver
9	Burckhardt Compression India Private Limited	Engineering		Pune	Maharashtra	Gold
10	Burckhardt Compression India Private Limited	Engineering		Pune	Maharashtra	Gold
11	Burckhardt Compression India Private Limited	Engineering		Pune	Maharashtra	Gold

12	Carefine Woodworks Pvt. Ltd	Engineering	SME	Sanaswadi	Maharashtra	Silver
13	Carriage Workshop	Railways		Matunga	Maharashtra	Bronze
14	Carriage Workshop	Railways		Matunga	Maharashtra	Silver
15	Chandla Industrial Plastics Pvt Ltd	Engineering	SME	Satara	Maharashtra	Gold
16	Chanvim Engineering (I) Pvt Ltd	Engineering	SME	Nagpur	Maharashtra	Bronze
17	Cipla Ltd	Pharma		Kurkumbh	Maharashtra	Silver
18	Clad Metal (India) Pvt. Ltd.	Engineering	SME	Aurangabad	Maharashtra	Gold
19	Clean Science Technologies	Pharma		Kurkumbh, Pune	Maharashtra	Silver
20	Corru Cartons (India) Pvt. Ltd	Engineering	SME	Palghar	Maharashtra	Gold
21	Cummins Generator Technologies India Private Ltd	Engineering		Ranjangaon	Maharashtra	Gold
22	Cummins India Limited - India Part Distribution Center	Engineering		Pune	Maharashtra	Gold
23	Cummins India Limited, Power Generation Business Unit, SEZ Plant	Engineering		Phaltan	Maharashtra	Gold
24	Cummins Technologies India Pvt Ltd, Recon, Phaltan	Engineering		Pune	Maharashtra	Gold

25	Cummins Technologies India Pvt Ltd, Recon, Phaltan	Engineering		Pune	Maharashtra	Platinum
26	Cummins Technologies India Pvt. Ltd. - High Horsepower	Engineering		Phaltan	Maharashtra	Silver
27	Deshmukh Udyog Pvt Ltd	Engineering	SME	Satara	Maharashtra	Platinum
28	Eaton Fluid Power	Engineering		Pune	Maharashtra	Gold
29	Eaton Industrial Systems Pvt. Ltd	Engineering		Pune	Maharashtra	Gold
30	Elegant Coatings Pvt. Ltd	Engineering		Aurangabad	Maharashtra	Gold
31	EMU Mahalaxmi	Railways		Mumbai	Maharashtra	Certified
32	Galaxy Surfactants Ltd	Chemical		Taloja, Mumbai	Maharashtra	Silver
33	Genius Polymer Industries	Chemical	SME	Shirwal	Maharashtra	Silver
34	Godrej & Boyce Manufacturing Co. Ltd,Godrej Locking Solutions & Systems	Engineering		Mumbai	Maharashtra	Silver
35	Godrej & Boyce Manufacturing Company Limited, Precision Engineering Division, Mumbai	Engineering		Mumbai	Maharashtra	Silver

36	Godrej & Boyce Manufacturing Pvt. Ltd, Plant 15, Process Equipment Division,	Engineering	Vikhroli, Mumbai	Maharashtra	Gold
37	Godrej & Boyce Mfg Co Ltd, Appliances Division	Appliance	Shirwal	Maharashtra	Platinum
38	Godrej & Boyce Mfg Co Ltd, Appliances Division	Appliance	Shirwal	Maharashtra	Platinum Plus
39	Godrej & Boyce Mfg Co Ltd, Godrej Tooling Division	Engineering	Mumbai	Maharashtra	Gold
40	Godrej & Boyce Mfg Co Ltd, Godrej Tooling Division	Engineering	Vikhroli, Mumbai	Maharashtra	Silver
41	Godrej & Boyce Mfg Co. Ltd, Security Solution Division . Plant 17	Engineering	Mumbai	Maharashtra	Silver
42	Godrej & Boyce Mfg Co. Ltd, Interio Division	Engineering	Shirwal	Maharashtra	Platinum
43	Godrej & Boyce Mfg. Co. Ltd, Godrej Interio	Engineering	Vikhroli, Mumbai	Maharashtra	Silver
44	Godrej & Boyce Mfg. Co. Ltd, Godrej Interio Plant 13 & 14	Engineering	Mumbai	Maharashtra	Gold

45	Godrej & Boyce Mfg. Co. Ltd., Lawkim Motors Group	Engineering		Satara	Maharashtra	Gold
46	Godrej & Boyce Mfg. Co. Ltd., Lawkim Motors Group	Engineering		Satara	Maharashtra	Platinum
47	Godrej & Boyce-Appliance Division	Appliance		Shirwal	Maharashtra	Gold
48	Godrej and Boyce MFG.CO.LTD, PES DIVISION	Engineering		Vikhroli, Mumbai	Maharashtra	Platinum
49	HPCL LPG Plant	Petroleum Marketing		Hazarwadi	Maharashtra	Platinum
50	Iconic Castings Pvt. Ltd.	Engineering	SME	Kolhapur	Maharashtra	Bronze
51	Indian Oil Corporation Ltd - Dhanaj LPG BP	Petroleum Marketing		Dhanaj	Maharashtra	Bronze
52	Indian Oil Corporation Ltd - LPG Terminal	Petroleum Marketing		Chakan	Maharashtra	Silver
53	Indian Oil Corporation Ltd - Pune Oil Terminal	Petroleum Marketing		Pune	Maharashtra	Bronze
54	Indoline Industries Pvt Ltd	Engineering	SME	Nashik	Maharashtra	Bronze
55	Jay Industries	Engineering	SME	Navi Mumbai	Maharashtra	Gold
56	K.K. NAG PVT LTD	Engineering	SME	Pune	Maharashtra	Bronze
57	Kashish Panel Works	Engineering	SME	Maharashtra	Maharashtra	Silver
58	KHUTALE ENGINEERING PVT LTD.	Engineering	SME	Satara	Maharashtra	Platinum

59	Kirloskar Brothers Limited	Engineering		Kirloskarvadi	Maharashtra	Silver
60	Kirloskar Brothers Limited	Engineering		Kirloskarvadi	Maharashtra	Gold
61	Kirloskar Brothers Limited	Engineering		Kondhapuri	Maharashtra	Bronze
62	Kirloskar Oil Engines Ltd	Engineering		Kagal	Maharashtra	Gold
63	Kirloskar Oil Engines Ltd	Engineering		Kagal	Maharashtra	Platinum
64	Larsen & Toubro Ltd	Engineering		Powai	Maharashtra	Gold
65	Lower Parel Workshop	Railways		Mumbai	Maharashtra	Bronze
66	M-Tech Innovations Limited	Engineering	SME	Kelwade	Maharashtra	Gold
67	Mahindra Vehicles Manufacturers Ltd	Automobile		Chakan	Maharashtra	Silver
68	Mech Tech Industries	Engineering	SME	Navi Mumbai	Maharashtra	Silver
69	Motibagh Railway Workshop	Railways		Nagpur	Maharashtra	Bronze
70	Mumbai International Airport Pvt Ltd,Chhatrapati Shivaji International Airport, Mumbai	Airport		Mumbai	Maharashtra	Gold

71	Mumbai International Airport Pvt Ltd,Chhatrapati Shivaji International Airport, Mumbai	Airport		Mumbai	Maharashtra	Gold
72	Nanda Glass Industry	Engineering	SME	Pune	Maharashtra	Certified
73	Oerlikon Balzers Coating India Pvt. Ltd	Chemical		Pune	Maharashtra	Silver
74	OHT Fastcomp Private Limited	Engineering	SME	Navi Mumbai	Maharashtra	Certified
75	P M Electro-Auto Pvt. Ltd	Engineering	SME	Palghar	Maharashtra	Silver
76	Parel Loco Workshop	Railways		Mumbai	Maharashtra	Certified
77	PM ELECTRO AUTO PVT LTD	Engineering	SME	Nashik	Maharashtra	Silver
78	Radhe Industries	Engineering	SME	Pirangut	Maharashtra	Platinum
79	RANE PLASTICS PVT LTD	Engineering	SME	Satara	Maharashtra	Gold
80	Reliance Industries Ltd	Petrochemical		Nagothane	Maharashtra	Gold
81	Robertshaw Controls Pvt Ltd	Engineering	SME	Pune	Maharashtra	Silver
82	SA Glass Ltd	Engineering	SME	Satara	Maharashtra	Platinum
83	Sharada Industries, MIDC Pimpri-Chinchwad	Engineering	SME	Pune	Maharashtra	Bronze
84	Siddhi Elasto Pvt. Ltd	Engineering	SME	Shivane	Maharashtra	Certified

85	SILVER TECHNO MECH PVT. LTD.	Engineering	SME	Mahape	Maharashtra	Silver
86	STI Sanoh India Pvt. Ltd	Engineering	SME	Ahmednagar	Maharashtra	Gold
87	Suvaan Energy Pvt Ltd	Renewable		Mhasale	Maharashtra	Silver
88	SVS Refcomp Pvt. Ltd.	Engineering	SME	Pune	Maharashtra	Silver
89	Tata Cummins Ltd	Engineering		Phaltan	Maharashtra	Silver
90	Tata Motors Limited - CVBU	Automobile		Pune	Maharashtra	Gold
91	Tata Motors Limited - CVBU	Automobile		Pune	Maharashtra	Gold
92	Tata Motors Limited, PVBU	Automobile		Pune	Maharashtra	Gold
93	Tata Steel Distribution Pvt Limited	Steel		Pune	Maharashtra	Gold
94	TATA Steel Downstream Products Limited (TSDPL)	Steel		Ranjangaon, Pune	Maharashtra	Platinum
95	Tata Steel India, Global Wires India	Steel		Tarapur	Maharashtra	Gold
96	Thyssenkrupp Electrical Steel Limited	Steel		Nasik	Maharashtra	Silver
97	UGC SUPPLY CHAIN SOLUTIONS PVT LTD	Engineering		Pune	Maharashtra	Bronze
98	UKB Electronics Pvt Ltd	Engineering	SME	Pune	Maharashtra	Bronze

99	UNITED GASKETS & COMPONENTS PVT LTD	Engineering	SME	Pune	Maharashtra	Bronze
100	Valvoline Cummins	Engineering		Ambernath	Maharashtra	Gold
101	Vi-Son Cables Pvt Ltd	Engineering	SME	Ranjangaon, Pune	Maharashtra	Bronze
102	Vishwadeep Pressparts pvt ltd	Engineering	SME	Pune	Maharashtra	Bronze
103	Vulkan Technologies Pvt Ltd	Engineering		Pune	Maharashtra	Bronze
104	Win Win Technologies	Engineering	SME	Satara	Maharashtra	Gold
105	Wipro Enterprises (P) Ltd	Engineering		Waluj	Maharashtra	Silver
106	Wudhouse Designs Pvt. Ltd	Engineering	SME	Mumbai	Maharashtra	Silver
107	Xpro India Limted	Engineering	SME	Pune	Maharashtra	Bronze

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